Groundwater governance in the states of São Paulo, Paraná, Santa Catarina and Rio Grande do Sul: An analysis from the instruments of the National Water Resources Policy

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Abstract: In the present scenario of implementation of the National Water Resources Policy (PNRH), there is consensus on the strategic importance of groundwater to achieve the basic objective of the policy, which is to ensure the current and future generations the necessary water availability, on quality standards appropriate to their uses. A specificity of groundwater in the Brazilian legal system is the exclusivity of your domain assigned to states by CF / 88. In this context, this article presents the partial results of research that has been carried out under the Project Network Guarani / Serra Geral, aims, carry out a comparative analysis of the governance of groundwater from the instruments of PNRH by check existence of such law, regulation and implementation of the same in the states of Sao Paulo, Parana, Santa Catarina and Rio Grande do Sul. To achieve the objective of the research an adapted methodological model of Foster et al [1] and proposed theoretical model by Turton et al [2] were used. The analysis of the results concluded that the states of São Paulo and Paraná obtained high performance in the implementation of the instruments of PNRH, while the states of Santa Catarina and Rio Grande do Sul had average performance.

Keywords: water resources policy; groundwater; governance

I. INTRODUCTION

In the current scenario of implementation of the National Water Resources Policy (PNRH) established by Law 9.433 / 97, there is consensus on the strategic importance of groundwater to achieve the basic objective of the policy, which is to ensure the current and future generations the necessary water availability, quality standards appropriate to their uses. But earlier, this finding was not so obvious, since the very Law 9.433 / 97 in its text has highlighted just surface water [3] and [4].

The first step to overcoming this regulatory gap under the PNRH, occurred with approval by the National Water Resources Council (CNRH) of Resolution No. 15 of 12/01/2001 establishing guidelines for integrated water management. Later other resolutions from CNRH regulated the protection and conservation of groundwater, as well as their consideration in applying the tools of PNRH such as resolutions CNRH No 22/01, No 91/08, No 92/08 and No 107 / 10.

A specificity of groundwater in the Brazilian legal system, which is under the Federal Constitution of 1988, Art. 26, I, its dominion is unique to the States, so this is the federal entity that must put into practice the integrated management of surface and groundwater. Just as it is the Union's responsibility editing general rules (principles standards), of national implementation over water , for the states regulations (rules-rules) for the application of general rules at the state level [5]. Thus, the applicability of PNRH occurs at the state level, through the formalization of a public policy management of water resources, including groundwater, which specifies, details and fits the general rule to state reality. The Estate, such as the national law, establishes its water policy by means of a law, that states the principles, objectives and guidelines that will guide the policy, the tools to put it into practice, as well as the organs responsible for its implementation, which make up the state system of water management. It is this set of rules, tools, processes and institutions that form the basic structure of governance that will enable the implementation of public policy on water resources in the state.

In this context, this article presents the partial results of research that has been carried out under the Project Network Guarani / Serra Geral, aims to carry out a comparative analysis of the governance of groundwater, from the existence of such law, regulation and implementation of the instruments of PNRH in the states of Sao Paulo, Parana, Santa Catarina and Rio Grande do Sul.
II. ASSESSMENT OF PNRH INSTRUMENTS AS CRITERIA FOR GROUNDWATER GOVERNANCE

