

Fachhochschule Köln
Cologne University of Applied Sciences



UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ
FACULTADES DE CIENCIAS QUÍMICAS, INGENIERÍA Y MEDICINA
PROGRAMAS MULTIDISCIPLINARIOS DE POSGRADO EN CIENCIAS AMBIENTALES
AND
COLOGNE UNIVERSITY OF APPLIED SCIENCES
INSTITUTE FOR TECHNOLOGY AND RESOURCES MANAGEMENT IN THE TROPICS AND SUBTROPICS

**WATER GOVERNANCE ASSESSMENT FOCUSED ON WATER SUPPLY AND SANITATION IN WATERSHEDS OF RIO
DE JANEIRO STATE, BRAZIL**

THESIS TO OBTAIN THE DEGREE OF
MAESTRÍA EN CIENCIAS AMBIENTALES
DEGREE AWARDED BY
UNIVERSIDAD AUTÓNOMA DE SAN LUIS POTOSÍ
AND
MASTER OF SCIENCE
"TECHNOLOGY AND RESOURCES MANAGEMENT IN THE TROPICS AND SUBTROPICS
FOCUS AREA "ENVIRONMENTAL AND RESOURCES MANAGEMENT"
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SARA MARCELA VERA AGUIRRE

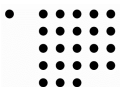
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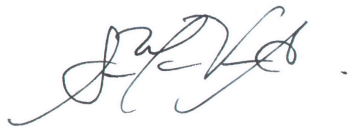
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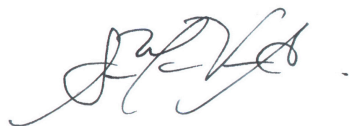
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Dedico este trabajo a mis papás Ana Esther y Luis Hermes.

*A ustedes debo todo lo que soy y estoy convencida de que
no he podido recibir una bendición más grande que tenerlos.
Ustedes son y serán siempre mi mayor motivación.
Gracias por regalarme alas para volar y apoyarme siempre.*

*A Mimi, por ser mi luz y mi compañera diaria.
Tu amor incondicional ha sido mi motor
y tu amistad mi más grande tesoro.*

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Gracias por tu ejemplo de generosidad, entrega y perseverancia.
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ABSTRACT

Water Governance is a concept that has been gaining importance since it was realized that the water crisis is often related to failures in decision-making processes. Understanding the relationships between water resources management (particularly the integrated approach of IWRM) and water governance constitutes the starting point of this research.

This research project aims to assess the performance of the water governance system in the State of Rio de Janeiro, Brazil. In addition, provides an analysis of the current stakeholder perceptions regarding different governance criteria in three selected watersheds: Guapi-Macacu, Guandu and Lagos São João. These were selected due to their strategic importance for water supply for most of the population in the State. In this region, the performance of water supply and sanitation systems still present several failures. Although the water availability is not an issue in the region, the demographic and economic drivers generate increasing water demand. In addition the rising untreated water discharges intensify the pressure in important watersheds for the State. Nevertheless, the evidence shows that probably the solution is not only related to water management measures but also with the governance aspects, perceptions and decision-making processes in the sector. Through the National Water Law, Brazil adopted a national strategy for water resources management, which incorporated the participation of different stakeholders, including the private sector. This framework has gradually provided different management instruments for the integrated and sustainable water management with the participation of all stakeholders.

A detailed characterization of each watershed region as well as comparison between the legal and institutional framework will help to understand each region particular context. Through the method of governance assessment, different stakeholder perceptions are analyzed with the help of a questionnaire and semi-structured interviews. The questionnaire is a partial adaptation from an existing methodology called Local Governance Barometer. In the discussion part, possible gaps in the governance structure are identified, in particular those related to water supply and sanitation services. Essentially, this research presents two particular contributions: an initial water governance assessment in strategic watersheds of Rio de Janeiro State and a state of the art of the governance system as well as possible recommendation for future improvements.

Keywords: Water Governance; Water resources management; Supply and Sanitation; Water Governance Assessment

La gobernanza del agua es un concepto que ha ido ganando importancia desde que se evidenció que la crisis de los recursos hídricos está relacionada con fallas en los procesos de toma de decisiones. El punto de partida de esta investigación consiste en comprender las relaciones entre la gestión integrada de recursos hídricos y la gobernanza del agua. Este proyecto de investigación tiene como objetivo evaluar el desempeño del sistema de gobernanza del agua en el Estado de Río de Janeiro, Brasil. Además, ofrece un análisis de las percepciones de los diferentes actores con respecto a diferentes criterios de gobernanza en tres cuencas seleccionadas: Guapi-Macacu, Guandu y Lagos São João. Estas cuencas fueron elegidas debido a su relevancia estratégica para el abastecimiento de agua de la mayoría de la población del Estado. En esta región, el desempeño de sistemas de agua potable y saneamiento todavía presentan varias falencias. A pesar de que la disponibilidad de agua no es un asunto determinante, los factores demográficos y económicos generan una demanda creciente de agua. Adicionalmente, las descargas de afluentes no tratados intensifican la presión sobre dichas cuencas hidrográficas.

No obstante, la evidencia muestra que probablemente la solución no depende sólo de cuestiones estrictamente relacionadas con mecanismos de gestión, sino también con los aspectos de la gobernanza, las percepciones y los procesos de toma de decisiones en el sector. A través de la Ley Nacional de Aguas, Brasil ha adoptado una estrategia para la gestión de recursos hídricos, que incorpora la participación de diferentes *stakeholders*, incluido el sector privado. El marco legal ha traído diferentes instrumentos de gestión para el manejo integrado y sostenible con la participación de todas las partes interesadas.

Una caracterización detallada de cada cuenca hidrográfica, así como la comparación entre el marco jurídico e institucional serán útiles para entender el contexto de cada región en particular. A través del método de evaluación de gobernanza, se analiza la percepción de diferentes grupos de interés por medio de un cuestionario y entrevistas semi-estructuradas. Dicho cuestionario fue desarrollado basándose parcialmente en la metodología denominada Local Governance Barometer. En la parte de discusión, se identifican las posibles deficiencias en la estructura de gobernanza, en particular las relacionadas con el suministro de agua y saneamiento. Finalmente, esta investigación presenta dos contribuciones particulares: una evaluación inicial sobre la gobernanza del agua en cuencas hidrográficas estratégicas de Río de Janeiro y un estado del arte del sistema de gobernanza y la posible recomendación para mejoras futuras.

Palabras clave: Gobernanza del agua; Gestión de recursos hídricos; Servicios de agua potable y saneamiento; Evaluación de gobernanza de agua.

ZUSAMMENFASSUNG

Wasser Governance ist ein Konzept, das sehr an Bedeutung gewonnen hat, seit man einen Zusammenhang zwischen fehlerhaften Entscheidungsprozessen und der Wasserkrise festgestellt hat. Das Verständnis für diesen Prozess unter Berücksichtigung des Integrierten Wasserressourcen-Management und der Wasser Governance bilden den Ausgangspunkt dieser Forschungsarbeit.

Dieses Forschungsprojekt zielt darauf ab, die Leistung des Wasser Governance Systems, im Bundesstaat Rio de Janeiro, Brasilien zu beurteilen. Darüber hinaus wird eine Analyse der aktuellen Stakeholder-Wahrnehmungen, im Bezug auf verschiedene Governance-Kriterien, in drei ausgewählten Einzugsgebieten durchgeführt: Guapi-Macacu, Guandu und São João Lagos. Diese wurden aufgrund ihrer strategischen Bedeutung, hinsichtlich der Wasserversorgung für den größten Bevölkerungsteil des Bundeslandes, ausgewählt. In dieser Region, ist die Leistungsfähigkeit der Wasserversorgung und Abwasserentsorgung noch fehlerhaft. Obwohl die Wasserverfügbarkeit in dieser Region kein Problem darstellt, erzeugt der demografische und wirtschaftliche Treiber eine zunehmenden Wassernachfrage sowie einen Anstieg des unbehandelten Abwassers. Dies führt zu einer enormen Belastung wichtiger Einzugsgebiete.

Dennoch zeigt sich, dass die Lösung wahrscheinlich nicht nur mit den wasserwirtschaftlichen Maßnahmen zusammenhängt, sondern auch mit den Governance-Aspekten, Wahrnehmungen und Entscheidungsprozesse des Sektors. Durch das Landeswassergesetz hat Brasilien eine nationale Strategie im Bereich Wasserressourcen-Management eingesetzt, die die Beteiligung der verschiedenen Interessengruppen einschließlich des privaten Sektors fördert. Dieser gesetzliche Rahmen hat verschiedene Management-Instrumente für die integrierte und nachhaltige Wasserwirtschaft, mit Beteiligung aller Betroffener, zur Verfügung gestellt.

Eine detaillierte Charakterisierung der einzelnen Einzugsgebiete sowie der Vergleich zwischen dem rechtlichen und institutionellen Rahmen, trägt dazu bei jede Region im Individuellen Kontext zu verstehen. Durch die Methode der Governance Evaluierung werden verschiedene Stakeholder Wahrnehmungen, mit Hilfe eines Fragebogens und semi-strukturierten Interviews analysiert. Der Fragebogen wurde von der bestehenden Methode namens Local Governance Barometer abgeleitet. In dem Diskussionsteil werden mögliche Lücken in der Governance-Struktur identifiziert, insbesondere im Bezug auf die Wasserversorgung und Abwasserentsorgung. Diese Forschungsarbeit konnte folgende Beiträge hervorbringen: zum einen, eine vorübergehende Wasser-Governance Evaluierung in strategischen gelegen Einzugsgebiete des Bundesstaates Rio de Janeiro und zum anderen, weißt sie den Stand des Governance-Systems sowie mögliche Empfehlungen für künftige Verbesserungen auf.

Schlüsselwörter: Wasser-Governance, Wasserressourcen-Management, Wasserversorgung und Abwasserentsorgung, Wasser-Governance Evaluierung

O conceito de governança da água vem ganhando importância uma vez que vem sendo comprovado que a crise da água está bastante relacionada às falhas nos processos de tomada de decisão. Desta forma, o ponto de partida deste pesquisa é compreender a relação entre a gestão integrada dos recursos hídricos e a governança da água.

Este projeto de pesquisa visa avaliar o desempenho do sistema de governança da água no Estado do Rio de Janeiro, Brasil. Tal projeto também fornece uma análise das percepções de usuários sobre diversos critérios de governança em três bacias hidrográficas: Guapi-Macacu, Guandu e São João Lagos. Estas bacias foram selecionadas devido à sua importância estratégica para o abastecimento de água da maior parte da população no estado. Nesta região, o desempenho dos sistemas de água e saneamento ainda apresenta várias deficiências. Embora a disponibilidade de água não é uma questão crítica, fatores demográficos e econômicos geram uma demanda crescente por água. Além disso, o aumento das descargas de água não tratada intensificam a pressão sobre as bacias hidrográficas.

Entretanto, observou-se que a solução não depende apenas sobre questões estritamente relacionadas com a gestão da água, mas também com os aspectos da governança, as percepções e os processos de tomada de decisão no setor. Através da Lei Nacional da Água, o Brasil adotou uma estratégia para a gestão dos recursos hídricos, incorporando a participação dos diferentes atores, incluindo o setor privado. O quadro legal trouxe ferramentas de gestão para a gestão integrada e sustentável dos recursos hídricos e a participação de todos os interessados.

Uma caracterização detalhada de cada bacia hidrográfica, e uma comparação entre seus quadros legal e institucional será útil para compreender o contexto de cada região em particular. Através do método de avaliação da governança, analisou-se a percepção dos diferentes stakeholders, com auxílio de um questionário e entrevistas semi-estruturadas. Na discussão, os possíveis pontos fracos na estrutura de governança foram identificados, principalmente aqueles relacionados ao abastecimento de água e saneamento. Finalmente, a presente pesquisa apresenta duas contribuições específicas: uma avaliação inicial da governança da água em bacias hidrográficas estratégicas do Rio de Janeiro e um estado de arte da governança no setor e recomendações para melhorias futuras.

Palavras-chave: Governança da água; Gestão Integrada de Recursos Hídricos; serviços de água e saneamento; Avaliação da Governança da água.

