Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 09, número 71, 2021

Characterization of ecologically dysfunctional municipalities: a contribution to Environmental Democracy

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Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 09, número 71, 2021

SUMMARY

This research aims to promote a discussion on how to characterize an ecologically dysfunctional municipality, in terms directly linked to environmental legal noncompliance, and how it can impact the axes of Environmental Democracy, based on the identification of institutionalized environmental conflicts by governmental agencies that have a duty to conduct investigations and punish its offenders. The methodology used was a documental analysis of works published on the subject in books, specialized magazines, scientific articles available in libraries or on the internet; and the analysis of a case study, which took place in a medium-sized municipality in the state of São Paulo. Using the methodology, we were able to characterize ecologically dysfunctional municipalities, and their impacts on the structural axes of Environmental Democracy, in order to provide access to information, increase citizen participation, and resolve environmental conflicts.

KEYWORDS: Environmental Democracy. Environment. Ecological municipalities.

1. INTRODUCTION

The creation and segmentation of public policies that contemplate the social, environmental and economic sustainability tripod must occur at the local level (UN, 2017). Additionally, the principle of sustainable development appeared in the Brundtland Report (WCED, 1987) defined as the "one that meets the needs of the present without compromising the ability of future generations to meet their own needs" (CMMAD, 1988, p. 46).

Further, sustainable development occurs when there is harmonization among social, environmental and economic subjects (CAVALCANTI, 1999; SACHS, 2008; IPIRANGA; GODOY; BRUNSTEIN, 2011; OLIVEIRA, 2019; NISTA, 2020). Therefore, it must be understood as a novel paradigm as it represents a new way of “facing nature and the necessary changes require multilateral efforts by different national governments”, with a need for change in the formulation, enforcement and monitoring of local public policies (MOURA; BARRETO FILHO, 2017, p. 23).

Sustainability requires us to rethink not only the developmental model, but also social, environmental and economic relations (ARAUJO; CARVALHO, 2011). And currently, municipalities are so deep in environmental crises (JACOBI, 2006), that they are becoming less and less ecologically functional.

This latent environmental crisis can be often linked to a number of factors. For instance, there is (1) the reduction of urban green areas; (2) the absence of public policies for pollution control and (3) the expansion of the public transport system and of the sewage network. Additionally, there is also (4) the contamination of bodies of water, and the risk it poses to the population; (5) the exhaustion of conventional waste disposal methods and problems resulting from contamination of groundwater and surface water by leachate; and (6) the precarious living conditions of a portion of the population (JACOBI, 2006).

A municipality with good environmental quality is one free from water and air pollution, with full accessibility for pedestrians, featuring beautiful parks and squares, equipped with sunlit, ventilated houses, with patios and landscaped corridors. Still, it has tree-lined streets, providing greater urban drainage and comfort, where mobility issues are present, as well as providing security for its individuals (MACEDO et al., 2012).

Therefore, an ecologically functional municipality has a good environmental quality, and is consequently healthier for human life, because people enjoy their right to well-being.

Furthermore, ensuring this right is only possible with environmental management and the application of the sustainable development principles, in an integrated manner. Thus, an ecologically functional municipality (imagining the territory as a whole, not just the urban area) can also be called sustainable, or one that meets the needs of its inhabitants, providing a healthy environment, for those who live in it at present and for the generations to come.

The Brazilian Federal Constitution states that everyone has the right to an ecologically balanced environment (BRAZIL, 1988, art. 225), so environmental laws must establish active and passive obligations to achieve this intertemporal right, which according to the constitution is essential to a healthy quality of life.

This study is based on the premise that full compliance with environmental laws must be sufficient for municipal ecological functionality, following a gradual and broad construction of environmental regulations by the Brazilian Government (LIMA; SHIRAISHI NETO, 2015; SILVA; TEIXEIRA, 2017).