There are several concepts of governance, as well demonstrated by Richard and Rieu [6] in a study of the historical evolution of the term or by Turton et al [2] to propose an ecosystem model of governance, which feature a basic typology based on three types governance, namely, corporate governance, cooperative governance or network and adaptive governance. What is evident in the analysis of these authors on the subject, is that there is a general concept of governance and a specific concept focused on water governance, from which you can extract some features: multi-agent and multi-scalar systems of self-organization and self-regulation, interdependent; powers and shared responsibility; ability to coordinate collective action in the face of changes in order to define shared goals, according to Richard and Rieu [6]; different elements of scale; relationships between people and ways in which they interact with each other and their environmental context; principles of systems, rules and regulations that serve to guide these interactions, according to Turton et al [2]. The latter, however, go further in its analysis, to differentiate governance as governance process as a product and to propose a new concept of governance, which translates as follows, "the process that informs decision makers and allows both exchanges between users competing for a given feature, the balance in the protection and benefit from such use, in order to mitigate conflicts, enhance equity, ensure sustainability and compromise the officers responsible [2]. Seen in this way, from the perspective of the authors, governance as a process involves a number of distinct elements, involving decision-makers and potentially questionable results, while governance as the product can be seen as the quality of these results, especially as regards the legitimacy of exchanges and the level at which they are contested or accepted by society in general.

Furthering the discussion, Turton et al [2] have a Trialogue Model of Governance based on three groups of actors, Government, Society and Science and its dynamic interactions, each connecting with each other through two interfaces. The Government-Society interface, the Government-science interface and the Science-Society Interface. These are interfaces that characterize the function of governance as a process. The quality of these interfaces determines the extent to which the government can generate incentives needed to develop society by allowing science inform the decision-making process. Finally Turton et al [2] analyze the applicability of the Trialogue Model of Governance for Integrated Water Resources Management (IWRM), and comprehend that IWRM can be understood as governance structure focused on institutional structure (central-local, watershed, public-private) and governance as a process, understood as management tools (evaluation, information, allocation of instruments) and environmental capacity (policies, legislation). The authors conclude that a key distinction must be made between governance as a product where quality aspects as "effective" or "sustainability" are examples, and governance as a process where procedures and institutional arrangements are examples. Given the fundamental structure of the three major groups of actors, and their dependence on a communication capability with other, its configuration can be described as a Trialogue. Inside addition, the effectiveness of governance becomes highly dependent on the quality of the interfaces and how the actors meet.

In the theoretical model proposed by Turton et al [2] norms and values, encoded in the law or only perceived in society, are central to support the key processes of water governance. According to Stephan [7], the law is a tool for the government to implement its policy, either domestically or internationally. It is possible to identify the interface between Government-Science, when the normative acts can translate scientific advances. On the other hand, there is the interface between Government-Society when given express public policy social expectations, and the law that implements it to establish rights and obligations, reflects the evolution of society in legal standards. There interface between science-society when scientific knowledge is widespread, communicated, transferred and put into practice in order to meet social demands.

So it appears that a public policy and a legal framework, based on scientific knowledge and the development of a particular society, are required to develop and implement water governance understood as a process. Although policy and legislation [8] go hand in hand, are fundamentally different. The policy serves as a guide for decision-makers, since the law imposes rights and obligations to be met [9]. In the Brazilian case, by observing the structure of Law n° 9,433 / 97, it appears that articles 1º to 4º, dealing with water resources policy, as they set their motives, objectives and guidelines that will guide the decision-making since articles 5º to 57, dealing with the instruments, institutions, skills and actions that in most cases, need a specific regulatory framework for the exercise and / or its implementation. If the federal level the legal structure of water resource management and the institutional arrangement for its implementation, are at an advanced stage of implementation, this fact does not reproduce in the federated States, since, although they have a water resources policy approved by state law, lack in certain areas of a regulatory framework and an institutional arrangement suitable for implementation. This situation is even more serious when it comes to the governance of groundwater, whose dominion, in the Brazilian legal system belongs to the States and on which it will hold scientific knowledge remains limited.
Foster et al [1] provide a concise guide to assess the status of groundwater and identify future needs in relation to its efficient and sustainable use, as well as present a list of 20 criteria that can assist in evaluating the effectiveness of existing provisions and institutional capacity to pursue the governance of groundwater. These criteria were drawn from four areas: technical, institutional and legal, operational and intersectoral policy coordination. When assessing the criteria belonging to the institutional and legal domain, the authors suggest to distinguish between: (i) Institutional Framework: federal or state constitution and related governmental structure; (ii) Organizational Arrangement: lower level of organization for the management of water resources and provision of water services; (iii) primary legislation: standard developed by the Legislative Power to establish policies, principles, methods and mechanisms; and (iv) Legal regulation: standard developed by the Executive Power to explain implementation details of primary legislation. Based on the criteria suggested by Foster et al [1] and checking how it is structured national water policy (Law nº 9,433 / 97), it was understood that the instruments provided for there are appropriate criteria for evaluating the governance of groundwater the sub-national level, as well as legal provision, there are secondary standards detailing them, are being implemented at the federal level and there is consolidated national doctrine on them. It should be clarified that research remains true to the original number of criteria proposed by Foster et al (2010) but adapted them to Brazilian reality, and that the partial results presented in this study are only five of the twenty criteria being the object of research. The instruments of PNRH have been widely covered in the national legal literature [10], [11], [12], [13] and [14] and there is no doubt about the importance of its implementation for an effective governance of water resources. The identification of the existence of PNRH instruments in sub-national level and its use for the governance of groundwater, was made based on the analysis of state legislation (primary and secondary standards) and information on the implementation stage of these instruments available the official websites of the agencies of the State System of Water Resources Management. It is necessary to clarify that it is not the purpose of the research study arrested and analytical instruments, or the examination of the validity or constitutionality of state laws on them.