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LIST OF ABBREVIATIONS

AGEVAP	Agência da Bacia do Rio Paraíba do Sul - Water Agency Rio Paraíba do Sul
ANA	Agência Nacional de Águas - National Water Agency
APA	Area de Proteção Ambiental - Environmental Protection Area
CEDAE	Companhia Estadual de Águas e Esgotos- State water and sanitation company
CERHI	Conselho Estadual de Recursos Hídricos- State Water Resources Council
CILSJ	Consortio Intermunicipal Lagos São João - Intermunicipal Consortium of Lagos São João
CNRH	Conselho Nacional de Recursos Hídricos – National water resources council
COMPERJ	Complexo Petroquímico de Rio de Janeiro - Petrochemical Complex of Rio de Janeiro
EPA	Environmental Protection Area
ETA	Estação de Tratamento de Água - Water treatment Station
FEEMA	Fundação Estadual de Engenharia do Meio Ambiente
GELA	Grupo Executivo de Trabalho Lagoa Araruama - Executive group
GELSA	Grupo Executivo de Trabalho Saquarema - Executive group
GERSA	Grupo Executivo de Trabalho São João, Una and Das Ostras Rivers- Executive group
GWP	Global Water Partnership
INEA	Instituto Estadual de Ambiente – State Environmental Agency
IWRM	Integrated Resources Management
JMP	Joint Monitoring Programme for Water Supply and Sanitation
LIGHT	Companhia de Energia Elétrica - Electric Energy Company
MDG	Millenium Development Goals
MSP	Multistakeholder- Platforms
ODA	Official Development Assistance
PSP	Private Sector Participation
RJ	Rio de Janeiro
SEA	Secretaria de Ambiente- Environmental Secretary
SEMADS	State Environmental and Sustainable development Secretary
SINGREH	Sistema Nacional de Gerenciamiento de Recursos Hídricos
UFRRJ	Universidade Fluminense Rural de Rio de Janeiro
UNEP	United Nations Environmental Program
WSS	Water supply and sanitation

Guaranteeing sustainable food and water security for all will require the full engagement of all sectors and actors. It will entail transferring appropriate water technologies, empowering small food producers and conserving essential ecosystem services. It will require policies that promote water rights for all, stronger regulatory capacity and gender equality. Investments in water infrastructure, rural development and water resource management will be essential.

Ban Ki-moon, Rio+20, 2012

1 Introduction

Water is fundamental for life and for sustainable socio-economic development. Every system –whether natural, social, or industrial- is intrinsically related to water resources. Its sustainable management represents the major challenge of our days. Currently, we are living in the 'Water for Life' Decade 2005-2015, a timeframe in which the United Nations is promoting efforts to fulfill international commitments made on water and water-related issues (UNDESA, 2012). Few years ago it was recognized that this natural resource is under high pressure and conflicts are envisaged, if the necessary measures are not applied. One example of this, is the water and sanitation infrastructure deficit, which claims more lives through diseases than any war claims through guns (UNDP, 2006).

The concern about the quality and quantity of available safe drinking and subsistence water has always been inherent to human societies but the demand was never so high. Nowadays the concern toward the sustainability of water resources has significantly increased due to the fact that the society has realized that it is facing an unavoidable governance crisis. Water resources are inherently interconnected to everything: food production (agriculture), energy generation, public health, and industrial activities among many others. The unsustainable practices focused on economic success in modern societies, together with the rapid population growth have set the most relevant pressures toward water resources.

The scarcity crisis is not anymore a hypothetical scenario for future generations, but seems to be more a problem driven by causes different than those related to the physical characteristics of certain territory. The human being has already transgressed the limits of growth and water. These are finite and irreplaceable goods but water security depends on more than mere availability. Even when it seems to be abundant, water can scarce. “Since access to water is mediated through institutions and infrastructure, ‘poverty, inequality and unequal power relationships’ can mean that people (and ecosystems) face water scarcity even where there is no physical shortage. This distinction corresponds to the difference between physical scarcity (where availability is the key determinant) and economic scarcity (where access is the key challenge)” (Cosgrove, W. and Rijsberman, 2000).

In the water sector the ‘governance’ concept became consolidated with the Johannesburg Rio+10 conference statement “the world water crisis is a crisis of governance – not one of scarcity” (from the No Water No Future speech at the conference by the Prince of Orange) (Mollinga, 2010). Through the history, nor the society nor the government have achieved a successful way to maintain the equilibrium that guarantees clean and drinking water for future generations, either because an irrational use of the resource or because of the lack of efficient policies. This situation is exacerbated in developing countries where the social and economic reality adds more complexity to management of natural resources and in general, to public concerns. Water problems are very diverse and have less relation to availability as with how the resources are distributed, used, and managed in all its stages and how these practices affect the water cycle, the ecosystems and human settlements¹(Biswas, 2004).

The term *governance* has been gaining importance in the area of water resources management in the recent years. The Global Water Partnership Toolbox begins stating that the Integrated Water Resources Management (IWRM) approach is the “new water governance and management paradigm”(Global Water Partnership, 2008a). Water

¹ Regarding to this idea, it is interesting what explains Asit K. Biswas: “Solutions to water problems depend not only on water availability, but also on many other factors, among which are the processes through which water is managed, competence and capacities of the institutions that manage them, prevailing socio-political conditions that dictate water planning, development and management processes and practices, appropriateness and implementation statuses of the existing legal frameworks, availability of investment funds, social and environmental conditions of the countries concerned, levels of available and usable technology, national, regional and international perceptions, modes of governance including issues like political interferences, transparency, corruption, etc., educational and development conditions, and status, quality and relevance of research that are being conducted on the national, sub- national and local water.”

governance has gained relevance not only for the policy making process but also for the inclusion of different actors in planning and implementing public policies. Today governments, international institutions, private companies and civil society are all interested and active in the decision – making processes that take place in water sector. It is not anymore just a matter of *water use*² or *water management*³ but about *water governance*. According to Mollinga (2010), understanding water resources dynamics, problematizing the roles and interests of the different stakeholders as well as the controversies' drivers that exist according to each context, is what leads to recognize water resources development as an intrinsically “political process”. It is essential to develop a more structured and integrated approach for governance in water services (supply and sanitation) that takes into account the local dynamics and that also links with wider governance agendas beyond the sector (Plummer & Slaymaker, 2007).

Brazil represents a recent example of governmental effort to build a decentralized administrative and legal network for water resources management. Nevertheless, as approximately 13% of the world's water resources are located in this country, a common perception of “abundance” delayed the implementation of guided measures and policies to manage the resources (ANA, 2002). This fact has made more difficult to successfully manage water resources on such a huge territory. However, the administrative decentralization as well as the water basin planning approach that has been implemented, turns Brazil into an interesting case in order to analyze the water governance issues.

The State of Rio de Janeiro is the study area for this research. It will be possible to identify the causes of actual performance of water sanitation and supply systems in watershed regions, which are strategically located near the capital city. This diagnosis will help to understand water governance dynamics between the different stakeholders in selected water basin and to identify suitable measures to improve water management. Each local context will give a general idea on how diverse stakeholders perceive water

² It is interesting to follow the explanation from Mollinga to understand the „governance dimension“ of water nowadays: *water use* key term refers to the mere operation of the system (operation and maintenance), its infrastructure and the technical aspects. Water infrastructure was seen just as a “technical device” that should be properly used.

³ Following Mollinga, *water management* came as a key term during the 1970's decade due to the fact that further demands began regarding efficiency and effectiveness of water infrastructure: the performance was not sufficient, particularly in developing countries. The introduction of this term meant the broadening of the perspective toward water resources: „from an exclusively technical (plus economics) perspective, to a perspective that also started to include the social relations (an participation) as a part of water resources development (...)“.

governance criteria and how they currently interact and decide regarding water resources in the region.

Through the National Water Law, Brazil adopted a national strategy for water resources management, which incorporates the participation of different stakeholders, including the private sector. This research will be helpful to make an approach of the way policies are working in the water sector –particularly in Rio de Janeiro State-: which entities are participating in this processes, how civil society is getting involved and at which level is the private sector taking part in the water resources management.

Within this context, a relationship between the theoretical frame of the *environmental governance* in the water sector and the evaluation of the stakeholders' perceptions in different case studies in Rio de Janeiro (three watersheds that supply water to major of inhabitants of this State) will help us to achieve the objectives of this research. Afterwards, a general overview will provide the elements to establish how are the perceptions regarding water governance, taking into account the legal instruments that exist and its current implementation in the particular context of each basin. This overview will useful to conclude what can be improved in the management model and which measures are suitable to strength water governance.

1.1 Problem Statement

Previous research has found that performance of water supply and sanitation systems⁴ still presents several failures in the State of Rio de Janeiro. Although water availability is not an issue in the region, the demographic and economic drivers generate increasing water demand and untreated discharges that cause pressures to important watersheds in the region. The way different stakeholders should interact toward these

⁴ According to Kelman, there are several reasons for this failures of water supply and sanitation services in Brazil: “1. Bad operational practices, because in general there is lack of proper planning and maintenance. 2. Bad commercial practices: The general picture is that metering is applied to a small percentage of consumers, subsidies are implicit rather than explicit, and there is no cutting –of-water policy for lack of payment. In addition, because the poorest segments of society are not commercially attractive, due to the high percentage of unpaid bills, sometimes they are simply not connected to the water distribution system, even in cases where the connection would be technically feasible. 3. Lack of financial and administrative autonomy of the public companies. 4. Lack of financial resources 5.Lack of agreement between State and city governments about how to share the benefits from State Companies.”Kelman, J. (1998). *Evolution of Brazil's water resources management system*. Retrieved 20 de 06 de 2011 from <http://www.kelman.com.br/pdf/watersource.pdf>

issues has been regulated through different legal instruments based on and supplementary to the National Water Law. Nevertheless, the evidence shows that probably the solution is closely related not only to water management measures but also with the governance aspects, perceptions and decision-making processes in the sector.

1.2 Justification

This project intends to provide a diagnosis of the current stakeholder perceptions regarding water governance criteria in selected water basins in Rio de Janeiro State. A water governance assessment constitutes a useful tool to reveal new information related to water governance and to identify mechanisms that enforce functional decision-making processes, particularly those related to water supply and sanitation issues.

1.3 General Objective

Assess the water governance focusing on the performance of water supply and sanitation systems in selected watersheds of Rio de Janeiro.

1.4 Specific Objectives

- I. Describe the theoretical relationships between water management and water governance.
- II. Review the actual legal framework in Rio de Janeiro State and identify main water management instruments.
- III. Diagnose the situation of the water sector in Brazil, particularly in selected watersheds, focusing on supply and sanitation services.
- IV. Evaluate the local water governance in selected watersheds of the state of Rio de Janeiro through governance assessment with different stakeholders.
- V. Identify possible gaps in governance of water supply and sanitation in selected watersheds and recommend suitable strategies to improve them.

The complexity, immediacy and ubiquity of environmental problems and crises demand novel and unusual human responses.

Arun Agrawal & Maria Carmén Lemos

2 Conceptual Framework

2.1 Water Resources Management

The *Integrated Water Resources Management* –IWRM– approach is intrinsically related to governance: it is indeed called the new water management and governance paradigm. Both legal framework and financing alternatives for the water sector are necessary to obtain suitable solutions, particularly in the water supply and sanitation services infrastructure. *Governance*, seen as a joint of structures for balanced and good decision-making, is also interdependent with *Multi-Stakeholder Platforms*, which provide a structure for effective cooperation and negotiation in this sector. The relationship between these and further concepts is the basis to understand the context in the study area and the fieldwork outcomes of this research.

2.1.1 Integrated Water Resources Management (IWRM)

Efficient⁵ management of natural resources is inherent to human kind evolution. As the population has been exponentially increasing during the last two centuries, these processes have also been getting more complex. In the particular case of water, different civilizations were early concerned about the way water resources should be found, stored, distributed and secured⁶ (Hassan, 2003). Water resources management is strongly related

⁵ Efficient understood as: working productively with minimum wasted effort or expense. (WorldReference, 2012)

⁶ Without recognizing the big efforts of prehistoric communities (due to extreme climate conditions) to find sustainable water supplies, it is important to note that the transition from hunter-gathering societies to agriculture societies almost 10.000 ago, represented the first significant improvement in water resources management. Irrigation channels were developed in order to transport water for crops and produce staples that could guarantee feeding big populations. Social transformations and the increasing population growth and denser human settlements have been determinant for the

to the spatial planning (under a vertical decentralization scheme⁷) but also with management in other sectors (like energy or food production), since the interdependence between water uses and other resources is continuously increasing. These links are often disarticulated. Sometimes, policy connections are indirect and water resources are planned and administrated under the sector approach. Since the administrative division of a territory does not always correspond to the water basin's distribution or to the competencies of the institutional authorities, water resources management has become a challenging area for policy-makers. The legal framework affects the local action since it should be linked and coordinated with the national policy⁸. The key factor for IWRM is the *basin level approach*, which is based on the natural boundaries of water ecosystems and not on the territorial political division. This leads to a horizontal decentralization, which supposes the existence of certain conditions such as legal framework, institutions and management tools in every particular context.