Even though ecological dysfunctionality can occur due to several factors besides the legal one, such as those caused by unexpected natural events, this research focused on the legal aspect. This is because it is important to seek full compliance with the environmental regulations as a way of achieving the constitutional rights to an ecologically balanced environment (BRASIL, 1988, art. 225), since environmental protection depends on conformity with the affirmed and recognized in the abstract plane (LUNELLI, 2015, p. 12).

Thus, from the moment that there is legal non-compliance, and it is necessary to identify which anti-legal behaviors exist and where they reside, the municipality is faced with situations that will make itself ecologically dysfunctional, and there must be adjustments in public policies so that anthropic actions or inactions are in agreement with environmental regulations.

The present research discussed how to characterize an ecologically dysfunctional municipality, in terms directly linked to environmental legal noncompliance and how this can impact the pillars of Environmental Democracy, starting from the identification of institutionalized environmental conflicts by governmental agencies that have a duty to investigate and punish offenders. For this, we carried out a documental analysis of books, specialized journals, and scientific researches published and available in libraries or on the internet. Further, we analyzed a case study, which took place in a medium-sized city, located in the countryside of the state of São Paulo, that ultimately enabled us to identify the methodology used to characterize ecologically dysfunctional municipalities.

2. ECOLOGICALLY DYSFUNCTIONAL MUNICIPALITIES REGARDING LEGAL BREACH, AND ENVIRONMENTAL DEMOCRACY

The concept of a 'functional city' was created in 1933, at the IV International Congress of Modern Architecture - CIAM, held in Athens. This event had as a main result the Athens Charter, a general overview of the theories of Rationalist or Functionalist Urbanism (PEPITONE, 2016). Its final conclusions created the theory of spatial organization in agreement with basic human activities such as work, housing, leisure and circulation/mobility. The Charter even

recommended that municipalities should be conceived in a functional way, with clear delimitations between residential, leisure and work areas (TIRLONI, 2013; PEPITONE, 2016).

In 1998, the European Council of Spatial Planners - CEU drafted a document called the New Charter of Athens, revised in 2003, that expanded the previous four concepts to 10 principles, proposing connected and inclusive municipalities, and giving citizens a central role in the decision-making process related to their cities, in order to involve the participation of several areas in urban development (GARCIAS; BERNARDI, 2008).

This urban dysfunction is characterized by social disorganization, degradation and exclusion caused by the intense process of urbanization without proper planning (MONTE-MÓR, 2015). Being that ecological functionalities are not only related to the ecological context, which in turn is related to ecosystem services or biodiversity functions (FREITAS NUNES-NETO, SANTOS DO CARMO; NIÑO EL-HANI, 2013).

Ecological function must be interpreted in a much broader way, surpassing the concepts established by Ecology, and considering the functions the environment plays in people's lives, including modern and urban life, which enjoy the same right to a healthy and hospitable environment. Thus, the municipality's functions are closely related to the legal sciences, as they find legal provisions based on the notions of human dignity, solidarity, social justice and well-being, in other words, fundamental rights in general (OOMEN, 2016).

Considering that the environment performs its ecosystem services (or biodiversity functions) to provide a healthy life for people, in urban and rural areas, environmental regulations aim to guarantee this fundamental right to all citizens. The Brazilian environmental legal system has been evolving in order to provide an ecologically balanced environment (essential to a healthy quality of life) as a fundamental right and of transindividual ownership, especially since its registration in the constitutional law (BRASIL, 1988; CICHELERO; NODARI; CALGARO, 2018; BOLLA; MILIOLI, 2019; REICHARDT; SANTOS, 2019).

According to Fiorillo (2012), since the Federal Constitution of 1988, the municipalities, regardless of the concept attributed to them, had to obey the parameters established by the Constitutional Environmental Law. This means that within the constitutional order as a natural and artificial environment, municipalities were legally defined as environmental goods regulated by article 225 of the Constitution (BRAZIL, 1988, arts. 182 and 225). Consequently, a process of decentralization of governmental competences began, from which the municipalities started to assume autonomy in the definition, conduction and execution of their public policies (OLIVEIRA; MELNICKY, 2017).