III. METHODOLOGY

To achieve the objective of the research, we used methodological model proposed by Bohn, Goetten and Pessati Primo [15] based on Foster et al [1], which proposes to carry out assessment of the governance of groundwater through twenty extracted criteria four areas: technical, operational / legal, institutional / legal and intersectoral policy coordination. The results presented in this study correspond to five criteria related to operational / legal domain, in which the instruments are related PNRH, (i) classification of water bodies into classes according to the predominant uses, (ii) granting of resource use rights water, (iii) charges for the use of water resources, and (iv) information on water resources system; and, (2) operating, corresponding to the instrument of PNRH (v) of water resources plan. Such criteria have been applied to the states São Paulo, Paraná, Santa Catarina and Rio Grande do Sul that are situated in the coverage area of the Guarani Aquifer System Integrated / Serra Geral. The survey was systematically going through the official websites of members of the State System bodies of Water Resources Management of the said States. The research was directed to the tools of PNRH and their use for the management of groundwater. Were only extracted, the information arranged by the States by the first half of 2014. The inventory data were systematized and then the evaluation criteria are applied. The following Table I shows the five criteria used in the research and Table II shows the way to evaluate the performance of the State, which took into account the existence of constitutional or legal provision on the instrument (primary standard), the existence of regulations detailing its application (secondary standard) and effective implementation of the instrument proven through advertising of administrative acts linked to it.

Table I – Identification of criteria to evaluate the governance of groundwater from the instruments of PNRH

<table>
<thead>
<tr>
<th>Instruments of National Water Resources Policy</th>
<th>Criteria for evaluating the governance of groundwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Water Resources Plan. b) guidelines on water bodies into classes, according to the predominant uses. c) Granting the right to use water resources. d) Charges for use of water resources. e) System of information on water resources.</td>
<td>a) Action Plan for the management of groundwater. b) Placement of groundwater according to its main uses. c) The grant of right to use groundwater. d) Collection for the use of groundwater. e) System of information on groundwater resources.</td>
</tr>
</tbody>
</table>

Source: Bohn et al [16].

Table II - General rules for awarding points as the domain of the criteria

<table>
<thead>
<tr>
<th>Score of operational domain criteria / legal and institutional / legal</th>
<th>Constitutional and / or legal provision</th>
<th>Infra legal regulation</th>
<th>Deployed</th>
</tr>
</thead>
<tbody>
<tr>
<td>No prediction</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
To make a comparative analysis of results from research in four states, was used to score each criterion, (according to Table IV) and by statistical application that indicates the number of classes and their intervals, put in a ranking the performance of States in relation to the governance of groundwater from the criteria analyzed[17].