In the water sector, the most “recent”⁹ model (more a process than an approach) is called Integrated Water Resources Management (IWRM) in which many aspects -such as water use and driving forces- are taken into account to reach a coordinated decision – making at different levels and scales. The main objectives of this process are achieving efficiency, equity and environmental sustainability. As seen below in *Figure 1*, it is not a fixed prescription but an iterative and complex process (Global Water Partnership, 2008b)

development of ingenious methods to harvest, transport and store rainwater, spring water, ground water and even air moisture. It interesting to revise historical evidences from the persians, egyptians, greeks and romans and how water technologies –for example water delivery systems- were gradually spread in ancient times among different civilizations.

⁷ Under the scope of the *administrative level* decentralization, this can commonly be divided in national, regional, provincial and local administration. Regarding to the decision-making (top down increasing detail in content) the most important instruments are policies, programs, plans and projects.

⁸ Exemplifying: water resources planning in Brazil begins first with a national policy, under it this, there is also a state policy and under them there are decentralized water resources plans for basin regions. These include several programs, objectives, initiatives and concrete actions.

⁹ It is interesting what Biswas (2004) analyzes regarding the “modernity” of the concept, which according to the Global Water Partnership, was inspired by the Dublin Principles from 1992. However, he argues that the concept was already launched in the international scenarios of 1950 by the United Nations and officially used in 1977 during the United Nations Water Conference in Mar del Plata, Argentina. Another important aspect that he stresses, is that the Dublin Principles came out from an “experts” meeting and not from a multiple actors (e.g. governments) context where official commitments are made.

The Global Water Partnership¹⁰ -GWP- defined IWRM as

”A process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.”

Water management should be based –under the IWRM perspective- on a participatory approach, involving users, planners and policymakers at all levels. Under this scheme, planning should aim to the accomplishment of the IWRM principles as well as the interaction with the national policy, the legislative framework, financing structure, organizational framework, and a range of management tools (Global Water Partnership, 2003).



Figure 1 - IWRM an iterative process (Global Water Partnership, 2003)

Similar to every policy instrument, water resources management requires a plan in order to identify the current situation and problems to solve, to develop strategies for action and accomplish the desired objectives. Seen under the sustainability perspective and taking into account the IWRM process, the cycle is dynamic and needs to be

¹⁰ The Global Water Partnership was created in 1996 as a common project from the World Bank, the United Nations Development Program, and the Swedish International Development Agency. It constitutes, a joint of government agencies, public institutions, private companies, professional organizations, and multilateral development agencies committed to the Rio Earth Summit and the Dublin principles.

constantly adapting depending on the context. It is relevant to have a defined division of competencies and locations in order to implement a plan that recognizes the local demands, stakeholders, and forecasted events. This “integration” toward the plan leads to more efficient management and therefore to what is known as *governance*.

The IWRM concept has become a slogan and its desired implementation in diverse contexts, has been the challenge of governments and international institutions during the last two decades. One example of this trend, is the outcome shown in the *Status Report on the Application of Integrated Approaches to Water Resources Management 2012*, launched after Rio+20 and which established that 64% of countries¹¹ have developed integrated water resources management plans and 34% report an advanced stage of implementation (UNEP, 2012). However, the conceptual conception has been criticized since the definition itself appears to be very vague and in the practice, un-implementable in operational terms. Biswas (2004) makes a controversial critic to the concept:

“(…) The concept uses many of the currently trendy words; it does not provide any real guidance to the water professionals as to how the concept can be used to make the existing water planning, management, and decision-making processes increasingly more and more rational, efficient and equitable. (...) IWRM, in a sense, can be viewed as a nostalgic approach to a broader and more holistic way to manage water, as may have been possible in the past. However, since the world has moved on, water management needs to move with it. (...) In a complex world, issues like water, energy, agriculture, or the environment are becoming increasingly interrelated and interdependent, and thus integrated management of any one of these resources is not possible because of accelerating overlaps and inter-linkages with the other resources.”

Nevertheless, the holistic focus¹² of the integrated approach has demonstrated to be a good beginning in the attempt to manage water resources. It is important to remember, that this focus is indeed, thought to organize an opened complex system¹³ (Espejel,

¹¹ Government officials from more than 130 countries provided detailed responses.

¹² The United Nations Conference of Environment and development created in 1992 the “Agenda 21”. On Chapter 18, referring to Freshwater Resources they emphasized that “The holistic management of freshwater (...) and the integration of sectoral water plans and programmes within the framework of national economic and social policy, are of paramount importance for action in the 1990s and beyond”. Chapter 18 called for “the application of an integrated approach to the development, management and use of water resources”. (UNEP, 2012)

¹³ The opened systems are those in which there are no linear interaction mechanisms and are affected by frequent perturbations (Prigogine, 1983). The components, elements or subsystems of that organized piece of reality that

Berhmann, Frich, Espinoza, & González, 2009) in the middle of a global reality that has dramatically changed during the last 20 years. From Rio Earth Summit 1992 to Rio+20 during this year, there are several transformations that have set water resources under more pressure. Some examples are the rapid demographic growth (5.3 Billion to 7.0 Billion), a higher water demand due to the increased wealth and living standards, the climate change that has originated several extreme events (e.g floods, droughts) and the energetic concern over non renewable or high risk energetic sources (oil, nuclear energy) among many others. Because of these reasons and the inherent complexity of resources management, IWRM must be dynamic rather than static and as stated above, “an on-going process”.

The definition from the GWP opens a wider framework of tools that serves as dissemination mechanism and capacity building in the IWRM arena. This framework is called Toolbox and was thought as a bridge between the concept and the praxis. It has become a global communication platform with one section of 54 guidelines to implement IWRM and an evolving section with case studies and references. The tools are grouped in three steps as shown in *Figure 2*, taking into account the economic efficiency, ecological sustainability and social equity:

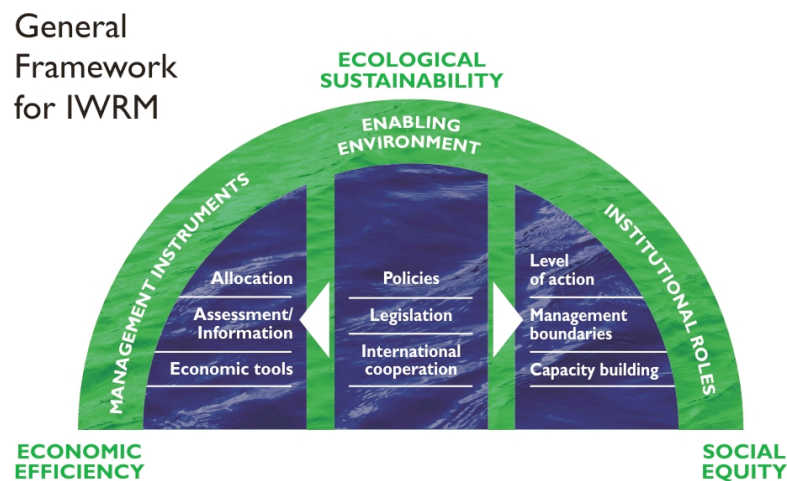


Figure 2 - General Framework for IWRM (Global Water Partnership, 2003).

constitute a complex system, are heterogeneous and interdefinible and these accomplish a function inside the system. This is only possible through their interrelation –among subsystems- which constitutes its own structure. (Espejel et al., 2009)

The enabling environment: This is achieved throughout the establishment of an adequate legal framework (e.g. water policies, national water law) as well as through financing structures in order to meet water needs.

Institutional roles: A clear organizational framework that helps to improve water governance (e.g. government agencies, local authorities, river basin organizations, community based institutions, private sector). Institutional capacity building and human resources development are also a significant component in this step.

Management instruments: There are several instruments to implement the IWRM as for example: preliminary assessments to understand the context, plans for IWRM, water demand management in order to use water efficiently, conflict resolution mechanisms and regulatory instruments for water allocation amongst others.

The model sets a cross-sector integration that is supposed to take into account the water uses for people, food production, nature, industry and other uses. Regarding these connections, it is pertinent to mention the latest approach among the Rio+20: the Water-Energy-Land Security Nexus, which is thought to improve governance in order to achieve the Millennium Development Goals (MDGs) and it is crucial for the *green economy*¹⁴.

The links seen in *Figure 3* reflect a strong interdependence between water, energy and land. According to The European Development Report, the demand for energy and water is expected to grow by 40% and for food by 50% by 2030 compared to present levels (ODI, ECDPM, & GDI, 2012). If the nexus is ignored whether at policy level or at consummation trends level, water resources demand will considerably increase to produce food and energy, putting them under higher pressure.

¹⁴ Officially seen as a path to achieve sustainable development, the concept of the green economy is controversial. According to the Rio+20 documents, a green economy “should protect and enhance the natural resource base, increase resource efficiency, promote sustainable consumption and production patterns, and move the world toward low-carbon development”. This is for detractors, a way to disguise the economic interest as altruist ones. Relating this concept to water resources, some critics state that “what’s novel and slippery about the “green economy” as a concept is that it goes beyond the mere commodification of water as a public good or service. Water as the engine of the “green economy” allows for the privatization and commodification of all dimensions of water: water catchment, watershed, water sources, aquifers, water quality, etc.” (Mahanan, 2012)

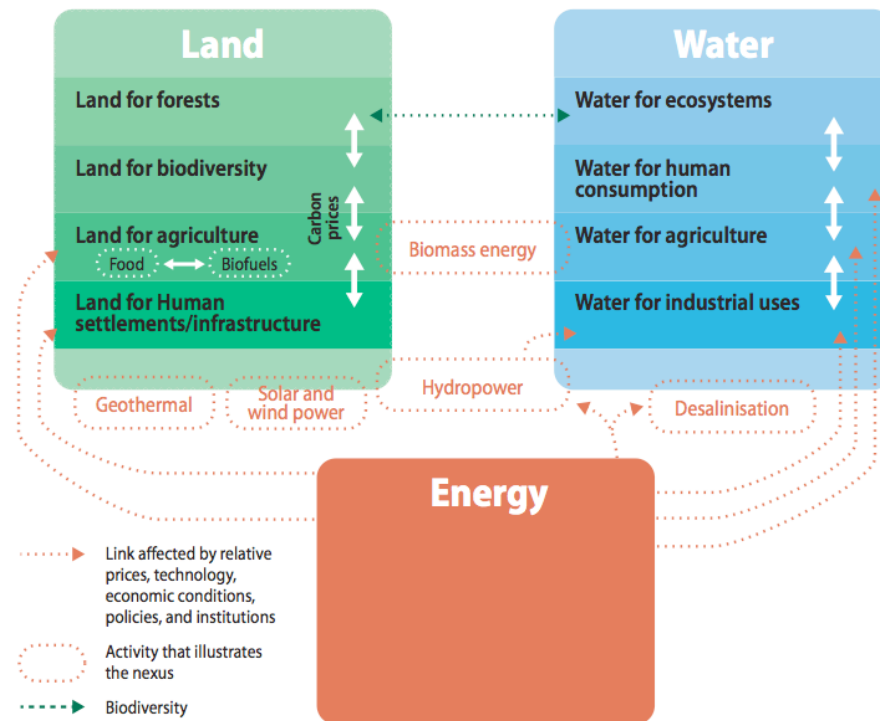


Figure 3 - Water Food Energy Nexus (ODI et al., 2012)

2.1.2 Private Sector Participation

After the World Water Forum in Kyoto 2003, the water panorama changed significantly: 20% of the world's population was without access to sufficient supplies of drinking water to cover basic daily needs. The "state failure" regarding the inefficiency to manage water supply systems, increased the involvement of the private sector in water supply management, due to the open advocacy of the participants. Thanks to this shift in international water policy, private water companies had been invited to meet with government delegations, international financial institutions, and bilateral aid agencies to develop solutions to solve the world's water problems (Bakker, 2007). The private sector participation has become a key element in water stewardship due to the increasing integration of different stakeholders in the process. Public services¹⁵ like water delivery

¹⁵ These are understood to be a public right for every citizen without class distinction or any other type of discrimination. In the past, public services were exclusively state-owned-monopolies.

and wastewater treatment are nowadays part of a newly recognized “industry” or “market segment” that receives as well the pressures related to commodities.