Furthermore, there are rules regarding ecologically functional municipalities beyond the Federal Constitution, both in relation to the normative hierarchy (OLIVEIRA, 2009; BOUCAULT, 2015), as well as their origin in the federative entity (SCHMITT; SCARDUA, 2015), and that establish a range of environmental rights and obligations, so that municipalities are able to fulfill their ecological functions.

Considering environmental laws regarding the ecological functionality of municipalities, through the constitutional and infra-constitutional normative archive, cities that are in non-compliance with them can be considered ecologically dysfunctional, which means they lack essential environmental attributes so that residents can enjoy an ecologically balanced environment, essential for a healthy quality of life.

There is a close relationship between the characterization of ecologically dysfunctional municipalities and Environmental Democracy because it has three structuring axes: (1) access to environmental information; (2) access to environmental justice; and (3) popular engagement (EBBESSON, 2015; MÉDICI COLOMBO, 2018; AGUILAR CAVALLO, 2020). These axes must be interconnected, so that people's right to an ecologically balanced environment is respected, which is essential to a healthy quality of life (BRAZIL, 1988, art. 225).

Environmental Democracy was formally defined in the Declaration of Rio/92, which states that the government must provide people with the right of access to environmental information and the opportunity to participate in decision-making processes, in addition to effective access to conflict-resolution procedures (DECLARATION, 1992, principle 10). Regarding principle 10 of the Rio/92 Declaration on environment and development, access to these rights was recognized as essential for the promotion of sustainable development, democracy and a healthy environment (DECLARATION, 2012).

The characterization of dysfunctional municipalities is very important for the field of Environmental Democracy, to make the necessary adjustments so that cities can provide access to information, increase citizen participation, and resolve existing environmental conflicts.

3. PRESENTATION, ANALYSIS AND DISCUSSION OF THE METHOD FOR CHARACTERIZATION OF ECOLOGICALLY DYSFUNCTIONAL MUNICIPALITIES

For the characterization of ecologically dysfunctional municipalities due to legal non-compliance, we analyzed an experiment that took place in São Carlos-SP, in which Oliveira et al. (2019) carried out a survey with public environmental agencies (Secretariat for the Environment - SMA, São Paulo State Environmental Company - CETESB, Brazilian Institute of the Environment and Renewable Natural Resources - IBAMA, State and Federal Public Ministries and State and Federal Legal departments), regarding institutionalized environmental conflicts over 11 years (2006 to 2016). Among the countless results presented, the systematic identification of institutionalized environmental conflicts existing in São Carlos draws attention. Thus, it is possible to take advantage of this result to characterize ecologically dysfunctional municipalities, based on the suggested procedures, in particular in relation to the research technique developed to obtain data, as well as their treatment and availability.

Therefore, in order to find out if municipalities are ecologically dysfunctional in terms of legal non-compliance, institutionalized environmental conflicts at the local level must be identified. It is precisely at this point that the experiment carried out by Oliveira et al. (2019) contributes, by demonstrating how to conduct a survey to identify such conflicts. According to the experiment, the collection of data on institutionalized environmental conflict must firstly recognize the environmental agencies responsible for conducting investigations and legal procedures, with the power of the environmental police. This competence is currently mainly regulated by the Complementary Law 140/2012, and in the Federal Constitution itself.

In the studied case of São Carlos, state and federal agencies were identified, and those found to have executive responsibilities (environmental agencies of the state and federal public administration) were the State and Federal Public Ministry, which are responsible for constitutional determination (BRASIL, 1988, art. 129); and the judiciary power itself, through the

State and Federal Courts, which by constitutional and infra-constitutional provision have jurisdiction to judge cases of non-compliance with environmental laws.

