CRITERIA FOR ANALYZING ENVIRONMENTAL ZONING AS AN INSTRUMENT IN LAND USE AND SPATIAL PLANNING[1]

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Introduction

Organizing and planning are an intrinsic part of human activities and their histories are inter-linked. Furthermore, organization and territorial management are common objectives of both organizing and planning, as Partidário (1999) explains.

In relation to the various concepts defining the term planning, Santos (2004) argues that they can be encapsulated as a continuous process involving the gathering, organizing and the systemized analysis of information through methods which result in the best possible use of available resources.

To make effective planning possible it is important to know the quantity and the quality of available resources, as well as the reasons for which they will be used. In this context, it is common to resort to zoning to evaluate an area, given that this process is thought to bring together environmental information (Silva; Santos, 2004).

In the last decades different zoning approaches have been employed in Brazil. According to Millikan and Del Prette (2000) zoning strategies are associated to two traditions: one refers to regulating the use of urban land and the other, agricultural land. The former is based on defining specific zones for different activities, so as to maintain residential areas away from potential inconveniences and disturbances. This gave rise to the "Zoning Law" which has normative characteristics. "Agricultural zoning", on the other hand, serves only to identify the best usage of land according to different production activities in rural areas. It does not impose land use regulations, but it is an aid to the decision-making process (Ranieri et al. 2005).

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Within this context, Environmental Zoning (EZ) is understood as an instrument for spatial planning, despite different views of its role which take into account the context in which it is discussed and applied. Therefore, as an instrument, EZ should incorporate environmental aspects within spatial planning so that human activities developed in the future within a particular space are viable, taking into account not only the economic and social, but also the environmental point of view.

The aim of this work is to further the discussion on the concept of Environmental Zoning. It seeks to analyze the differences and similarities between outcomes obtained, and understand how this concept is drawn up and used, as well as how it is integrated to other instruments, thus contributing towards identifying the most successful practices and further consolidating the notion of Environmental Zoning.

Therefore, the main objective of this study is to identify criteria to assess whether Environmental Zoning studies are meeting their goals and are effective tools for reaching the objectives of the Brazilian National Environmental Policy (NEP).

In order to achieve this, the following specific objectives were drawn up: establish a minimum number of criteria which can be used as reference for analyzing Environmental Zoning as an instrument for spatial and land use planning; analyze zoning case studies in light of the criteria established; identify the positive and negative factors which emerge from the case studies analyzed and which may be taken as reference points for other zoning exercises.

Environmental Zoning and Ecological-Economic Zoning

NEP, Legislation n. 6.938, 1981, established Environmental Zoning so that, together with other instruments proposed by the National Environmental Policy, it could contribute to preserve, improve and recover environmental quality as well as assist in social-economic development, national security and protecting the dignity of human life. However, the delay in regulating Environmental Zoning left some crucial factors relating to its drafting unresolved.

When observing the outcomes of Environmental Zoning in Brazil during the last decades, and its variants of different names (for example, ecological-economic, ecological, geo-environmental zoning), Souza (2009) and Ranieri et al. (2005) noted that according to the professionals and institutions involved in its development, there are differences in relation to: scale, map legends, methods and objectives. A common feature of these studies is that they seek to incorporate environmental aspects when dividing territories into zones.

According to Montaño et al. (2005), Environmental Zoning can be understood as an instrument which facilitates the formulation of development strategies and policies. It promotes a clear understanding of areas susceptible to natural processes and it also allows us to assess the level of suitability of particular areas in view of specific activities.

In relation to Environmental Zoning practices Milaré (2004) highlights that public officials and environmental managers pay little attention to this instrument. Considering that there is a number of different laws at the various national political-administrative

levels (Federal, State and Municipal government), they tend to use Environmental Zoning as little as possible.

Many academics see the end of the 1980s as a watershed in relation to Environmental Zoning (Millikan; Del Prette 2000; Lima, 2006). This is the period when it became known as Ecological-Economic Zoning (EEZ). It is also when territorial planning for the Amazon region starts to integrate environmental elements, incorporating ecological concepts in land planning for the region (Acselrad, 2001). The main purpose of Ecological-Economic Zoning is to support economic development, whilst accounting for environmental issues (thus its name). This way, land use planning can take better advantage of spaces and public policies.

In 2002, the Brazilian federal government regulated Environmental Zoning as part of the National Environmental Policy (NEP) by means of Decree n. 4.297, from 10th July. Regulations were based on assessments of the zoning experiences undertaken in the previous decades and took into account the various criticisms made by different sectors of society. Thus, Environmental Zoning was ratified as a land planning instrument, upholding the need for its compliance within public and private plans, works and activities, setting out environmental quality measures and standards (Art. 2).

It is important to note that EEZ is not just an instrument for indicating the suitability of a territory. Rather, it is similar to land use regulations "establishing bans, restrictions and alternative land usage" (Art. 3).

Integration with other instruments in the National Environmental Policy

The NEP establishes 12 other instruments, in addition to Environmental Zoning whose use should be integrated. Examples of some of these instruments are Environmental Impact Assessments, the licensing of actual or potential polluting activities and the establishment of specially protected areas.