Nevertheless, it is important to understand the different ways in which private sector participation can positively contribute to manage the sector competently, together with the interaction of the government and the final users among other actors from the civil society. It is important to consider, that this type of participation can jeopardize the proper administration of the common goods¹⁶ if there is not a proper legislation and regulatory mechanisms that contribute to a harmonic interaction between service provision and fair revenue. One of these mechanisms is the clear understanding of the *water rights* and how this ownership affects the administration in the long term.

There are many advantages when the private sector covers some of the duties of the state in a better and more efficient way. However, this is controversial in the water sector, because due to its unique characteristics “certain forms of water represent ordinary private goods while other forms represent different types and degrees of market failures”¹⁷(Gunatilake & F., 2008). Unlike other goods, water represents a natural monopoly and is a “tradable good” that is a requirement for life (McNallen, 2006). As summarized in *Figure 4*, the leading forces to integrate private sector in water resources management are directly related with goals such as efficiency in the operation through better infrastructure, processes to lower costs and improved service. Another reason is to reduce government responsibilities in the sector, due to the fact that the expertise is not enough to satisfy the common benefit. “Contracts providing for private operation of municipal water supply and treatment systems tend to tie contractor revenues to the most efficient operation of the system, and to require the contracting firm to construct or repair a given number of water pipes or meters, to establish new water connections for a set number of households, or in other ways contribute to the extension or maintenance of the existing water infrastructure” (Baumert & Bloodgood, 2004).

¹⁶ A public good which should be accessed by everyone in a fair way. Implies the right to be accessed but also the responsibility and awareness about the conscious consum.

¹⁷ Market failures occur when the prices of goods and services send false signals about their real value, distorting the communication between consumers and producers. They reflect non-Pareto-efficient resource allocations by the market. The classical market failures include incomplete markets, monopoly and other market imperfections, externalities, public goods, and nonconvexities. Gunatilake, H., & F., M. J. (05 de 2008). *Privatization Revisited: Lessons from private sector participation in Water supply and sanitation in developing countries*. Retrieved 13 de 04 de 2011 from Asian Development Bank: http://www.adb.org/Documents/ERD/Working_Papers/Wp115.pdf

Table 1 - Motives for introduction PSP in WSS

Motives for introducing private sector participation in water and wastewater services	
Goal	Method of achieving goal
Increase efficiency of water/wastewater service operations	Introduction of a profit motive often leads to lower costs, lower prices, and water conservation
Increase stock of water infrastructure	Invite private investment to increase available capital without raising taxes to unsustainable levels.
Raise revenue for government	Privatize water sector by selling off existing, government-owned water assets.
Reduce government responsibilities	Transfer ownership or management of the water services industry to the private sector.

Source: (Baumert & Bloodgood, 2004)

Private sector participation can be typified according to (McNallen, 2006) as follows:

Private Sector Participation (PSP): Is the involvement of the private sector entity or person at some stage in the delivery of a public service. This type of participation includes several legal forms such as construction, service or management contracts, leases, concessions, build-operate-transfer (BOT) and divestiture.

Public-Private Partnerships (PPP): Is a form of association between the government and the private sector. The government is the grantor of rights and duties as well as the legal entitlement holder, owns the public works assets and has the service responsibility.

Privatization: This includes the whole transfer of property rights and responsibilities from the government to a private sector entity or person and means in the practice the ownership transfer of state-owned enterprises to the private sector. Nevertheless, this may have no validity in the context in which the natural monopoly would be transferred, since the “public citizenry” would not allow this scenario.

As shown in *Figure 5*, the types of PSP differ according to duration of the contract, the ownership of the assets, sources of capital investment and responsibilities.

Table 2 - Characteristics of selected methods of water sector privatization

Characteristics of selected methods of water sector privatization						
	Privatization	BOO/BOT	Concession	Lease	O/M Contract	Outsourcing
Duration	-----Indefinite-----	-----20-30 years-----	-----5-15 years-----	-----3-7 years-----	-----1-2 years-----	
Ownership of assets	-----Private-----			-----Public-----		
Source of capital investment		-----Private-----			-----Public-----	
Scope of private sector responsibilities	-----Entire system-----	-----Parts of system-----		-----Entire system-----		-----Parts of system-----

Source: (Baumert & Bloogood, 2004)

There are many advantages from the PSP for the public sector such as financing and/or expertise in expanding infrastructure or responsibility transfer but it is important to realize that it cannot be seen as a magical solution to reach a good performance of water utilities. If there is a weak legal framework of a unwilling or unable government to commonly take the sector problems, the private intervention may be useless. That is why privatisation would not be a desirable scenario for water resources management since the only incentive in a deregularized context, would remain the profit instead of the universal access to water.

It is worth to mention that the introduction of private operators needs to be carried out taking into account the attributes for effective water governance (these will be discussed in the next section of this chapter). Some general principles for good utilities governance include (*Rogers & Hall, 2003*):

- Extensive social and parliamentary debate to reach consensus on private sector participation;
- Design of an adequate system of subsidies to ensure the needs of the poor are satisfied;
- Economic assessment of long term affordability of privatized services, including the impacts that any government guarantees, for example on exchange rates, would eventually have on the efficiency of purveyors and on public deficits;

- Incorporation to the extent possible of effective competition;
- Design to take maximum advantages of economies of scale and scope;
- Assurance of reasonable rates and returns, transferring efficiency gains to the consumers;
- Control of price changes;
- Provision of timely and adequate information to consumers and regulators, including state of the art regulatory accounting;
- Provision of opportunities for meaningful and opportune users' participation;
- Setting up independent and capable regulatory bodies;
- Design of conflict-solving mechanisms that ensure social, environmental and economic factors relevant to governance are adequately considered when adjudicating conflicts.

2.1.3 Water legislation and public policy

Legislation plays an essential role in water regulation and in the interaction between different stakeholders. This is the spinal cord of an effective IWRM implementation. Nowadays the debate toward the real application of outstandingly conceived legal frameworks that are too difficult to accomplish in certain contexts is opened. Despite of it, a national water resources policy is the main instrument in order to determine water allocation, water rights and ownership, water uses and pricing as well as management instruments among many others. A main directive has to be set for determining water quality standards; universalized access to water resources plus many ecological aspects related to water sources. The whole policymaking and implementation process has to be linked in order to be on top of the national agendas.

A *national water policy* is the starting point for the articulation of the multiple issues in the sector and therefore a sector public policy. Some key characteristics of a public policy are: stability in the long term, adaptability, coherence and coordination, efficiency, effective implementation potential, consideration of the public interest (Banco

Interamericano de Desarrollo & David Rockefeller Center for Latin American Studies Harvard University, 2006). Policymaking is a government responsibility but it is desirable to count on the input of other actors. The goals in the water policy formulation phase must be the sustainable development of water resources, the effective implementation and the involvement of key actors/stakeholders in the process (Rogers & Hall, 2003). All the measures related to water sector financing sustainability and service provisions (regulation regarding taxes, subsidies, tariffs, quotas) should be established according to each country's particular context.

The legislation should also take into account the creation of solid and transparent institutions that advocate for good practices among the actors that intervene in the sector such as service or infrastructure providers, contractors, and public enterprises. This is unavoidable, particularly in developing countries where the water sector has historically been a corruption-prone¹⁸ (Saghir, 2008). In order to avoid this potential threat, there are several anticorruption tools that must be promoted: assessment and monitoring, access to information, ethics and integrity, and institutional reforms. (Asís, O'Leary, Ljung, & Butterworth, 2009) It is interesting to note the Klitgaard's Corruption Formula in which:

$$C=M+D-A$$

Corruption equals **M**onopoly power plus **D**iscretion by officials minus **A**ccountability.

"Corruption tends to be reduced by the separation of powers; checks and balances; transparency; a good system of justice; and clearly defined roles, responsibilities, rules, and limits."

The misallocation of financial resources in this sector can be devastating since the main affected is the poorest and most vulnerable population. As many of the public health problems are linked with deficient water supply and sanitation infrastructure, corruption

¹⁸ According to Asís et. Al (2009) there are seven forms of corruption: "**Bribery**: the giving of some form of benefit to unduly influence some action or decision on the part of the recipient or beneficiary; **Collusion**: an arrangement between two or more parties designed to achieve an improper purpose, including improperly influencing the actions of another party; **Embezzlement and theft**: taking or conversion of money, property, or other valuables for personal benefit; **Fraud**: use of misleading information to induce someone to turn over money or property voluntarily; **Extortion**: involves coercive incentives such as the use of threat of violence; **Abuse of discretion**: abuse of an office for private gain, but without external inducement or extortion. **Favoritism, nepotism, and clientelism**: involve abuse of discretion. This practices occur often in the hiring and promoting of staff."

must be strongly avoided through concrete legal mechanisms that promote financial accountability and transparency.

In order to study in depth the water legislation structure, the next chapter (3) will offer a complete overview of the Brazilian legal framework, the numerous instruments that have been implemented and how these are translated in the local basin management level.

2.1.4 Water finances

It was discussed below, that one of the appealing features of a PSP is the availability of financial resources for infrastructure and utilities management. Among the Millennium Development Goals, it was stated in 2000, that the population without access to safe water and sanitation, should be halved by 2015. This target has been gradually set on top of the policy priorities. However, the financial needs to achieve these goals have been steadily recognized but remain a critical element, because the awareness toward a linkage between the integrated approach, good water governance and financing is still missing (Winpenny, Rees, & Hall, 2008). Multi-level hybrid alternatives (Public Private Partnerships, Public Social Partnerships, Co-management) are getting more popular in this sector in order to address the demands for water services. These hybrid approaches will be discussed, in depth in the *environmental governance* section.

Many developed countries have reached proper infrastructure and service provision through public investment that usually came from the central government. The *government budgets* are administered differently according to the decentralization scheme in every country and its distribution strongly depends on exogenous social and political priorities. In developing countries the financial availability is often not sufficient to satisfy these needs (not even basic infrastructure for universal supply of water) and that is why other forms of financing should be integrated. Usually, there are three financing sources for the water sector, called the 3Ts (EUWI-FWG, 2003):

Tariffs from water users: Tariff revenues from user charges should also contribute to absorb investment costs if they are administered well. Thanks to future cash flows, the operation and maintenance expenses can be covered. Volumetric tariffs represent a way to understand water as a scarce good and

should give an incentive to use it carefully. Tariffs serve, also as environmental protection mechanism, since encourages conservation and penalizes the discharge of untreated wastewater.

Tax-funded subsidies from taxpayers: The central government can act as financial provider that administers the tax expenditures. Government grants and loans on concessional terms are also broadly used to fund capital investment. Subsidies may be wrapped into “soft” loans, which have the merit of containing signals and incentives necessary to nudge utilities towards greater financial autonomy. Since the decentralization has been gradually set in many countries in order to manage the fiscal system in a better way, financing water at the sub-sovereign levels of administrations – regional and state governments, municipalities, specialized infrastructure financing agencies, utilities, etc. has considerably increased. Nevertheless, there is a trend of high level of unspent budgets for water supply and sanitation due to the fact that actual disbursements of water budgets are routinely only a fraction of the allocated amounts. This may reflect deep governance constraints, bad central-local coordination because of excessive bureaucratic obstacles and corruption.

Transfers from external sources (grants) or philanthropist: These external transfers are also known as Official Development Assistance (ODA) and usually come from International Funding Institutions such as the Interamerican Development Bank, the European Development Bank or the African Development Bank. If there are donations, they correspond to private, non-tax source of revenue.

However, the **3Ts** are usually not enough to finance the water sector and there is “gap” that must be covered with *repayable financing sources*. “At the most basic level, this financing would include *loans* (on either commercial or concessionary terms) and *equity investments* from private investors. If repayable financing is not available (either because the cost of borrowing is too high or expected revenue streams are not sufficient to repay), the financing gap would result in an investment gap, which means that necessary investments are not carried out for lack of finance.” (WHO, 2012) The general financing scheme for the water sector can be appreciated in *Figure 4*.