Once the agencies holding the cases of environmental legal non-compliance have been identified, they need to be contacted in order to provide access to data, invoking the Right of Access to Information (BRASIL, 2011). Accordingly, each agency follows their own procedure, and there are differences, for example in the case of SMA, CETESB and IBAMA, data was collected electronically (on their web page), whereas at the State and Federal legal department, and at the State and Federal public Ministries, an official request had to be submitted by letter, with a justification. The letters requested not only for access to the agency's database (primary data) but also to physical access to administrative and judicial lawsuits, and investigative procedures.

While communicating with the agencies, it is important to establish the period in which the data will be accessed, and it is recommended to establish a relatively extended period, of at least five years, from which the data may be simply updated. It is suggested that, if this method is constantly used in a municipality, the history of cases within specific subjects will facilitate the analysis of conflicts, as well as the search for the best environmental solutions.

After establishing the period for data collection, at least the following points must be identified: (1) parties (legal person), (2) year of the conflict, (3) legal basis of the infraction, (4) location of the infraction, (5) summary of the process / procedure and (6) final result. These factors are crucial to identify the highest incidence of non-compliers (parties); periodicity (year of conflict); violated laws (legal basis of the infraction); precise indication of conflicts for the construction of maps (location of the infraction); and situation of conflicts (summarized history of the process / procedure, combined with the final result).

The prior elaboration of a form, such as a questionnaire in an Excel spreadsheet is recommended as a way to order, standardize and direct the data collection. This form may have to be adapted according to the data that will be collected in each consulted agency, for example in the case of administrative and judicial lawsuits, as well as investigative procedures. In addition to this questionnaire, a script should be developed to complete the research questionnaire (OLIVEIRA et al., 2019).

Once data is received from the public agencies, or even collected in a presential way, questioning the agencies with the objective of physically accessing the lawsuits / procedures, always accompanied by a form previously prepared; the selection, tabulation and coding of primary data should proceed (GIL, 2008; APPOLINÁRIO, 2012) in Excel spreadsheets. To register and tabulate information, researchers worked with the aid of notebooks, in addition to a digital camera and smartphones (with the *CamScanner* application installed) to record the information that is most relevant to the study. Then, analysis were performed with the aid of descriptive statistics (APPOLINÁRIO, 2012), enabling the interpretation of data and a tabular representation of the main characteristics of the conflicts.

Afterward, data was processed and treated in order to ensure the documentation and integrity of the information collected in every agency. The data was uploaded through online file sharing and storage services, such as *Google Drive* and *Dropbox*. This procedure made it easier to systematically organize information, categorizing it by institution (OLIVEIRA et al., 2019).

Subsequently, as the data was already collected and tabulated in the Excel spreadsheet editor (Microsoft Office), it passed through a stage of descriptive statistical analysis (frequency distribution, central tendency and dispersion measures) which resulted in graphs, tables and illustrative figures. The results produced in the analysis were displayed in such a way that they could be widely disseminated because of their visual layout.

The localities where the environmental and urban conflicts took place were also mapped, and this happened simultaneously with the process of data collection. For that, geographic coordinates were manually introduced in the Google Earth software. From the geolocation of the conflicts in Google Earth, vector files (shapefiles) were inserted in the free and opensource software QGIS, a Geographic Information System (GIS). In this way, alphanumeric data with the characteristics of the verified conflicts (typology, theme, duration, etc.) were added, in order to obtain a complete, digital and georeferenced database on each investigated lawsuit / procedure. This insertion in QGIS created qualitative and quantitative thematic maps from the analysis (OLIVEIRA et al., 2019).

Following the mapping process, the legal typology of the institutionalized conflicts was classified. An individual categorization by subject of the judicial processes and extrajudicial procedures was instituted, in addition to the current mapping of the places in the municipal sphere. This is in line with the construction of the alphanumeric database that was used to elaborate thematic maps of conflict.