Environmental Zoning refers to assessing the capacity of an environment and hence is closely linked to Environmental Impact Assessments (EIAs) used to analyze the environmental viability of policies, plans, programs and projects - PPPPs - (Montaño et al., 2005). Souza (2000) argues that information provided by EZ on a particular environment facilitates decision-making relating to the requirements of an EIA, usually presented in an Environmental Impact Study (EIS), and its simplified version the EIR.

According to Ranieri et al. (2005), from the moment EZ indicates which areas are best suited for specific activities, it points to whether there is a need to carry out an EIS-EIR. It may then be used as the basis for simplified environmental licenses, as long as the damage potential is low.

Ranieri (2000) states that the importance of Environmental Zoning in relation to the establishment of specially protected areas lies in the fact that it systematizes knowledge of an area, thus assisting in the identification of sites to be defined as Conservation Units.

In this article we understand Environmental Zoning to be an environmental policy instrument capable of introducing environmental variables to land use planning. It should be used in conjunction with other environmental policy instruments in order to

highlight environmental issues as well as economic and social issues which are usually prioritized during planning.

Input material and method

This research is mainly exploratory-descriptive and followed the stages detailed below.

First, a literature review was conducted which was fundamental to provide the theoretical basis for Environmental Zoning as an instrument of the National Environmental Policy and to identify other studies on this subject, thus underpinning this research appropriately.

The selection and proposal of a set of criteria was grounded on the literature review. It focused on the specialized literature on this topic, taking into account the following key publications as reference:

– "Diretrizes metodológicas para o Zoneamento Ecológico-Econômico do Brasil" [Methodological Guidelines for Ecological-Economic Zoning of Brazil], Ministry of the Environment. Brasília, 2001.

– "Planejamento ambiental: teoria e prática" [Environmental Planning: theory and practice], by Rozely Ferreira dos Santos. São Paulo, 2004.

– "Introdução ao ordenamento do território" [Introduction to land use planning], by Maria do Rosário Partidário. Lisboa, 1999.

The literature pointed to aspects which should to be considered when planning and producing land use and environmental planning policies, in particular in relation to the stages to be followed and factors to be taken into account. This background literature was used to establish a set of criteria for analyzing the development and use of Environmental Zoning studies. A set of basic (minimum) criteria was used to trigger a discussion on environmental aspects linked to the physical and biological (natural and man-made) environments, without venturing into the social and economic aspects of planning.

Once criteria were identified, an adapted procedure of Faria's (2004) work was adopted. This author works with effectiveness indicators in the management of conservation units. He proposes the development of optimum management scenarios for each of the criteria analyzed, setting up a classification scale from 0 (worst situation) to 4 (best situation). In this paper, a scale from 0 to 2 was originally devised to classify each criteria analyzed in the different zoning initiatives being studied.

Subsequently, research specialists were consulted (academics working in the area of environmental and land use planning) in order to validate the criteria selected and the classification method used. Of the 6 specialists consulted via email, 4 replied positively to our request and individual meetings were set up.

After meeting each specialist, considerations and recommendations were made. The most frequent suggestion related to the organization of the criteria. This led to a sub-division into groups reflecting zoning procedures: pre-planning, planning and

post-planning, reflecting the planning, development and implementation stages of zoning.

In addition, it was suggested that initially a single idealized optimum scenario should be used, given the subjectivity of some concepts and expectations relating to Environmental Zoning and the difficulty and perhaps even non-applicability of classifying the criteria proposed on a scale from 0 to 2. Thus, the criteria in this study were conceived based on the literature and the knowledge gained by the researcher and complemented by discussions during the consultation phase.

Subsequently, the zoning case studies were selected for analysis. The research made use of Environmental Zoning case studies developed for different territory types - all within the state of São Paulo - where information was available for consultation on the internet.

Data-gathering of the zoning case studies selected was conducted by consulting maps, legal documents and technical reports, as well as interviews with technicians and managers involved in the planning, development and use of the Environmental Zoning exercises.

Results

Once the preliminary proposal of criteria and the consultation and validation process with specialists were conducted, three charts were compiled which included the pre-planning, planning and post-planning stages. The first two stages relate to the development stage of zoning exercises and the third to their usage.

Charts 1, 2 and 3 below present the criteria proposed, followed by explanations about each criteria and how each optimum scenario suggested is set up within the context of this work.

Chart 1: Pre-planning Chart, criteria and optimum scenarios

Pre-planning Chart	
Criteria	
Comments	**Optimum scenario**
1.1 Motivation	
It is crucial that different sectors understand the significance of conducting Environmental Zoning as a basis for decision-making. However, actual proposals for carrying one out may emerge from identifying a need, a response to an unexpected situation, a specific opportunity or a legal imposition.	Zoning was conducted due to an understanding of its value as an environmental policy instrument for planning by various actors (for example, municipal and state councils and water basin committees) and not just a specific sector (e.g. the government).