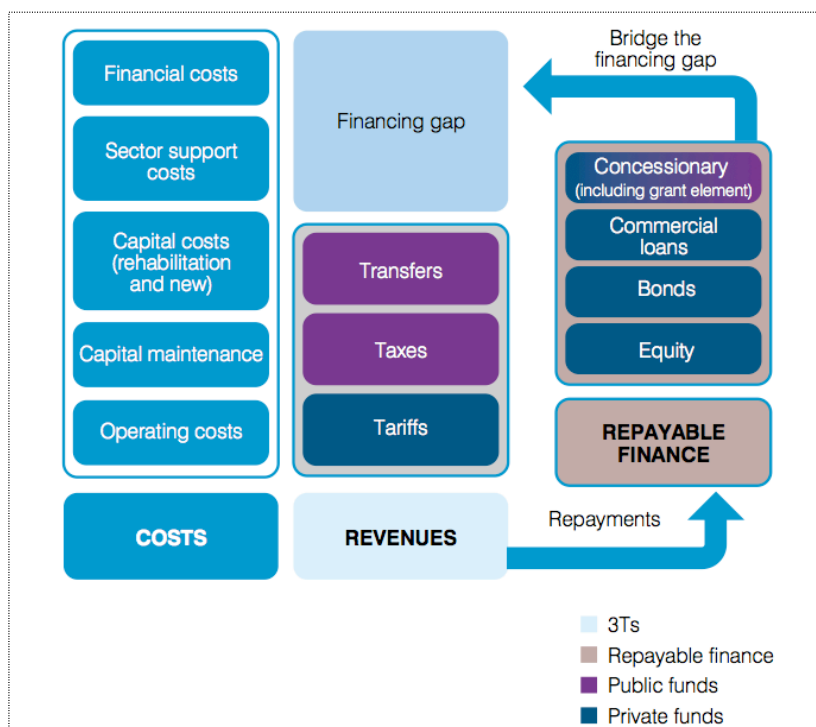


Figure 4 - The 3 Ts!: Transfers, Taxes and Tariffs (WHO, 2012)

2.1.5 Water supply and sanitation

Understanding water legislation and how the sector reforms and improvements can be financed is particularly important to hasten progress toward water supply and sanitation services. According to the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (JMP), 37% of the developing world's population – 2.5 billion people – lack improved sanitation facilities, and over 780 million people still use unsafe drinking water sources (UNICEF, 2012). Although water supply and sanitation have become an interconnected concept, it is necessary to clarify the characteristics and scope for each field.

Water supply is closely related to water cycle, the water availability in a catchment, (groundwater or surface water) in a certain region and if the end user receives drinking water in good quality and quantity in the house tap or enough volume, in the case of big

water users. On the first hand, it should be considered the groundwater balance and exploitation, the bank filtration and groundwater recharge as well as aquifer preservation. On the second hand, initiatives should be implemented to improve water bodies' drainage and conservation (lakes, rivers, reservoirs) and rainwater harvesting. It also includes everything related to drinking water facilities –catchment storage, operation of treatment facility, supply network construction and infrastructure maintenance- irrigation systems and dams among others. Summarizing, water supply refers to the everything related to: water catchment, water quality and treatment and water distribution (Sturm, 2011).

Water sanitation refers to the disposal of household wastewater, which may or may not involve sewerage, and may or may not involve water. Sewerage is the collection and treatment of wastewater on a shared basis. In many countries or rural areas, sanitation is often a “household decision” and depends on funding availability of the existing technological options: disposal of wastes can either be on-site (into septic tanks or pits) or into public sewers; on-site facilities may be self-regulating or may need to be emptied (e.g. by municipal or private tankers) (EUWI-FWG, 2003). The sanitation system is compound of a user's interface, a collection and storage procedure, a conveyance complex, an adequate treatment and a correct disposal or reuse (Udert & Tilley, 2011).

Although universal water supply is still a main target, the most challenging actions must be implemented for sanitation solutions and technologies, particularly in the rural areas. “Wastewater management or the lack of it, has a direct impact on the biological diversity of aquatic ecosystems, disrupting the fundamental integrity of our life support systems, on which a wide range of sectors from urban development to food production and industry depend. It is essential that wastewater management is considered as part of integrated, ecosystem-based management that operates across sectors and borders, freshwater and marine” (Corcoran et al., 2010).

Water sanitation is a public health issue since wastewater contains numerous contaminants that may represent a risk for the population. Several management measures can be adopted to avoid impacts related to the toxicity of the contaminants *Figure 5* such as decreased ecosystem health, contaminated drinking water, contaminated food or decreased human health etc.

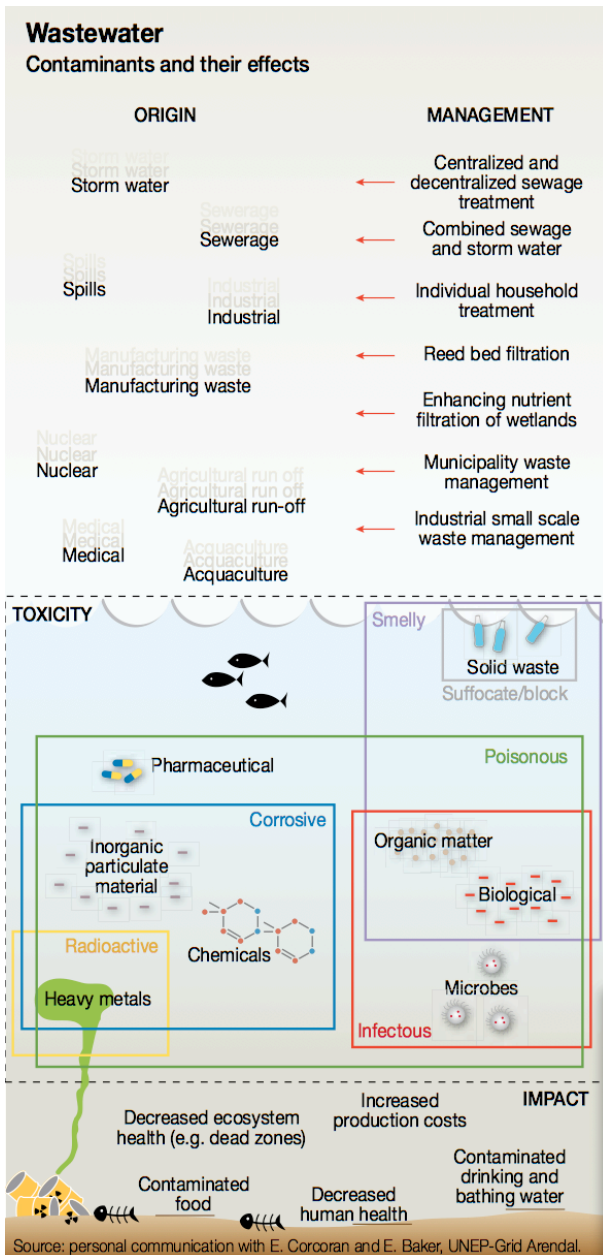


Figure 5 - Contaminants in Waste Water (Corcoran et al. 2010)

Since sanitation is the major challenge in the actual context in Brazil, it is pertinent to summarize some important characteristics of this sector in the following table:

Table 3 - Physical and Economical Characteristics of Water Sanitation Sector

	CHARACTERISTICS	REPERCUSSIONS
PHISICAL	The major part of the assets (water and sewage networks) is buried.	Difficult determination of conservation state; High maintenance costs and complexity to determine possible water leaks in the pipeline network.
	Technological standards change at slow pace.	Few gains in efficiency through technological advances; Assets with extended lifespan.
	Complex verification of product quality (by users)	Need for adequate infrastructure to monitor the quality of products and services offered by utilities.
	Integrated network in urban centers.	Involvement of more than one federal/state entity in the service management; Infrastructure expansion associated with urban planning.
	Essentiality in the use and consumption of products (drinking water and sewer).	Service is independent of users' capacity to pay; Generation of positive and negative externalities to public health, environment, water resources, among others.
ECONOMIC	Elevated fix costs.	Low flexibility to split investments in the time (investing in different phases).
	Long-lasting assets.	Natural monopoly; Inexistence of alternative uses and low resale value; Very remote possibility that utilities' companies get out of the market; Little attractiveness for investment.
	Information asymmetry.	Other actors in the sector depend on the technical and financial information provided by the concessionaries.
	Inelastic demand.	Possibility of extracting significant revenues by service provision (monopoly).
	Scale economies.	Feasibility of service provision by a single utilities' company (monopoly).
	Scope economies.	Common costs in the operation of water services and sewerage as well as sewage treatment. There is a high probability, that a single company accomplishes the service provision (monopoly).

Source: (Junior & Paganini, 2009) Free translation from the author

2.2 Water Governance

2.2.1 Governance and the relation with water

The concept of governance was used in the past almost as a synonym for government and the act of steering society, specifically in regard to authoritative direction and control (Tropp, 2007). But governance is not a synonym of government: it is a hybrid of shared actions, interventions and outcomes of all the political actors in society that have an incidence in decision-making. Under this perspective, governance would actually be practiced in all the countries where a legitim authority leads a territory but not in the ideal and equilibrated manner. Tropp (2007) makes an interesting characterization of governance:

“It is a process of interactions rather than as a formal institution/regime is based on accommodation rather than domination—decision-making is increasingly **based on negotiations**, dialogue and networking; provides alternatives to top-down hierarchy, such as **through horizontal networks**; includes both private and public sectors and the interactions and relationships between them are critical for governance outcomes; is action-orientated (governance for the **common good** or for solving common problems) and **appears at all scales**, from local to global.”

Moreover, recent analyses tackle the conceptualization as a process and as a product. *Governance as a process* involves a number of distinct elements, particularly the decision-making about potentially contestable outcomes. *Governance as a product* can be seen as the quality of those outcomes and the legitimacy of the trade-offs (Turton, Hattingh, Claassen, Roux, & Ashton, 2010). Therefore, governance is also:

“The process of **informed decision-making** that enables trade-off between competing users of a given resource so as to balance protection with beneficial use in such a way as to mitigate conflict, enhance equity, ensure sustainability and hold officials accountable.” When this process runs well the product can be even good/effective or bad/non effective (governance).

After having a wide overview in the last section of this chapter, about the multiple factors that are relevant to achieve the IWRM approach, hereon it will be explained why

governance represents the core element to make the whole engine work. The integrated approach refers not only to the unified vision and management of the water cycle components as a whole unit. It also submits to the integration of all stakeholders in decision-making processes, which ensure that management outcomes are the right for the context and count on legitimacy (Turton et al., 2010). Governance in the water sector is essential if a sustainable and effective management is desired. Some of the first authors that defined water governance are Rogers and Hall (2003):

“Water Governance refers to the **range of political, social, economic and administrative systems** that are in place to develop and manage water resources, and the delivery of water services, at different levels of society”

Water Governance is also a key factor in conflict resolution and has to be encompassed with the legal framework, the management instruments and the stakeholders dialog. There is no standard path to reach water governance and it depends on the particular context of a region, the specific water demands, the interconnection with other sectors and the stakeholder integration among others. Negotiated solutions through dialogue-based processes should lead to transparent, equitable and participative solutions in the water sector. Taking bad decisions or even not taking any decision can lead to bad governance and high costs for the society. It is useful to understand the link between the IWRM approach and governance of water after Turton *et al.*:

Water governance is a process and successful IWRM is the product of good governance.

Governance is usually interrelated to the fact of “doing things right” (Plummer & Slaymaker, 2007) and in many cases this begins with a good policy framework, a decentralized political system and a healthy fiscal system. According to Plummer and Slaymaker there are several policy instruments of water governance:

Technical: Measures used in resources assessment and design of structures used to control, store and supply water for different purposes.

Economic: Measures used to encourage efficient and responsible allocation and use of water resources including pricing, charges, subsidies and penalties.

Administrative: Information systems, maps/models, plans, guidelines and other decision support and management tools.

Institutional: Regulatory bodies, management arrangements, planning procedures, coordination and partnership mechanisms.

Social/Participatory: Measures to increase awareness of water issues and mobilize users to participate in planning, management and financing of water resources development.

Every context is different: problems in developing countries are different than in developed ones; water uses and issues are different in Nordic countries in comparison to China; water availability is more stressed in Egypt than in Brazil. The trend about “democratizing” and “de-globalising” environmental issues has been increasing in the recent decades. This means that local and decentralized solutions are the best way to achieve “good” governance and effective management of the water resources. It is useful to go through some important concepts such as environmental governance and afterwards through the criteria for effective water governance.