Where:

\[ NC = 1 + 3.3 \log (n) \]  
\[ IC = \frac{A}{NC} \]

NC – number of classes;  
\( n \) – Number of individuals.  
IC – Class Range;  
A - Data width (difference between the maximum and the minimum value sampled).

Thus the performance ranking of the four states surveyed in the governance of groundwater from the criteria analyzed was established within the defined range and number of classes given by the method.

IV. RESULTADOS

<table>
<thead>
<tr>
<th>Criteria</th>
<th>SP</th>
<th>PR</th>
<th>SC</th>
<th>RS</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Action Plan for the management of groundwater.</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>b) Placement of groundwater according to its main uses.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>c) The grant of right to use groundwater.</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d) Charging for the use of groundwater.</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>e) System of information on groundwater resources.</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>total score</strong></td>
<td>11</td>
<td>11</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

Applying the formula to obtain the number of classes and its range, its possible to build a rank with the performance of States related to the applicability of the instruments of PNRH. Where the number of classes is equal to 3 with an interval between classes of 5 points. Thus the ranking is shown in Table V.

Table V. Performance Ranking of the analyzed States

<table>
<thead>
<tr>
<th>Baixo</th>
<th>Médio</th>
<th>Alto</th>
</tr>
</thead>
<tbody>
<tr>
<td>-</td>
<td></td>
<td>Santa Catarina</td>
</tr>
<tr>
<td>-</td>
<td></td>
<td>São Paulo</td>
</tr>
<tr>
<td>Rio Grande do Sul</td>
<td></td>
<td>Paraná</td>
</tr>
</tbody>
</table>

V. DISCUSSION

From the ensemble of collected data it is possible to notice that in the States of Rio Grande do Sul and Santa Catarina the NWP (National Water Policy) instruments are legally predicted.

However, it is also noticeable that in the aforementioned States the Executive fails in regulating these instruments completely, even though it represents a fundamental aspect in their implementation. Even the structure of the law implementing the SWP (State Water Policy) in Santa Catarina is not technically adequate. In this particular State the mechanisms/instruments for charging water usage, determined by the national law 9.784/94, is located in the section that describes infractions and penalties.

Regarding the framing it was only possible to distinguish a legal recognition in all the States investigated. In the case of Santa Catarina is not even an instrument of the SWP (State Water Policy). Also in the normative aspect, Santa Catarina lacks a legal recognition of a specific governmental agency responsible for the framing. This one is only mentioned as “competent governmental agency”. In the States of São Paulo and Rio Grande do Sul social participation in the framing...
setting is explicitly predicted by the law whereas this aspect is not mentioned in the States of Paraná and Santa Catarina.

The granting/concession instrument was the one to exhibit the best fulfilment in our analysis being regulated in Santa Catarina and implemented in Paraná, Rio Grande do Sul and São Paulo. The same applies to the “Guide/manual”. Santa Catarina is the only State that does not make it available. All the States hold a record of water users or predict publication of issued grants/concessions.

Concerning water usages charging the States of São Paulo and Parana have this instrument already implemented whereas in Rio Grande do Sul and Santa Catarina this instrument is only legally predicted. The existence of a technical charging guide was only acknowledged in São Paulo, which was the only State to legally recognize and accomplish the publishing of amounts collected and their employment. The reward of water users is only recognised in the States of Paraná and São Paulo. Concerning the responsibility to define values of water charges, it was assigned to the water basin committees in all the four States. A particular fact was pointed out in the State of Rio Grande do Sul in which it was not possible to identify any legal prediction on charging groundwater usage. This was pointed as unwise considering that the State is national agroindustrial polo, thus a large water consumer.