To this end, the researchers elected two legal norms of reference for environmental conflicts: Decree 6,514 / 08 and Law 9,605 / 98. Both rules feature typologies and sanctions in case of non-compliance and using them, a template was elaborated for both the subject and for the legal typology. In addition, for subjects related to Urban Law, the table of the Court of Justice of the State of São Paulo was used, which provides the separation by subject, and the legal typologies were attached to the access of the legal basis of the process, judicial or extrajudicial, or of applicable urban standards.

Separating cases by legal subjects and typologies makes a series of subsequent analysis possible, based on the identified issues and the legal types allegedly infringed. In the case analyzed, the template of subjects and typologies must be highlighted (OLIVEIRA et al., 2019), because it presented a range of legal rules related to environmental infraction. This combination of the two legal norms serves as a reference for environmental conflicts, and therefore it is proved to be efficient for environmental legal norms, but with the possibility of application to other fields, as was the case of urbanism.

Proceeding with the mapping, the researchers started to manually and individually insert each one of the addresses or geographic coordinates contained in the verified documents, to create personalized Google maps (*My Maps*) and locate places where environmental and urban conflicts occurred in the studied municipality. Searching addresses (geocoding) and inserting geographical coordinates resulting in the spatialization of conflicts, which were saved in *.kml* (Keyhole Markup Language), a file format used to display geographic data. The *.kml* file with the spatially distributed data was integrated into the QGIS software (version 2.14.18 Essen), a free and open-source Geographic Information System (GIS).

The Excel spreadsheet with the remaining information about the conflicts (such as theme, year of occurrence / institutionalization, subject, object and current situation) was saved

as a *.csv* (Comma Separated Value) file, which was later imported into QGIS (adding a function layer from a delimited text) and used to insert the conflict information in the attribute table. This process of data crossing was performed based on the identification number of each lawsuit / procedure (OLIVEIRA et al., 2019).

With this georeferenced database referring to conflicts (vector files in ESRI shapefile format with Coordinate Reference System defined in the Universal Transverse Mercator Projection (UTM), Datum SIRGAS 2000 spindle 23S), it was possible to perform the management and spatial analysis of the collected information. This process enabled the creation of thematic maps that represented the spatial occurrence of conflicts, as well as their attributes (OLIVEIRA et al., 2019).

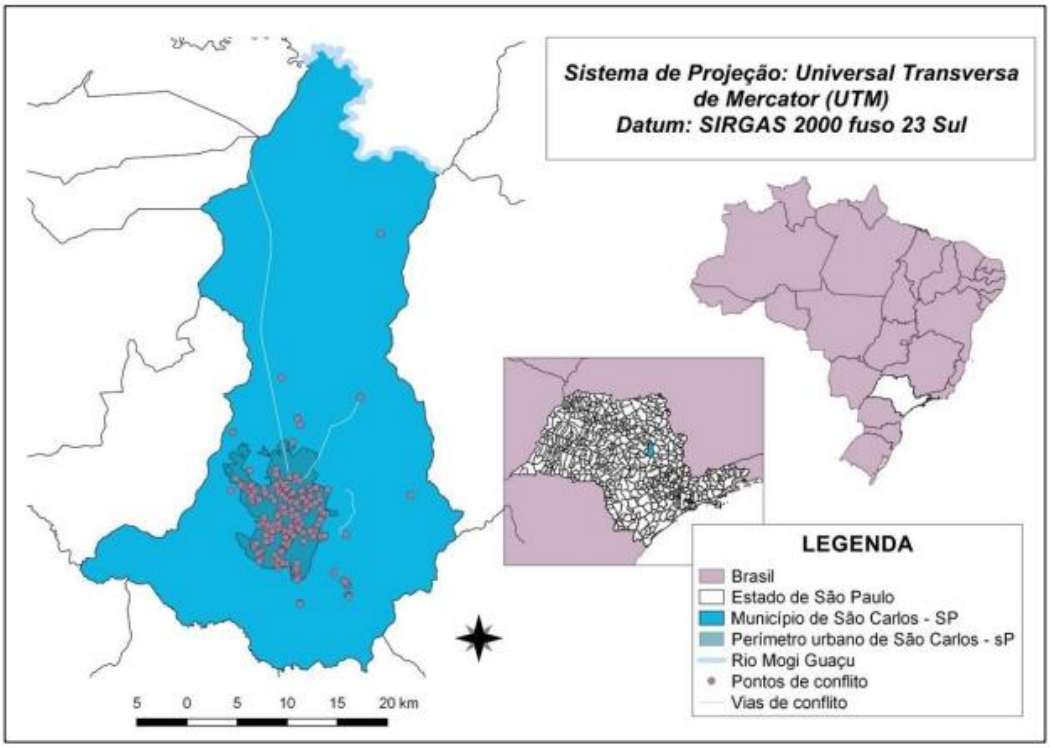
In QGIS, from the layer with the georeferenced location of the conflicts, a Kernel Map (or heat map) was built. Presenting the density of the points, this representative method facilitates the identification of clusters with high concentrations, providing an estimate of the intensity of occurrence (of conflicts in the case) (GRISOTTO et al., 2012) through the study area, generating qualitative data (OLIVEIRA; OLIVEIRA, 2017) on the distribution of conflicts in the territory (OLIVEIRA et al., 2019).