2.2.2 Environmental Governance

Environmental Governance is nowadays more than a merely “state issue”. It is synonymous with interventions aiming at changes in environment-related incentives, knowledge, institutions, decision-making, and behaviors. Furthermore, this concept refers to the set of regulatory processes, mechanisms and organizations through which political actors influence environmental actions and outcomes (Lemos & Agrawal, 2006). The decision-making process is very complex and involves a wide range of actors that can be grouped -for the aim of the subsequent analysis- as follows: *governments* -local, state, and national levels-; *individuals* –seen as citizens, rural communities, civic organizations-; and *interest groups* -national and transnational corporations and international bodies amongst others-.

It is important to describe several mechanisms or strategies that include the different stakeholder interactions in order to build environmental governance. When all actors

shown in *Figure 6* are adequately integrated in these kind of processes it is called multi-partner governance and also features three other major forms of “hybrid environmental governance” (Agrawal & Lemos, 2007)

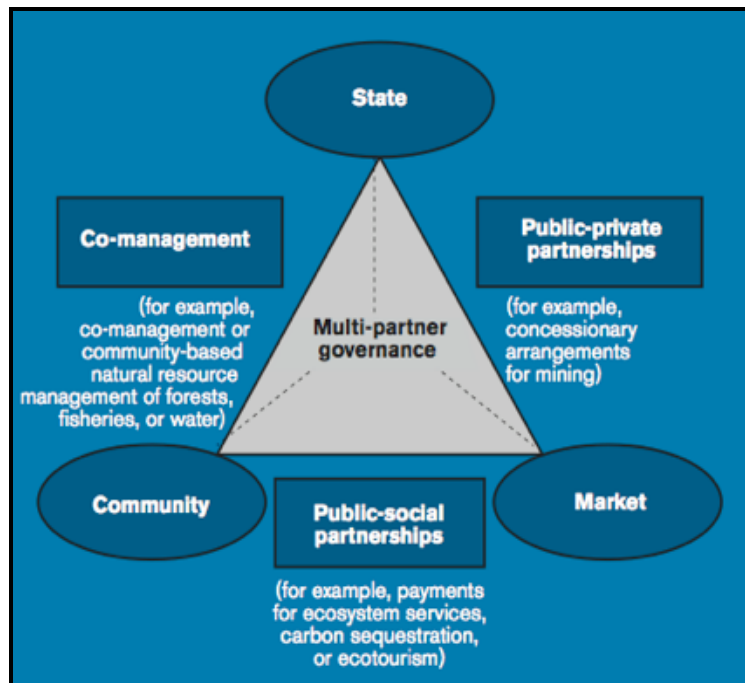
Public-Private Partnerships (between state agencies and market actors and already explained in the last section),

Comanagement –between state agencies and communities- and

Private-Social partnerships – between market actors and communities-.

These hybrid forms of contemporary environmental governance simultaneously illustrate its dynamic and fast-changing nature. It is interesting the inclusion of community and local participation to the environmental governance approaches. This has two benefits according to Agrawal & Lemos (2007): first, “communities possess unique time-place-specific information that may help solve complex environmental problems that distant state agents don’t possess” and second “the formal involvement of community members in governance can allow for more equitable allocation of benefits from environmental resources.” In the case of Brazil, Comanagement strategies have been gradually and successfully implemented through the Watershed Management Committees¹⁹. This hybrid governance form can be grouped under the “community based natural resource management”.

¹⁹ Most committees in Brazil are in the formative stage. With the participation of the society organized in committees, watershed communities in the Atlantic Forest can obtain water quality that to allows its use for several activities that can ensure sustainable rural development. These uses go from quality drinking water for human supply, for economic activities such fisheries, irrigation, industrial use, and tourism -diving and swimming activities- amongst others. The co-responsibility and participation enables commitment of citizens in decision-making in order to strengthen the management process. To see more see the case of Rio Pardo Watershed in Santa Cruz do Sul. Brinckmann, W. E. (09 de 04 de 2001). *Sociedad Civil, Participación Y Conocimiento: La Gestión Del Agua En La Cuenca Hidrográfica Del Río Pardo, Río Grande Do Sul, Brasil*. Retrieved 03 de 04 de 2011 from Universidad de Sevilla: http://area.us.es/ciberico/archivos_acrobat/sevilla4brinckmann.pdf



**Figure 6 - Mechanisms and strategies of environmental governance
(Lemos and Agrawal, 2006)**

In order to understand the actual context in the water sector in Brazil, it is very useful to know about the trends that are shaping the environmental governance today: globalization, decentralized environmental governance, market- and agent -focused instruments (MAFI'S), and governance across scales (Lemos & Agrawal, 2006). These trends constitute a classification that corresponds to new innovative ways to manage environmental- and natural resources events providing challenging existing forms of governance. This has been gradually happening as other actors have continuously getting more involved in environmental issues. The experience and traditional knowledge of individuals, the capacities and expertise of the private sector as well as the efficiency of the state actions in decentralized forms of government, are interacting to set the best ways to deal toward environmental problems. As mentioned above, one of the interesting trends of environmental governance in water's case is the effect of globalization on it. Due to this fact, the increasing participation of private actors in the management of water

resources has found a new approach by integrating new actors (mostly private) not only in Brazil but in the entire world²⁰.

As it is broadly known, globalization produces positive and negative pressures on governance. Governments try to globalize environmental problems or needs enhancing the depth of participation and the diversity of actors shaping them. The willingness to attempt better management instruments, new and more efficient technologies as well as better services –coverage, quality- for the citizens are some of the motivational factors of this trend. However, the globalizing environmental problems trend does not mean that these have to be tackled thinking “big”. Indeed, this is a way to reach awareness in the political level but real governance occurs when integrated local consensus is achieved in a decentralized scheme and the outcomes are appropriated for the specific context.

2.2.3 Effective Water Governance

As seen above, the new emphasis of governance is focused on the diversity of actors and the distribution of responsibilities and rights. As shown in *Table 4*, in every level-local and national- some trends have been appearing in the water sector: increasing private sector participation such as public and private partnerships as well as decentralization of water management (including management by user groups) and service delivery (Tropp, 2007).

²⁰ The poor performance of developing country public water utilities instigated a privatization drive in the 1990s. Sixty-eight developing countries have brought private sector participation (PSP) to their water sector since 1990. By 2005, 54 of those countries still had the private sector engaged in operational water projects (consisting of more than 220 contracts). Gunatilake, H., & F., M. J. (05 de 2008). *Privatization Revisited: Lessons from private sector participation in Water supply and sanitation in developing countries*. Retrieved 13 de 04 de 2011 from Asian Development Bank: http://www.adb.org/Documents/ERD/Working_Papers/Wp115.pdf

Table 4 - New and old forms of governance

Old governance emphasises	New governance emphasises
Emphasises the government and bureaucracy	Civil society and markets. The government and bureaucracy are still important entities but with reduced authority
Political power monopoly	Co-steering
Steering	Diversity of actors and power diffusion
Hierarchical control	Horizontally shared control
Enforcement of rules and regulations	Inter-organisational relations and coordination Decentralisation/bottom-up management
Control	Formal and informal institutions
Top-down management	Co-governing (distributed governance)
Formal institutions	Network governance
Inter-governmental relations	Process orientation
	Expansion of voluntary exchange, self-governance and market mechanisms
	Dialogue and partnership
	Participation and negotiation

Source: (Tropp, 2007)

Effective water governance requires a policy environment that promotes decentralization, interaction, and commitment of relevant government departments and civil society actors, including the private sector. Nevertheless, achieving this is not easy due to the existence of several governance gaps. In order to overcome whether governance, market or system failures (or a combination of these) occur, more effective governance regimes or systems need to be designed/created (Rogers & Hall, 2003).

The solutions have to address the failures specifically and systematically since “there are no blueprints for improved water governance and locally valid approaches have to be developed”(Moriarty, Batchelor, Laban, & Fahmy, 2007). The IWRM Toolbox from the GWP provides suitable solutions to address particular failures such as inappropriate price regulation, bureaucratic obstacles, inappropriate legislation or ignorance about water markets and risks among many others.

There is no single pattern to follow, in order to achieve more effective water governance, but it is important to identify some universal attributes that represent an ideal situation. According to Rogers & Hall, for effective water governance there are several *attributes* and *performance & operation* principles that are essential -*Figure 7*.

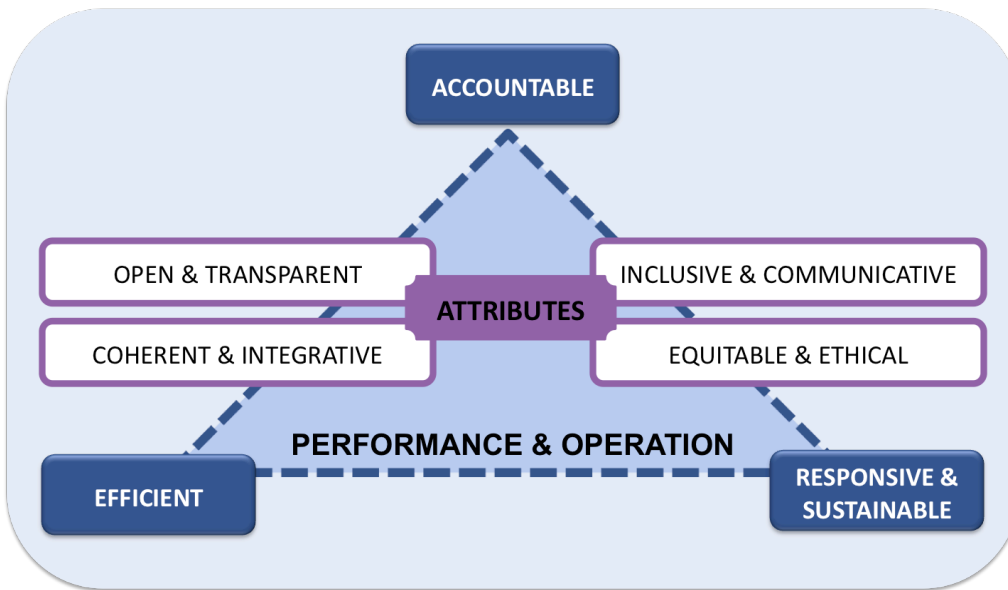


Figure 7 - Effective Water Governance (authors adaptation from Rogers & Hall,2003)

The attributes of effective water governance can be explained as follows:

Institutions should work in **an open** way and **policy processes** have to be **transparent**.

It is known that IWRM has an implicit planning process. This should be **inclusive, informative** and promote wide participation from all stakeholders. A horizontal and vertical dialogue is essential between all levels.

Policies and actions should be **consistent**, congruently formulated and **coherently** implemented. This requires political leadership. All actions should enhance the effectiveness of the IWRM.

Water management must to be **ethical** and **equitable** among and between various stakeholders and water users.

Regarding the performance and operation it is important to understand that:

Institutions must have defined roles and responsibilities, legal processes and general rules should be clear for all. Decision-makers are **accountable** to the public and institutional stakeholders.

Political, social and environmental **efficiency** should be balanced with the economical approach of the term efficiency.

Each situation is different and therefore needs outcomes that correspond to that specific reality. That **is responsiveness** and should implicitly include **sustainable** solutions in the long term.

2.2.4 Selected criteria for Water Governance Assessment

For the purposes of this research²¹, the measurable attributes and performance/operation criteria were classified and defined as follows:

- **Effectiveness:** The planned activities are realized and discounted results are obtained. Refers to the success of public authorities regarding to the existence of a clear vision, good planning processes and decision-making based on reliable and updated information. It is also related to the citizens' satisfaction toward the quality and accessibility to delivered water services (Dufils, Ramasinjatovo, Kjaer, Randrianarisoa, & Memela, 2005).
- **Efficiency:** Stakeholders at different levels successfully assume their roles relating to water efficiency, what means that institutions perform well, water finances are healthy and water service provision counts is competently achieved (Furlong & Bakker, 2007).
- **Transparency:** Water institutions should work in an open way, the information should flow freely among all stakeholders, while decisions and decision-making processes must be open to public scrutiny. (Rogers & Hall, 2003)
- **Rule of law:** Legal frameworks must be implementable, should be fair and enforced partially (Svendsen, 2010).
- **Accountability:** The "rules of the game", legislative roles and executive processes should be clear for all stakeholders. Each water-related institutions should assume

²¹ The water governance assessment (Chapter 6) is based on the selected criteria.

responsibilities and must be able to account the citizens about the water related issues and management (Moriarty et al., 2007).