1.2 Demands	
It is important to clarify whether zoning objectives are set in order to provide an answer to demands which are clearly of an environmental nature or due to the specific interests of particular sectors. In the case of Environmental Zoning, it is crucial to identify demands, in particular of an environmental nature.	Environmental demands where identified and considered within the specific objectives of the zoning strategies developed, over and above socio-economic demands.
1.3 Institutional cooperation	
It is important that different sectors are represented and cooperate in a representative way during the development of the study. The inclusion of the names of institutions as being involved with the study solely in order to provide greater credibility to the work is not desirable.	Organizations representing different sectors were given the opportunity to participate in a balanced way during the development the zoning exercise.

Chart 2: Planning Chart, criteria and optimum scenarios

Planning Chart	
Criteria	
Comments	**Optimum scenario**
2.1 Presentations and public meetings	
It is important that presentations and meetings open to public participation take place to communicate decisions, gather information or listen to opinions.	Informative presentations and meetings open to public participation occurred.
2.2 Level of participation of society	
The participation of society gives greater credibility and acceptance to the suggestions put forward by Environmental Zoning.	Society participated in the decision-making process at important times, for example, in identifying demands or establishing the criteria to be considered in the studies carried out.
2.3 Equity in participation	
It is important to observe how participation occurs, whether there are opportunities for public participation or whether participation occurs because of the private interests of certain sectors in the specific objectives addressed by the Environmental Zoning in question. Do most sectors participate in a balanced way or does one sector predominate over the others?	Different sectors interested in the studies and outcomes of the Environmental Zoning in question participated in the meetings. The process was not characterized by the negotiation of economic interests of sectors with greater influence.
2.4 A clear methodology which can be replicated	
It is crucial that the methods used to carry out each task during the development of Environmental Zoning are recorded and clearly described so that they can be reproduced in other studies.	Each task is clearly recorded in documents referring to the development of Environmental Zoning policies, allowing us to understand and reproduce this process to attain outcomes, create maps and so on.

2.5 Current legislation (can it be represented in spatial terms)	
In addition to the physical and biotic components, laws and/or regulations which can be mapped are crucial to the development of zoning, taking into account, for example, areas of permanent preservation, recommended distances between infrastructure and particular activities and uses. However, these factors may be considered in a spatialized form in maps or as non-mapped suggestions to be taken into account by decision-makers.	Most of the laws and/or regulations which can be spatialized were considered in the suggested restrictions and in the potential use of areas and these were represented in the final output maps.
2.6 Natural physical and biotic components[ii]	
The natural physical and biotic environment is mainly the result of natural processes and phenomena. It is very important to consider these when determining the potential uses of the environment.	Information on the natural physical and biotic environment which were taken into account during the development of studies, are in line with the specific objectives of Environment Zoning in question.
2.7 Man-made physical and biotic components[iii]	
The man-made physical and biotic environment also influences the definition of potential uses of the environment. Factors which fall within these criteria are often collected or observed, but are not mapped.	Information about the man-made physical and biotic environment was taken into account in this study, according to the specific zoning objectives. This information was mainly displayed in spatial form in maps.
2.8 Appropriate spatial scale[iv]	
According to the specific purpose of zoning, and its territorial characteristics, scales are suitable for collecting and cross-checking data.	Data collected are displayed on a spatial scale which is suited to the territorial characteristics of the Environmental Zoning in question.
2.9 Field data collection	
The information obtained from secondary sources cannot be duly detailed, updated or adapted to the needs of the study unless it is confirmed or complemented by field data.	Field data collection was conducted in order to cross-check information from secondary sources and/or complement them when necessary. When this did not take place, data obtained from secondary sources were sufficient to carry out the study.
2.10 Final outcomes	
It is important that the maps representing the results are clear and provide explanatory captions and information that is easy to read so as to facilitate the interpretation of findings.	The final maps presented are clear and both explanatory captions and colors used are easily distinguishable and identifiable, facilitating the decision-making process.

2.11 Explanatory report	
It is important to provide an explanatory report of the Environmental Zoning conducted, with information on, for example, its development stages, specific objectives and results.	A clearly written and comprehensive report was produced and made available. It contains most of the information on the studies conducted and results obtained concerning the Environmental Zoning in question.
2.12 Clarity of use	
It is crucial that in the maps, regulations and reports produced specific objectives are easily identified and the purpose of Environmental Zoning is clearly laid out.	The specific objectives of Environmental Zoning and its recommendations and terms of use are clearly stated in the outcomes.
2.13 Adequacy of financial resources	
The amount of financial resources available to conduct Environmental Zoning may or may not be adequate to the needs of the study in accordance with the specific objectives established. Final results may be compromised if there is a need to gather more detailed information, increasing costs.	Most of the stages of the work and data collection which were crucial for achieving good results were conducted without being hindered by lack of financial resources.