To determine which conflicts were within the municipality's urban area, the polygonal vector layer of the urban perimeter had to be created, based on the georeferencing and vectoring of Annex 02 of the municipal Strategic Master Plan (PMSC, 2016). Then the shapefile of the digital meshes was added with the delimitation of the country to spatialize conflicts in the national territory (with the division of the geographic regions), and of the municipalities of São Paulo (IBGE, 2015), filtering the municipal limits of interest (OLIVEIRA et al., 2019).

As for hydrography, the shapefile file with the São Paulo State Drainage Network was downloaded (and subsequently inserted and cut in QGIS). This shapefile was made available by the Environmental Planning Coordination, linked to SMA (SÃO PAULO, 2018). Thus, it was possible to build maps with the identification of conflicts, as in Figure 1, separated by subjects (Figure 2) and even heat maps, separated in low, medium and high density, as in Figure 3. Through this methodology it was even possible to make specific maps for each subject, as in Figure 4.

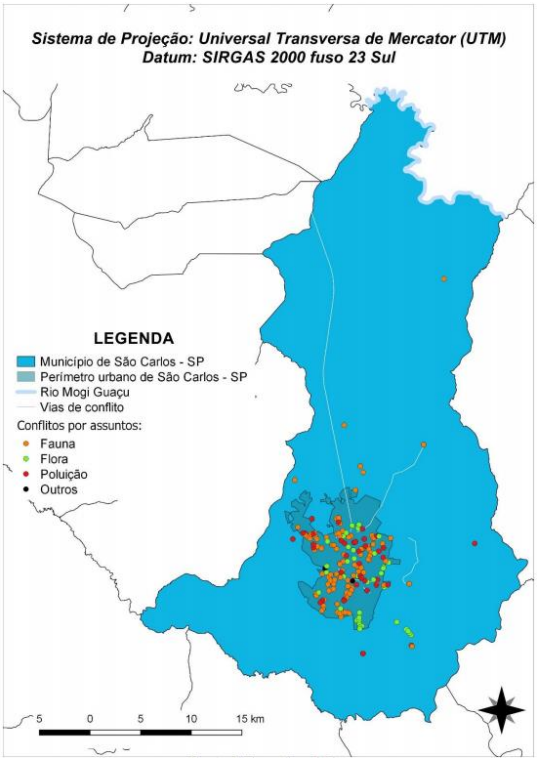
Revista Nacional de
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 09, número 71, 2021

Figure 1: Map of environmental conflicts in the municipality of São Carlos, from Brazil-São Paulo to the municipality



Source: OLIVEIRA *et al.*, 2019.