- **Conflict resolution:** The capacity to mediate and solve water related conflicts or issues.
- **Participation:** “All citizens, both men and women, should have a voice, directly or through intermediate organizations representing their interests, throughout water governance policy formulation and decision-making” (Svendsen, 2010).
- **Awareness:** Stakeholders at all levels should have the ability to perceive and be conscious about water related issues.
- **Equity:** Equity between and among various stakeholders and user groups should be carefully monitored throughout the policy development and implementation process. Special attention should be given to the needs and participation women as well as to marginalized population (Moriarty et al., 2007).
- **Articulation/ mobilization:** The legal framework, the institutional structure and the multi-stakeholder dialog, should contribute to the effective implementation of the water management instruments.

2.2.5 Multi-Stakeholders Platforms

In order to close the gap between the theoretical basis of water governance and the ideal characteristics of an effective implementation to the outcomes on water resources management, it is pertinent to link the applicability of any suitable water management approach to multi-stakeholder platforms (MSP). A widely accepted definition defines:

“A platform is a decision-making body (voluntary or statutory) comprising different stakeholders who perceive the same resource management problem, realize their interdependence solving it and come together to agree on action strategies for solving the problem” (Steins and Edwards as cited in Moriarty et al., 2007)

Such platforms should enable multi-stakeholder dialogs. Currently, it is evident that there is an overwhelming opinion supporting a participatory approach in water

governance (participatory water governance), and of the demand to make necessary institutional and legal changes to make water governance more decentralized (Joy, Paranjape, & Kulkarni, 2008). The MSP should make a difference in order to improve performance, enhance sustainability and facilitate decentralized governance.

MSPs enable different stakeholders to take decisions in a legitimate way through “coordinated consensus-seeking” which is the best way to prevent or solve conflicts. Water management is inherent to conflict resolution and consequently one sign of effective stewardship is the minimization of conflict situations. These platforms also facilitate the adaptability to situations derived from climate change effects, political or legal transformations or other circumstances that can stress the water sector. Another important fact about MSP is that it might empower those participants who are equipped to negotiate and take advantage of their voice and of new information. However, marginal groups may well be deficiently organized and easily co-opted or bribed. The poorest may not participate, as their opportunity costs are too steep (Warner, 2007). This remains a challenge in developing countries, where the poorest are the most vulnerable to water problems and deficiencies.

3 Brazil Water Legal Framework

3.1 General context

Brazil has plenty of water resources but also presents a “water anomaly”. Although “thirteen percent of the world’s fresh water resources flow within its borders, yet scarcity due to drought in the Northeast and pollution in the Southeast prevents much of the population from receiving potable water” (McNallen, 2006). According to Brazil’s National Water Agency –ANA- forty million of the 180 million citizens do not have access to treated drinking water and fifteen million, lack drinking water service of any kind. Several efforts have been done within a complex context in water resources access and management –e.g. supply and sanitation- and one of the main concerns, has been the solution for big urban areas²².

In the case of Rio de Janeiro State, the economic activity and development of the industrial and the touristic sectors have increased the pressures toward water bodies due to the accelerated urban migration and the high water demand (for energy production in hydro electrical plants and industrial uses). These concerns have become main topics for the federal and state governments in order to mitigate the risks of water scarcity. One of the main strategies has been the establishment of an articulated water resources management system, which is based on the National Water Law, a public policy that has concrete planning processes, instruments and directives.

²² Most water use studies in Brazil have focused on engineering aspects of large urban water systems and few on socioeconomic aspects of rural water sources, even though the highest prevalence rates of water-related diseases are found in rural communities.

3.2 Planning and approach to the water sector

Brazil is a federal republic with 27 states and more than 5,400 local governments. Therefore, there are defined different levels of planning and fiscal autonomy at the federal, state, and municipal government levels. Planning has been seen in Brazil as a development instrument since 1930s and has been influenced by several peculiarities of the territory (Farret, 2001):

- a) its huge extension –over 8.5 million square kilometers- and heterogeneous in the socioeconomic and environmental characteristics;
- b) the rapid transformation from a rural country to a urbanized one -80% of the population living in urban areas (2000)-;
- c) the persistence of high levels of income inequalities and,
- d) a high level of poverty.

Taking into account these characteristics, Brazil's economic development began by targeting the urban centers and the industrial activity in order to strength the economy and generate monetary stability. Due to the rapid growth of these centers, the planning concept in Brazil was based on the understanding of the spatial and social differences in the country. Policies began to be focused on sector priorities like health, public services, and transportation (CEPAL & Global Water Partnership, 2000).

The national development plans are the planning and development instrument in the country. As Farret (2001) explains, the actual plan called *Plano mais Brasil 2012-2015* entered into force through the legal law instruments and has the following priorities: reducing social and regional inequalities; the increasing social participation; the promotion of environmental sustainability; the promotion of cultural and national identity; excellence in management to ensure the provision of goods and services and the guarantee of national sovereignty. These priorities have to be achieved through concrete policy instruments at each level of government, taking into account the vertical decentralization (federal, state, regional), understood as a political and administrative distribution of responsibilities and horizontal decentralization, which constitutes an integration and cooperation process between same level institutions.

In the case of the water sector, the different levels (whether national, state or regional level) are in charged whether of the *policy formulation*, the *water management* or the *deliberation*. It is important to note that the territorial planning unit is the watershed and different institutions interact in these processes *Figure 8*.

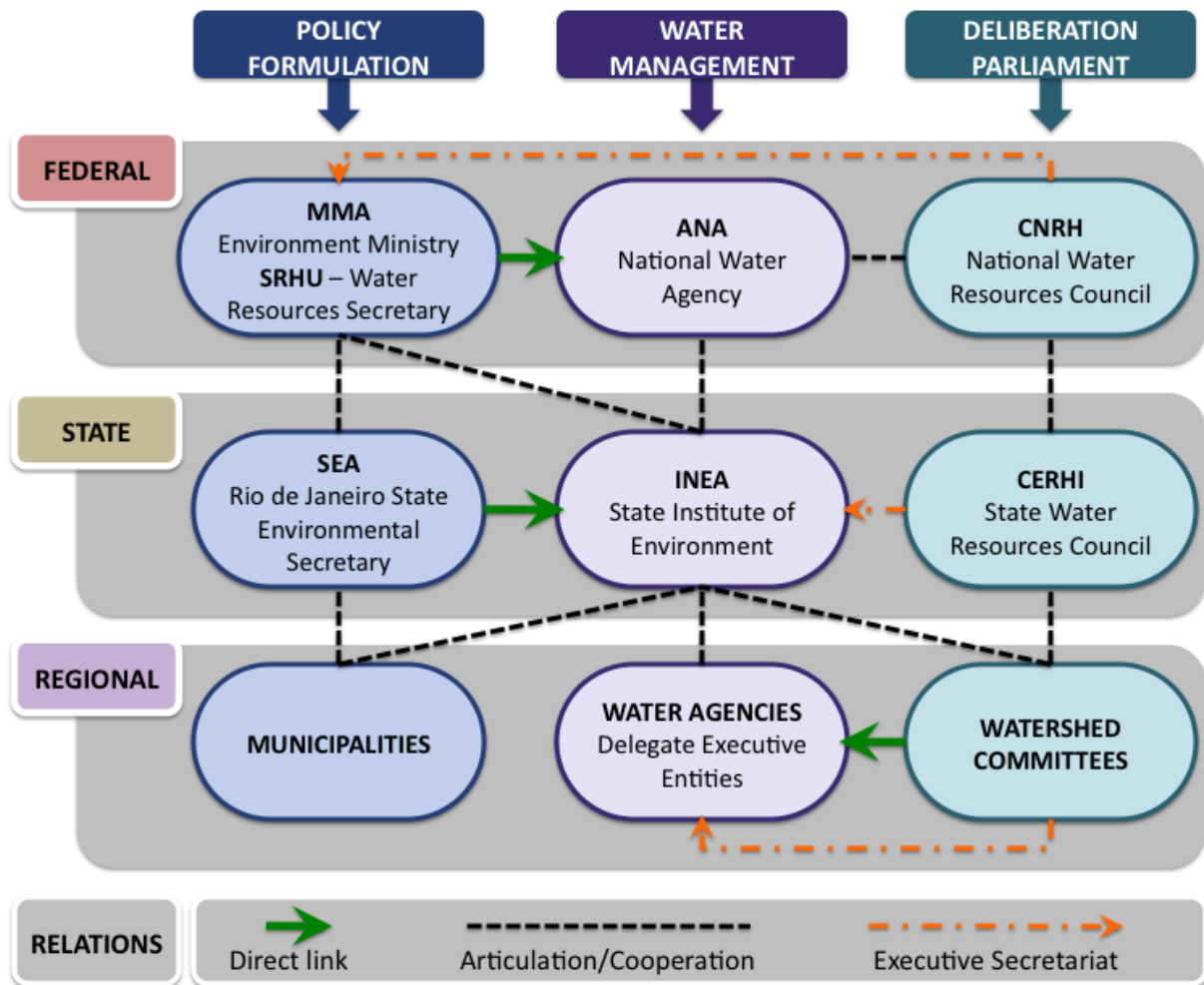


Figure 8 - Rio de Janeiro State Water Resources Management System (adaptation and free translation from the author) (Instituto Estadual do Ambiente, 2011)

The plans should be developed in autonomous way according to the local context and be implemented by the different interconnected institutions at each level. In this case, water resources plans are supposed to be developed in order to guide future decision-making and are to be developed for each river basin. The main goal is to make a

harmonization effort and to establish guidelines and priorities to the water allocation and water pricing (Porto & Kelman, 2000). In the next section of this chapter it would be possible to have a general overview of the legal framework of the water sector in Rio de Janeiro.

3.3 Legal and Institutional Framework

In Brazil, the main policy for water resources management is the Federal Law N° 9.433/97 which is based in the Dublin principles²³. The major objective of this law is to ensure enough water resources availability for the current and future generations, taking into account the suitable quality standards and multiple uses. There are several institutions that work together to achieve this goal (*Figure 8*). Decentralization, responsibility recognition, integration and public participation play an important role for the success of this policy. In the State of Rio de Janeiro the process has followed a gradual adaptation, which can be evidenced by the different laws and decrees for water resources management.

It is important to mention, that the State Water Resources Management System constitutes the institutional framework that should enable good water governance. Since different stakeholders are integrated in this system, several efforts must be done in the local or watershed level, in order to accomplish the fulfillment of the legal postulates. In the next table, the most important federal and state legal instruments are presented²⁴. This information should offer a general overview of the legal framework that rules the management of the water resources in Brazil and particularly, the case study areas selected for this research.

²³ 1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment 2. Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels. 3. Women play a central part in the provision, management and safeguarding of water. 4. Water has an economic value in all its competing uses and should be recognized as an economic good.