Chart 3: Post-Planning Chart, criteria and optimum scenarios

Post-planning Chart	
Criteria	
Comments	**Optimum scenario**
3.1 Removal or adaptation of activities	
Despite the fact that Environmental Zoning is not classed as a normative instrument and does not foresee the removal of activities which conflict with its recommendations, it is argued that the study's recommendations could be used as a basis for finding the best location or adapting the technology of these activities, preventing future risks due to the inappropriate use of the area.	Activities which conflict with the recommendations of the Environmental Zoning study and are considered inappropriate for a particular area were removed or had to be adapted in order to remain on site.
3.2 Meeting objectives	
The consultation process and whether recommendations and/or restrictions of use proposed by the Environmental Zoning study were met, are good criteria for establishing its effectiveness.	The Environmental Zoning has been used in reference to most applicable activities.

3.3 Other uses	
Implementing or carrying out the specific objectives of Environmental Zoning may depend on other factors. This means that its implementation may be delayed or it may not be implemented at all. However, given Environmental Zoning provides systematized information on the environment, it can be consulted for other purposes and activities which were not foreseen to be within its scope.	Systemized information and maps produced by Environmental Zoning have been consulted in cases which were not originally foreseen.
3.4 Review	
A study which assesses the actual state of a particular area and suggests potential uses should be periodically reviewed and updated, given that land use and activities developed will inevitably alter the original scenario.	There is a pre-established Environmental Zoning review plan, which includes the necessary resources to carry it out and a review timetable. Review takes place at the pre-established time or soon after in accordance to rules set out.

Test Cases

Once the criteria had been established and organized, they were applied to three selected test cases which are succinctly presented, outlining the sources consulted during the data-collection process for each case:

a) Brotas Environmental Zoning (EZ-Brotas): has a municipal nature and was conducted in 2007. This zoning is suggestive and its objectives are to identify areas which are propitious for urban expansion; areas which are suitable for conserving and recovering native vegetation; and areas which are adequate for the disposal of domestic solid waste.

Sources consulted: report published on the production of this zoning and its outcomes (Municipality of Brotas, 2007); interview with a member of the technical team responsible for producing the zoning and an interview with a member of staff working in the municipality's Environmental Department.

b) Ecological-Economic Zoning of the Northern Coast of the State of São Paulo (ZEE-LN): it was concluded in 2004 and presents the regional and normative characteristics. It was regulated by Decree n.49.215, 2004. It emerges as an instrument of the State of São Paulo's Coastal Management Plan, Law n. 10.019, from 1998. Its objectives are to identify units of land that deserve special attention and to establish which activities will require prior environmental licensing.

Sources consulted: legislation relating to ZEE-LN and coastal management plans; publication contextualizing the planning and drafting process of ZEE-LN (São Paulo, 2005); interview with a staff member of the Environment Department of the State of São Paulo, the executive secretary of the Northern Coast Sectorial Group during the drafting of the ZEE-LN; official site of the State of São Paulo's Environment Department.

c) Agro-Environmental Zoning for the sugar/alcohol sector for the State of São Paulo (ZAA-SP): concluded in 2008. This instrument has state-wide reach and is part of the Green Ethanol Strategic Environmental Project. It has a suggestive nature and its

objectives are to control land expansion and occupation by the sugar/alcohol sector. It provides the basis for environmental licensing.

Sources consulted: resolutions SMA/SAA n.004 and SMA n.88, both from 2008; São Paulo State Environmental Department site[v]; interviews with officials from the São Paulo State Environment Department, including with the ZAA-SP development coordinator and a staff member of Projeto Etanol Verde (Green Ethanol Project).

Applying the criteria case by case - results

The grey color is used to show whether the optimum scenario is met in relation to each criterion, dark grey shows that criteria are met and light grey that they are not. A lack of color means that it was not possible to obtain enough information in relation to a particular criterion in order to classify it.

Chart 4 shows, in a simplified way, results of criteria application to the cases. This is followed by a discussion on the positive and negative aspects highlighted for each case and a general analysis of results.

Chart4: Synthesis of the outcome of applying the criteria to the test cases

Test Cases Criteria	Brotas Environmental Zoning EZ Brotas (SP)	Ecological-Economic Zoning of the Northern Coast of the State of São Paulo ZEE-LN (SP)	Agro-Environmental Zoning for the Sugar/Alcohol Sector in the State of São Paulo ZAA-SP (SP)
1.1 Motivation			
1.2 Demands			
1.3 Institutional cooperation			
2.1 Presentations and public meetings			
2.2 Level of participation of society			
2.3 Equity in participation			
2.4 Clear methodology which can be replicated			
2.5 Current legislation (may be spatialized)			

2.6 Natural physical and biotic components			
2.7 Man-made physical and biotic components			
2.8 Appropriate spatial scale			
2.9 Field data collection			
2.10 Final outcomes			
2.11 Explanatory report			
2.12 Clarity of use			
2.13 Adequacy of financial resources			
3.1 Removal or adaptation of activities			
3.2 Meeting objectives			
3.3 Other uses			
3.4 Review			

The Brotas EZ seems to meet the suggested optimum scenario for 55% of the proposed criteria. It is closer to the optimum scenario during its development stage (Pre-Planning and Planning) than in the deployment stage (Post-planning).

Among the positive points highlighted for this case are: public participation at the decision-making level (criteria 2.1 and 2.2) and the identification of proposals for demands and specific objectives conducted with the participation of society which makes zoning recommendations more acceptable and credible.