The State Water Information System (SWIS) is implemented in São Paulo and Paraná, although there is no regulation upon them. In Santa Catarina and Rio Grande do Sul the SWIS is only legally predicted, nevertheless both possess official websites presenting the scope of what would be an ideal SWIS. The Santa Catarina State was the only one to legally predict the compatibility between the SWIS and the NWIS (National Water Information System). Similarly Santa Catarina and Paraná were the only States in which the existence of information on groundwater is expressly legally predicted to integrate the SWIS. Likewise of these instruments that the States provide the required information to orient people, being this a fundamental aspect to strengthen the Society-Government interface.

Another attention drawing aspect is the fact that until now the States of Rio Grande do Sul and Santa Catarina have not implemented the SWPL (State Water Plan) even if this is the main instrument that directs the whole SWP (State Water Policy), specially for groundwaters. In both States groups were created in 2005 and 2006, respectively, to coordinate and/or watch the SWPI elaboration. However, it was only concluded in Rio Grande do Sul where it waits for the State Congress approval. In Santa Catarina the SWPL remains unfinished until now, even though funding from the EM (Environmental Ministry) was received in 2004.

In all the States, apart from Santa Catarina, it was possible to acknowledge the existence of terms of reference designed to accomplish the SWPL. This facilitates social attending of the procedure and allows us to verify if groundwater is being integrated to the SWPL.

In Paraná and São Paulo all the water managing instruments analyzed are parts of the SWP. In both the SWP are well structured and include instrument regulation, SWPL, right to water usage grant/concession and water usage charging. In these States the SWPLs are being executed and include specific groundwater studying programmes. This demonstrates concerning about gaining of knowledge to allow regulatory framework increment and also social actors guidance towards groundwater usage and protection.

VI. CONCLUSION

Evaluation on the four States fulfillment of SWP instruments structuring and implementation, emphasizing groundwater, was performed considering governance as a process rather than a product.

Rating obtained by each State indicates (shown in table IV) its capability, of implementing groundwater governance. (Não sei onde colocar “no grupo Governo”, porque não entendi o que significa).

Results shown in table V indicate a lesser capability of Rio Grande do Sul and Santa Catarina State governments to implement groundwater governance compared to Paraná and São Paulo States.

From data analysis it was possible to identify some aspects that contribute to greater or lower fulfillment of groundwater governance in the four studied States. Concerning legislature it is noticeable that the higher ranking States hold a superiorly structured SWP law in terms of content, distribution of titles, chapters and sections as well as in terms of “sharing jurisdiction”. Concerning the Executive it is perceptible that the delegation of state water agency attributions to a State Secretary by means of a specific sector, as adopted in Rio Grande do Sul and Santa Catarina does not appear to be most adequate model to achieve governance. In Paraná and São Paulo specific autarchies were created as State Water Agencies which allows a greater autonomy concerning personnel and financial resources. Also State Secretaries are meant to establish policies and define the state action priorities and not to execute these policies. In the Brazilian environmental management the execution of these policies generally lies under the responsibility of indirect managing government agencies. These agencies are the ones to hold the competence to execute the policies established by the State. In this regard an important aspect of groundwater governance implementation to be considered is the legal water agency legal “personality”. Another important aspect concerns the SWPL. The lack of a SWPL in the State of Santa Catarina hinders other instruments implementation. It is impossible to
achieve an adequate water governance without action planning, aims, responsibilities and deadlines. This applies to water governance in general and particularly to groundwater governance. At last another aspect that needs to be pointed out is the negligence by all the four States regarding the implementation of the SWIS (State Water Information System). Even though all of them have an official website designed to fulfill this instrument and actually bring information about groundwater in the State territory they are not compatible with the NWIS (National Water Information System) even if this aspect is predicted by their own SWPs. This lack of compatibility between the state and the national systems further contributes to the inefficiency of this instrument.

VII. REFERENCES

[8] O termo legislação aqui utilizado, abrange tanto a norma primária elaborada pelo Poder Legislativo, quanto a norma secundária elaborada pelo Poder Executivo e órgãos vinculados, no exercício de sua competência regulamentar.