Figure 2: Map of environmental conflicts in the municipality of São Carlos, separated by subject



Source: OLIVEIRA *et al.*, 2019.

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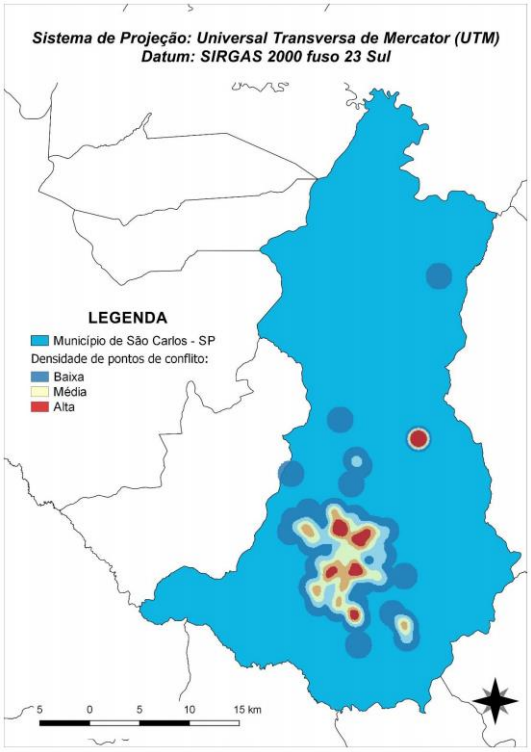
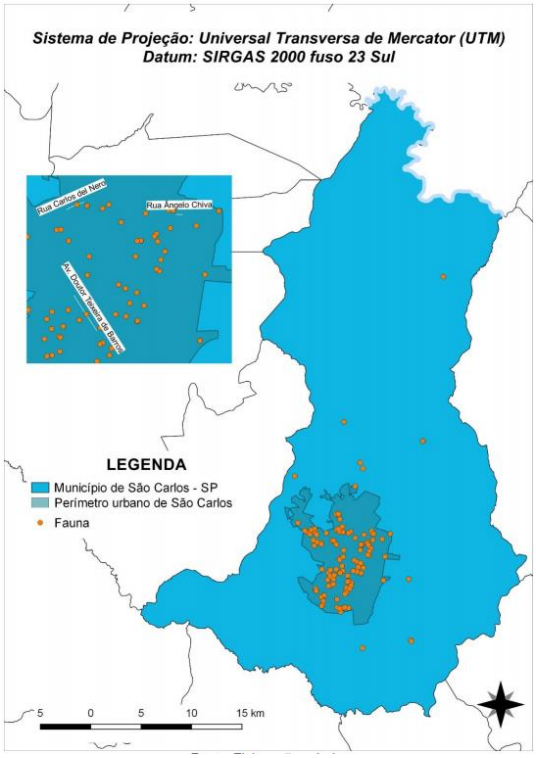
Gerenciamento de Cidades
ISSN eletrônico 2318-8472, volume 09, número 71, 2021

Figure 3: Heat map of environmental conflicts in the municipality of São Carlos



Source: OLIVEIRA *et al*., 2019.

Figure 4: Map of environmental conflicts in the municipality of São Carlos, from Brazil-São Paulo to the municipality



Source: OLIVEIRA *et al*., 2019.

Analyzing the method, given the data collected and compiled in spreadsheets, it was possible to map the conflicts to identify their hotspots, which in turn can help to build the formal agenda (within the public environmental policy). In addition to identifying legal non-compliances, researchers also identified a location for a more direct intervention, and also the greatest incidence, in order to contribute to the agenda of priorities and achieve the goals of Environmental Democracy. It is believed that, with this, the cycle of public policy can begin (SOUZA, 2006; RAEDER, 2014; FONSECA; BONFIM FILHO, 2019), because there will be a problem identified, that is, an environmental diagnosis.