In addition, a high quality report was produced (criterion 2.11) containing information on the planning, development, participation and methodological procedures, as well as all records made and shared through this instrument.

Amongst the negative aspects observed, the most significant was the lack of practical application of zoning outcomes, resulting in the non-compliance with established objectives (criterion 3.2).

In the case of ZEE-LN, most criteria (60%), both in the Planning and the Post-planning stages, are in line with the optimum scenario, whilst this situation is reversed in the Pre-planning stage.

With regard to the positive points identified in this case, institutional cooperation (criteria 1.3) stands out, together with the participation of society (criteria 2.1, 2.2 and 2.3) at the decision-making level. According to the answers obtained, the tripartite organization which involved state and municipal government representatives and members of

organized civil society in a balanced way resulted in an agreement that the various sectors would present their concerns, opinions and experiences during the development stages of the zoning study. This served as an example to be followed by other zoning experiences.

Another positive aspect was that it complied with ZEE-LN objectives (criterion 3.2) in relation to land use and occupation. The fact that there is no occupation which contravenes its recommendations or that restrictions are taken into account in environmental licensing processes demonstrated the effectiveness of its application to land use planning. It also reinforces its relationship with other NEP instruments. However, it is important to find out how committed the licensing body is to this process.

Among the negative aspects there is a lack of planning in terms of financial resources (criterion 2.13), making the development process of the zoning somewhat inconsistent and uncertain. Furthermore, the ZEE-LN development process was not duly recorded and published (criterion 2.11). This is a disadvantage for the responsible institution and for those which could make use of this information as reference. Another negative point is the lack of clarity (criterion 2.12) in relation to its specific objectives. Despite having reached clear outcomes which included classification, recommendations and detailed restrictions for particular zones, ZEE-LN objectives are very wide, making it difficult to clearly assess whether they have been complied with.

In the ZAA-SP, which was produced to meet the needs of a particular agricultural activity, zones are classified into suitable, suitable with environmental limitations, suitable with environmental restrictions, and inappropriate, thus indicating the suitability of each area to sugarcane production. This zoning meets 50% of optimum scenarios suggested by this paper, despite the fact that one of its criteria has not been classified due to lack of data. In relation to the development and user stages, the criteria related to Planning revealed lower compliance with the optimum scenario.

Within the context of this work, among positive aspects were the formulation of legislation relating to environmental licensing (conclusion reached by analyzing criteria 2.12 and 3.2). It was based on the outcomes of zoning, resulting in compliance guidelines to be adopted by existing businesses in areas classified as suitable with environmental restrictions. This reveals that the State of São Paulo body interprets and puts in practice NEP recommendations and instruments, providing the basis for land occupation planning whilst taking into account environmental aspects.

With regard to the negative aspects identified, there was a total lack of participation of society (criteria 2.1, 2.2 and 2.3), revealing the fact that this was a unilateral process. This fact was aggravated, after the publication of ZAA-SP final outcomes, by the reaction of the interested sector, pointing out the failures of the results linked to the lack of field data in order to confirm the information used.

Comparing the cases

When comparing the cases by analyzing Chart 4, what first stands out is the fact that ZEE-LN meets more criteria in accordance to the optimum scenario than the other two cases analyzed. On the other hand, for all three cases, the number of criteria met

is greater than the number of those not met. It is important to note however, that for ZAA-SP, it was not possible to collect information on one of the criteria; it therefore could have tipped the balance either way in relation to meeting the standards set in the optimum scenario.

The following criteria in the three cases met the requirements set in the optimum scenario: (2.6) physical and biotic natural components, (2.10) final outcomes and (3.3) other uses. In relation to physical and biotic components each case took into account a different set of factors, meeting their specific objectives, where the following factors were most frequent: topography, soil condition, vegetation, water resources and climate. With regard to the final outcome, all cases presented maps and interpretation which were easy to read, containing clear information about their recommendations. In the cases of ZEE-LN and ZAA-SP, the characteristics of areas indicated are placed next to the map, describing information in detail. With regard to 'other uses' all three cases pointed to uses which had not been foreseen as outcomes of the zoning exercise. Therefore, the use of these outcomes is laid out as systemized information on the area studied a tool which could facilitate the decision-making process of other planning situations which had not been originally foreseen.

There was only one criterion which was not in accordance with the optimum scenario in all three cases: (2.5) current legislation (can be represented in spatial terms). Despite the fact that final results pointed to recommendations set out in the Forestry Code, particularly in the case of ZA-Brotas and ZEE-LN, they had not been represented in the final mapped results. In the case of ZAA-SP, there was a suggestion that this legislation could not be spatialized and that it should be taken into account during the decision--making process. Brasil (2001) points to the need to consider the legislation applicable to the area of study in order to produce the Environmental Zoning. This relates to the Forestry Code as well as other legislation at the various levels of government. However, this was not the case and should be addressed more carefully during the production stage of other Environmental Zoning exercises.

Another criterion which stood out in relation to the different answers obtained in the three cases related to the lack of adequate financial resources (2.13). In relation to ZA-Brotas, it is thought there were sufficient financial resources for producing the zoning exercise. Amounts were known from the beginning of the study, steering the planning stages and the research required, given that financial resources are a key requirement for them to take place. However, with regard to ZEE-LN and ZAA-SP, also carried out by the São Paulo State Environment Department, despite the fact that activities were included in the routine of the department, information provided by interviewees point to a lack of funds. In relation to ZEE-LN, as explained during an interview, funding and even the number of staff varied according to the management and interests at hand. This resulted in there being no financial planning or a set timetable for the zoning which took years to be concluded. On the other hand, according to an interviewee, there were no major consequences of insufficient funding to the ZAA-SP. The zoning was carried out accordingly, as part of the routine of the Department; there was no overlapping of tasks or delays.

By analyzing both the negative and the positive aspects highlighted in each case, it can be observed that there was public participation, marked by institutional cooperation between different sectors, as well as presentations and participative meetings (criteria 1.3, 2.1 and 2.2) in the cases of Brotas EZ and of ZEE-LN, in contraposition to ZAA-SP where there was no participation during the development process.

Another interesting point to analyze relates to meeting specific objectives (3.2) of each Environmental Zoning. According to findings, in the case of the Brotas EZ the optimum scenario was not achieved, differently from ZEE-LN and ZAA-SP. It is interesting to note that these two zoning exercises conducted by the Department of the Environment of the State of São Paulo provided the grounding for laws and resolutions with a view to guiding the environmental licensing process. ZEE-LN was responsible for organizing a series of activities and ZAA-SP organized activities solely linked to the sugar/alcohol sector. Regardless of their main objectives, according to the sources consulted, both zoning exercises have been taken into account by the licensing authorities during the decision--making process. This points to the fact they are being used and that specific objectives are complied with, thus contributing toward attaining NEP objectives. That is organizing land use in conjunction with other instruments that make up this policy.

Furthermore, another point worth highlighting from the joint analysis of their contexts, outcomes and results is the normative character conferred to these zoning exercises if we consider the fact that both are the basis for drafting or regulating legislation. However, whilst the ZEE-LN emerges from a legal context rooted in wide-range planning based on laws and decrees - giving rise to a final map directly linked to legislation which foresees uses and activities, establishing guidelines and environmental and social economic targets for the Northern Coast (Litoral Norte) of São Paulo - the outcome of ZAA-SP was a map describing the suitability of areas for the sugarcane activity, according to its characteristics. Thus, the ZAA-SP, understood as linked to Resolution SMA/SAA n.004 which establishes the classification for areas identified through zoning, does not regulate land occupation according to sugarcane activity. It only provides the grounding for environmental licensing of the activities of the sugar/alcohol sector when a decision is taken.

Another point worth making with regard to the Brotas EZ and the ZEE-LN is the relation between Environmental Zoning and the municipal master plan. In the case of Brotas, it was foreseen that the development of Environmental Zoning would be associated to the drafting of the Brotas master plan. In fact this did not take place given that the EZ was only concluded after the publication of the Brotas municipal master plan. However, as an interviewee remarked, when the master plan is reviewed in the next few years, the suggestions made in the Brotas EZ results will be taken into account. The ZEE-LN was expected to assist in the development of the master plans of the municipalities encompassed by the area. There is no information to confirm that this has been the case. There would need to be a more detailed information gathering program to include consulting the local municipal authorities involved.

Finally, although this has already been mentioned in relation to each individual case, it is important to highlight that the recording and publication (criterion 2.11) of procedures, activities, stages and all other work conducted during the zoning exercises

should be recorded in accessible language. Each zoning exercise should be understood as an Environmental Zoning experience, as one of a number of methods and existing instruments. Therefore, recording and making accessible all the steps of each procedure so that they can be analyzed is crucial for advancing our knowledge about best practices and shortcomings. Moreover, this procedure is necessary to consolidate Environmental Zoning as an NEP instrument.

Final considerations

The criteria proposed based on optimum scenarios provide the foundations for a debate about Environmental Zoning as an instrument for land use and spatial planning, allowing its development and use to be analyzed in different cases and situations, thus strengthening this discussion, albeit in a preliminary way.

By comparing test cases to the optimum scenario we reach the conclusion that not all the zoning exercises considered met their specific objectives, whilst at the same time, it can be observed that they are being used as a systemized basis for information on the environment. Thus, they end up assisting in the decision-making process in areas and plans which have not been predicted within their specific objectives. Environmental Zoning also appear to be useful when working in conjunction with other planning tools such as municipal master plans, environmental licensing and Environmental Impacts Assessments, and may even lead to the establishment of specially protected areas. It seems likely therefore, that the National Environmental Policy objectives of preserving, improving and recovering environmental quality are being met in most cases.

It was also possible to identify positive and negative aspects within the cases analyzed; in particular public participation was strongly promoted in the cases of Brotas EZ and ZEE-LN whereas it was almost inexistent in ZAA-SP. This can be better understood or discussed in future research which may include an understanding of the reasons for denying participation, that is, whether this occurs for methodological or ideological reasons.