All this information, in the form of spreadsheets and maps, must be available to the public, and not only to decision makers (the first sector). One way to ensure this is to build a web page, without any restriction on access for the general population.

Using the described methodology, based on the identification of cases of legal non-compliance, systematically separated in subject, legal typology and georeferencing, ecologically dysfunctional municipalities are identified. And with that, performing public intervention is easier, because it promotes a discussion about public policies to achieve the precepts of Environmental Democracy.

The analyzed case demonstrates the construction of an important collection of environmental information, that should be easily available to the population, respecting the first axis of Environmental Democracy: access to environmental information. Tartaruga and Heidrich (2009) consider that the information derived from the communication process between different individuals (politicians, technicians and citizens), is built through intense and open discussion about local problems in the search for consensus to overcome a conflict. Further, according to Creighton (2005), the success or failure of public environmental policies depends on how well-informed citizens are about the existing conditions or about how a decision should be implemented in the municipality. So, providing access to information can impact on the search for solutions on existing environmental conflicts.

Access to environmental information must occur in a broad and unrestricted way, and can even be, as identified in the case studied, through a web page. In addition, Environmental Democracy has “the right to information as a precondition for the effective exercise of the rights to political participation and access to justice” (PAROLA, 2020, p. 266). Hence, one of the consequences of this access to environmental information, is on citizen participation in local affairs in a greater and better way (quantitative and qualitative). This participation is pointed out by Garbeline (2017) as a possibility for people affected by environmental public policies to feel included in Politics. Aguilar Cavallo (2020) considers that environmental participation is a specific manifestation of Environmental Democracy.

And the last structural axis of Environmental Democracy is the access to conflict resolution procedures, called access to justice, which in the case studied can be considered as a way of increasing the number of people who are environmentally informed about the existence of conflicts. These people are therefore able to make use of the judicial and administrative means of conflict resolution to search for the reestablishment of the *status quo ante* and to guarantee the right of ecological balance, and consequently, the right for an ecologically functional municipality.

Still, it may be that conflicts do not even reach the administrative or judicial sphere, causing them to be resolved or mitigated by alternative means, once other axes (information and participation) have been implemented, where citizens can express their needs and concerns to the public authorities (CREIGHTON, 2005).

4. CONCLUSIONS

Full compliance with environmental legal standards is believed to be sufficient to guarantee ecologically functional municipalities, given the broad and gradual construction of environmental regulations by the Brazilian Government.

When faced with environmental legal noncompliance in a municipality, once that is properly characterized through the identification of institutionalized conflicts, the city can be considered ecologically dysfunctional, deserving the effort, through public policies, to (re)adapt local anthropic actions or inactions to the applicable environmental laws.

Further, a municipality's ecological functions are closely related to the legal sciences, as they find legal provisions linked to the notions of human dignity, solidarity, social justice and well-being, that is, fundamental rights in general.

Based on the existence of environmental laws applicable to the ecological functionality of municipalities, and considering the identification of cases of legal non-compliance, it is possible to determine cities in ecological dysfunction, as they lack essential environmental attributes so that people can enjoy an ecologically friendly environment, essential for a healthy quality of life.

This research identified a methodology for this characterization, based on institutionalized environmental conflicts, and its application allows the recognition of the subject, the parties involved, periodicity of conflicts, legal types violated, situation of conflicts, and precise indication of conflicts for the construction of maps, thus enabling these cases to be considered in the discussion of municipal environmental public policies, in order to resolve such conflicts.

Lastly, the characterization of dysfunctional municipalities contributes enormously to Environmental Democracy, enabling the necessary adjustments to be made in order to provide access to information, increase citizen participation, and reduce the existing environmental conflicts.

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