In addition, bringing in an environmental variable with regard to the physical and biological components seems to comply with the specific objectives of all the cases considered. No case has considered relevant legislation to the areas involved in a spatialized way, that is, using maps. Another aspect highlighted was the importance and the need to publish methods and procedures which were carried out in the development of zoning exercises so as to record and allow for the replication of actions carried out. This was only suitably addressed by one of the case studies.

The analysis also allowed us to understand the importance and influence of the context of each Environmental Zoning exercise on the outcomes obtained. According to the examples considered, for example, the ZEE-LN and the ZAA-SP which related to larger projects or plans, it can be noted that greater attention is given to the zoning recommendations and suggestions. Particularly if they are institutionalized by norms and legislation, thus linking them to other instruments, for example, environmental licensing.

Finally, the joint analysis of test cases confirmed and reinforced points often suggested in the literature with regard to the following: the number of different outcomes, the recording and publication of processes, the use of captions, the character adopted (normative/suggestive), territorial breakdown approaches, specific objectives produced for each Environmental Zoning, amongst other points in the cases analyzed. The question arises as to whether some of these aspects originate from the reasons and motives for conducting the Environmental Zoning, or whether they also depend on the people carrying it out. Those responsible may be a firm selected through a bidding process, a contracted company, or an interested public authority. This situation makes it difficult to standardize outcomes, given the diversity of interests which may steer these studies. The debate about these aspects deserves to be further developed in future work.

Notes

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ii These correspond to territory elements which emerge from very slow natural processes in comparison to events which occur in 'human' time (Partidário, 1999).

iii These are active elements in land use planning and are the result of human action and may be, to a greater or lesser degree, in equilibrium with natural factors (Partidário, 1999).

iv This work adopted the classification in use in Brasil (2001), following the relation between territorial scope/reach and order of magnitude: Local (1:25,000/1:1,000), Municipal (1:100,000/1:50,000), State (1:250,000/1:100,000), Regional (1:1.000.000/1:250.000), National (1:2,500,000/1:1,000,000).

v <http://www.ambiente.sp.gov.br/etanolverde/>

References

ACSELRAD, H. **Zoneamento Ecológico-Econômico:** entre ordem visual e mercado mundo. 2001. 28p. Rio de Janeiro: IPPUR-UFRJ. Disponível em: <http://www.abep.nepo.unicamp.br/docs/anais/pdf/2000/Todos/Zoneamento%20Ecol%C3%B3gico%20Econ%C3%B4mico%20Entre%20Ordem%20Visual....pdf> Acesso em: 10 mai. 2011.

BRASIL. Ministério do Meio Ambiente. **Programa Zoneamento Ecológico-Econômico**: diretrizes metodológicas para o Zoneamento Ecológico-econômico do Brasil. Brasília: MMA/SDS, 2001. 109p.

BRASIL. Decreto n° 4.297, de 10 de julho de 2002. Regulamenta o art. 9º, inciso II, da Lei nº 6.938, de 31 de agosto de 1981, estabelecendo critérios para o Zoneamento Ecológico-Econômico do Brasil - ZEE, e dá outras providências. Disponível em: <http://www.planalto.gov.br/ccivil_03/Decreto/2002/D4297.htm>. Acesso em: 04 mar. 2012.

FARIA, H. H**. Eficácia de gestão de unidades de conservação gerenciadas pelo Instituto Florestal de São Paulo, Brasil**. Tese (doutorado) – Universidade Estadual Paulista, Presidente Prudente, 2004, 401 p.

LIMA, A. **Zoneamento Ecológico-Econômico à luz dos direitos socioambientais**. Curitiba: Juruá, 2006. 288p.

MILARÉ, E. **Direito do ambiente:** doutrina, jurisprudência, glossário. 3ª ed. São Paulo: Revista dos Tribunais, 2004. 1119p.

MILLIKAN, B.; DEL PRETTE, M. E. **Documento base para discussão sobre metodologia de Zoneamento Ecológico-Econômico na Amazônia**. In: Seminário de Avaliação da metodologia do Zoneamento Ecológico-Econômico para a Amazônia Legal. Programa Piloto de Proteção das Florestas Tropicais Brasileiras. Manaus, AM, 2000. 1 CD-ROM.

MONTAÑO, M.; OLIVEIRA, I. D.; RANIERI, V. E. L.; SOUZA, M. P. A necessidade de incorporação do Zoneamento Ambiental como instrumento de planejamento e gestão territorial urbana. In: International Congress on Environmental Planning and Management, 2005, Brasília. **Proceedings...** Brasília: Universidade Católica de Brasília, 2005. p. 1 – 22.

PARTIDÁRIO, M. R. **Introdução ao ordenamento do território**. Lisboa: Universidade Aberta, 1999. 210p.

PREFEITURA MUNICIPAL DE BROTAS. **Zoneamento Ambiental do município de Brotas (SP)**: subsídios ao planejamento ambiental - relatório final. Brotas: Prefeitura Municipal de Brotas, 2007. 35p.

RANIERI, V. E. L. **Discussão das potencialidades e restrições do meio como subsídio para o Zoneamento Ambiental:** o caso do município de Descalvado (SP). 2000. 87 p. Dissertação de Mestrado. Universidade de São Paulo, São Carlos, 2000.

RANIERI, V. E. L.; MONTAÑO, M.; FONTES, A. T.; OLIVEIRA, I. D.; SOUZA, M. P. O Zoneamento Ambiental como instrumento de política e gestão ambiental. In: ESPÍNDOLA, E. L. G.; WENDLAND, E.. (Orgs.). *PPG-SEA:* **Trajetórias e perspectivas de um curso multidisciplinar**. São Carlos: Rima, 2005. v.4, p.109-136.

SANTOS, R. F. **Planejamento Ambiental -** teoria e prática. São Paulo: Oficina de textos, 2004. 184p.

SÃO PAULO (Estado). Secretaria do Meio Ambiente. Coordenadoria de Planejamento Ambiental Estratégico e Educação Ambiental. **Zoneamento Ecológico-Econômico** – Litoral Norte São Paulo/ Secretaria de Estado de Meio Ambiente. Coordenadoria de Planejamento Ambiental Estratégico e Educação Ambiental. São Paulo: SMA/CLPEA, 2005. 56p.

SILVA, J. S. V.; SANTOS, R. F. Zoneamento para planejamento ambiental: vantagens e restrições de métodos e técnicas. **Cadernos de Ciência e Tecnologia**, v. 21, n. 2, p. 221-263, mai./ago., 2004.

SOUZA, M. P. **Instrumentos de gestão ambiental**: fundamentos e prática. São Carlos: Editora Riani Costa, 2000. 112p.

SOUZA, M. P. As bases legais e os Zoneamentos Ambientais. In: 2° Simpósio de Geotecnologias no Pantanal, 2009, Corumbá. **Anais eletrônicos...** Campinas: Embrapa

Informática Agropecuária; São José dos Campos: INPE. Disponível em: <http://www.geopantanal2009.cnptia.embrapa.br/cd/pdf/palestra8.pdf>. Acesso em: 16 nov. 2011.

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CRITERIA FOR ANALYZING ENVIRONMENTAL ZONING AS AN INSTRUMENT IN LAND USE AND SPATIAL PLANNING

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Resumo: No Brasil, Zoneamentos Ambientais têm sido elaborados para diversos recortes territoriais e com objetivos distintos. Ainda que o instrumento tenha sido regulamentado sob o nome de Zoneamento Ecológico-Econômico em 2002, os métodos utilizados em sua elaboração não seguem um padrão e esta situação gera dúvidas sobre o real papel deste instrumento. O presente trabalho propõe critérios para a análise do Zoneamento Ambiental como instrumento de planejamento e ordenamento territorial no contexto da Política Nacional do Meio Ambiente (PNMA). Para tanto, é apresentada uma revisão bibliográfica e documental sobre o tema e são analisados três estudos de caso. Conclui-se que nem sempre os Zoneamentos Ambientais atingem seus objetivos, mas, como aspecto positivo, o instrumento serve como base de informações sistematizadas sobre o meio, além de colaborar para o alcance dos objetivos da PNMA.

Palavras-chave: Política ambiental; Ordenamento territorial; Zoneamento Ambiental.

Resumen: En Brasil han sido elaboradas zonificaciones ambientales en diversos ámbitos territoriales y con distintos objetivos. Aunque el instrumento fue reglamentado en 2002 con el nombre de "Zonificación Ecológica-económica", los métodos utilizados para su desarrollo no siguen un modelo único, situación que genera dudas sobre el papel real del instrumento. El presente trabajo propone criterios para el análisis de la zonificación ambiental como instrumento de planificación y ordenamiento del territorio en el contexto de la Política Nacional del Medio Ambiente de Brasil (PNMA). Se presenta una revisión bibliográfica y documental sobre el tema y el análisis de tres estudios de caso, que permiten concluir que las zonificaciones ambientales ni siempre logran sus objetivos. Sin embargo, como aspecto positivo, el instrumento sirve como una base de informaciones sistematizadas sobre el medio ambiente, además de contribuir con el alcance de los objetivos de la PNMA.

Palabras clave: Política ambiental; Ordenamiento del territorio; Zonificación ambiental.

Abstract: In Brazil, Environmental Zoning policies are produced for different territorial areas and distinct goals. Despite the fact that Ecological-Economic Zoning - as this instrument is also known - was regulated in 2002, there are no standard methodologies used in the process of producing Environmental Zoning studies. This paper establishes a set of criteria to analyze Environmental Zoning as a tool for land use and spatial planning in the context of the Brazilian National Environmental Policy (NEP). A literary and document review is presented and three case studies are analyzed. While it is possible to conclude that not all Environmental Zoning studies have achieved their goals, it can be argued that one positive aspect of the instrument is their use as a source of systematized information on the environment and subsequent contribution to the achievement of NEP goals.

Key-words: environmental policy, spatial planning, environmental zoning.