²⁴ This compilation is based on the book: *Base Legal para a gestão das águas do Estado do Rio de Janeiro (1997-2011)*. (T. Machado, Ed.) (Gerência d., p. 378). Rio de Janeiro: Instituto Estadual do Ambiente (2011)

Table 5 – National Legal Framework

LEGAL INSTRUMENT	MAIN ASPECTS
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">FEDERAL</p> <p>NATIONAL WATER LAW N° 9.4333/97</p>	<ul style="list-style-type: none"> ❖ Establishes the National Water Resources Policy: <ul style="list-style-type: none"> ➤ <u>Sector principles (Art. 1)</u> <ul style="list-style-type: none"> ○ Water as a good of public domain ○ Water is a limited natural resource and has an economic value ○ Management should envisage the multiple uses ○ Water basin is the territorial unit for the policy implementation ○ Water resources management should be decentralized and should involve participation of the Government, the users and the community ○ In case of water scarcity, priority should be given to human consumption and watering of animals. ➤ <u>Management instruments (Art. 5)</u> <ul style="list-style-type: none"> ○ Water Resources Plans ○ Classification of water bodies according to main uses ○ Water Permits (water use rights) ○ Water Tariffs (Charging Fees) ○ Water Resources Information System ❖ Creates the National Water Resources Management System <ul style="list-style-type: none"> ➤ <u>Institutional framework (Art 32) (Figure 8)</u> <ul style="list-style-type: none"> ○ Federal, state, and municipal organizations which competences are related to the management of water resources ○ National Water Resources Council –CNRH- ○ National Water Agency –ANA- ○ State and Federal District Councils on Water Resources ○ Watershed Committees ○ Water Agencies ➤ Objectives: <ul style="list-style-type: none"> ○ Coordination of integrated water resources management ○ Arbitration at an administrative level of disputes related to water resources among different stakeholders ○ Implementation of the National Water Resources Policy ○ Planning, regulation, and supervision of the use,

LEGAL INSTRUMENT	MAIN ASPECTS
	<ul style="list-style-type: none"> ○ conservation and recovery of water resources ○ Enforcement of water tariff rules

Table 6 - State Legal Framework

LEGAL INSTRUMENT	MAIN ASPECTS
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">STATE OF RIO DE JANEIRO</p> <p style="text-align: center;">STATE WATER LAW N° 3.239/99</p>	<ul style="list-style-type: none"> ❖ Establishes the Rio de Janeiro State Water Resources Policy following the principles, instruments and institutional framework of the national law. ❖ Includes the Watershed Committee Plans as a management instrument. ❖ Creates the State Water Resources Management System integrated by: <ul style="list-style-type: none"> ➤ CERHI State Water Resources Council: Collegiate institution that has normative, consultative and deliberative attributions in the state level. ➤ FUNDHRI State Water Resources Fund: Financial Fund with unlimited validity to be executed. These resources come mainly from the revenues originated from water charge and should be invested in water resources programs and projects. ➤ WATERSHED COMMITTEES <ul style="list-style-type: none"> ○ Collegiate institution that has normative, consultative and deliberative attributions in the water basin level. They should be recognized and authorized by a decree issued by the State Water Resources Council –CERHI- ○ The intervention area is one ore a group of water basins. ○ It is integrated by representatives from different stakeholder groups: <ul style="list-style-type: none"> • Water Users • Organized Civil Society • Municipal Authorities ○ Main competences (Art.55): <ul style="list-style-type: none"> • Suggest the CERHI the authorization to constitute the water agency. • Approve and send to the CERHI the Water

LEGAL INSTRUMENT	MAIN ASPECTS
	<p>Basin Plan (for endorsement)</p> <ul style="list-style-type: none"> • Accompany the Water Basin Plan execution • Solve in first instance, possible conflicts related to the use of water resources. <p>➤ WATER AGENCIES</p> <ul style="list-style-type: none"> ○ Executive entity, which acts as the secretariat from the watershed committee, has own legal personality, financial and administrative autonomy. This is all instituted and controlled by one or more watershed committee. ○ Its operation must be authorized by the State Water Resources Council –CERHI- if the following requirements are accomplished: <ul style="list-style-type: none"> • Pre-existence of the Watershed Committee. • Financial viability ensured through the water charging mechanism. ○ Main Competences (Art. 59) <ul style="list-style-type: none"> • Keep an adequate water resources balance. • Keep the water users database (register). • Charge for water use (in coordination with the State Environmental Institute –INEA-) • Monitor the financial administration of the collected water resources fees. • Implement the State Water Resources Information System –SEIRHI-. • Elaborate own operation budgetary proposal as well as the Water Basin Plan for the consideration of the Watershed Committee. • Suggest the following aspects to the Watershed Committee: <ul style="list-style-type: none"> ○ Water Bodies classification ○ Values to be charged for water use ○ Investment plan of charged fees ○ Cost distribution for multiple uses <p>➤ Federal, State and Municipal Organisms</p>
<p style="text-align: center;">WATER CHARGING LAW (Charging fees) N° 4.247/03</p>	<p>❖ Establishes the charging regulation for water use (water use fees)</p> <p>➤ Objectives:</p> <ul style="list-style-type: none"> ○ Recognize water as an economic good ○ Encourage rational use of water resources

LEGAL INSTRUMENT	MAIN ASPECTS
	<ul style="list-style-type: none"> ○ Encourage allocation and spatial distribution of productive activities ○ Promote low-polluting productive processes ○ Obtain financial resources for plans, programs, projects, civil works, studies financing as well as all management interventions to implement the State Water Resources Policy.
<p style="text-align: center;">CREATION OF INEA LAW N° 5.101/07</p>	<ul style="list-style-type: none"> ❖ Creates the State Environmental Institute –INEA-. ❖ Merged three state institutions: Feema (State Environmental Engineering Foundation), SERLA (State Agency for Rivers and Lagoons) and IEF (State Forest Institute). This action joined the brown (for licensing of polluting activities), blue (for water resources management) and green (for the management of green areas) environmental agendas with the aim of having a single institution that brings a more holistic, comprehensive and complete approach to address the environmental problems of the State. ❖ Main competences (Art. 5) <ul style="list-style-type: none"> ○ Lead environmental licensing processes ○ Carry out the role of “environmental and water resources police”. ○ Issue regulation norms. ○ Edit water permits. ○ Charge for water use ○ Manage State Nature Conservation Units
LAW N° 5.234/08	<ul style="list-style-type: none"> ❖ Modifies Law 4.247/03, adding different providences.
<p style="text-align: center;">MANAGEMENT CONTRACT LAW N° 5.639/10</p>	<ul style="list-style-type: none"> ❖ Provides regulation for the management contracts between the manager and executor entity of the State Water Resources Policy and the executive secretariat with water agencies functions. ❖ Regulates the transference FUNRHI Resources.
<p style="text-align: center;">CREATION OF STATE WATER RESOURCES COUNCIL</p>	<ul style="list-style-type: none"> ❖ Creates the State Water Resources Council –CERHI-. Some functions are: <ul style="list-style-type: none"> ○ Promote the state planning articulation with the national, regional and user’s sector.
<p style="text-align: center;">DECREE N°27.208/00</p>	<ul style="list-style-type: none"> ○ Promote integration between the State Water Policy and other state regulations (e.g Environmental Policy)

LEGAL INSTRUMENT	MAIN ASPECTS
	<ul style="list-style-type: none"> ○ Establish criteria for the creation of Watershed Committees and a Water Agencies. ○ Approve constitution proposal of Watershed Committees. ○ Authorize the operation of Water Agencies. ○ Establish guidelines to elaborate Watershed Plans and follow up the State Water Resources Plan. ○ Mediate in existent conflicts in the Watershed Committees.
<p style="text-align: center;">CREATION OF STATE WATER RESOURCES FUND FUNDRHI DECREE N° 35.724/04</p>	<ul style="list-style-type: none"> ❖ Creates the regulation of art. 47 of the State Water Law, which authorizes the executive level to institute the State Water Resources Fund –FUNDRHI- ❖ The resources of the FUNDRHI mainly come from: <ul style="list-style-type: none"> ○ Revenues originated from the water charge (derivate from water use permits). ○ Collected fines (originated from specific actions toward water resources). ○ Other funds consigned in the national or state budget as well as credit resources. ○ Third parties' contributions, among others.
<p style="text-align: center;">DECREE N° 40.156/06</p>	<ul style="list-style-type: none"> ❖ Establishes the technical and administrative procedures to regulate superficial and groundwater uses. ❖ Establishes guidelines for integrated supervision actions for water sanitation services companies.

After the previous description of the most relevant laws and decrees, it is relevant to emphasize the importance of the watershed committees for the successful accomplishment of the different management instruments. In the recent years, INEA has been strengthening the structuring process of the watershed committees, by following up the integration of different stakeholders and encouraging the creation of water agencies in each hydrographic region.

According to the Water National Law, (cap. IV, section I) it is relevant to note, that *Water Basin Plans* are the main directive for the different actions and projects in

determinate watershed region. These should include a diagnosis about the basin (s) situation and level of conservation or degradation, as well as demographic facts and evolution of productive activities. An initial assessment should provide a balance between the water availability and future water demands. In order to accomplish this balance, the *classification of water bodies according to main uses* is mandatory. Some category examples are: public supply, recreation, flora and fauna preservation or agricultural activities. Each water body must be classified according to the water quality and general basin characteristic.

The *Water Basin Plans* should also provide the watershed priorities for water permits as well as the necessary criteria for water charging. As explained before, the water charging fees are the financial water resources collected from water users that have a state permit to use a certain amount of water. The FUNDRHI is the financial fund that collects the water charging resources for every water basin and should be executed by the watershed agency. It is important to differentiate water user from end customer. For example: A concessionary is a water user that takes the water from the basin according to a permitted amount and pays the water charge/tariff. The concessionary is also a public services entity and reaches financial sustainability through the water bill revenues from end customers. In *Figure 9* it is possible to see the different water management instruments and the interactions between different levels.

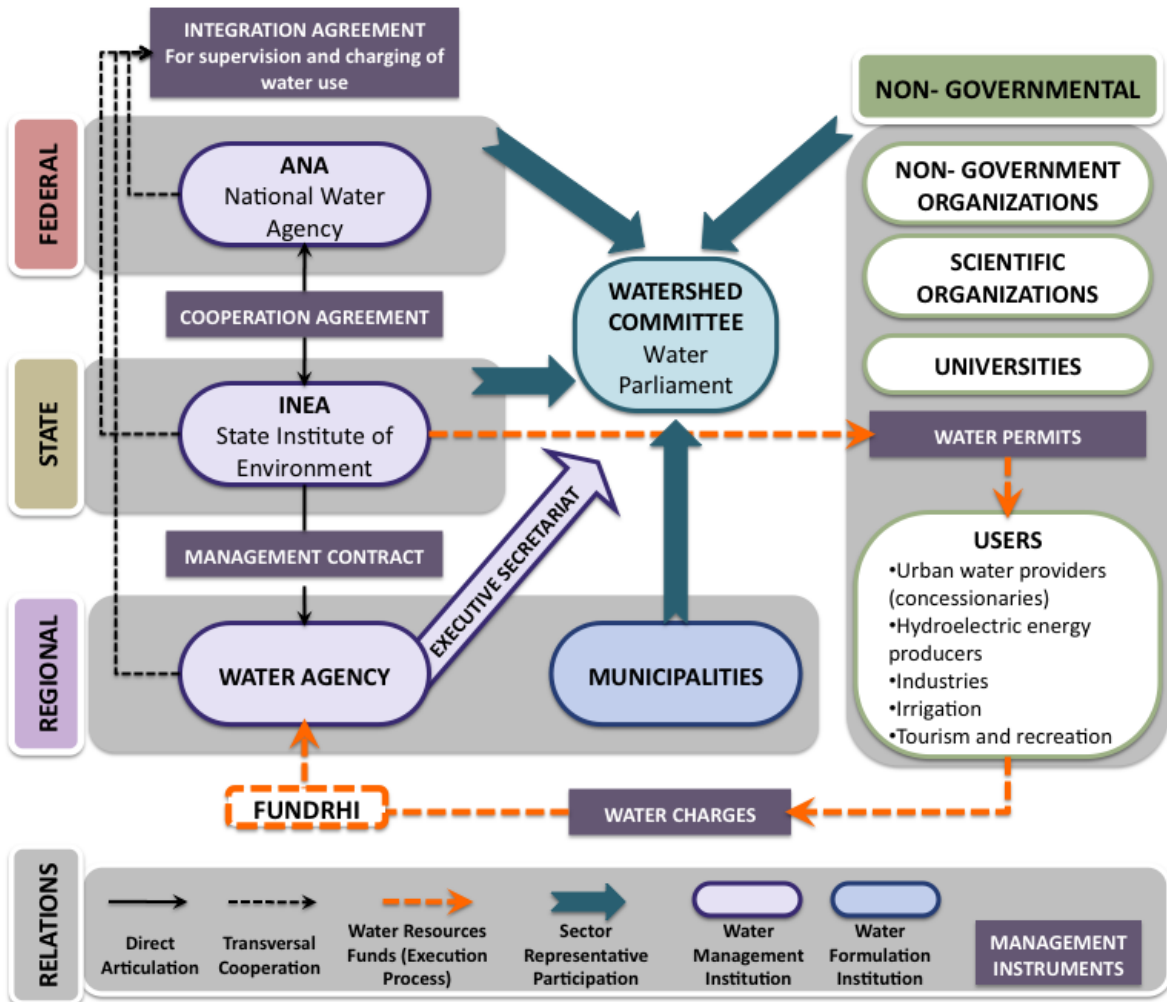


Figure 9 - Management Instruments

(Free authors conception, based on the legal framework)

4 Study area: Selected Water Basins of Rio de Janeiro

In order to apply the methodology of this research, there were selected three different watershed regions in Rio de Janeiro State: Guapi-Macacu (sub basin of the Guanabara Bay hydrographic region), Guandu and Lagos São João. The Guanabara Bay region is the one, which probably presents more diverse and complex environmental problems. As the metropolitan region and the bay itself is not the focus of this research, there was selected a sub basin in the northeastern part of the region (Guapi-Macacu) which has strategic importance for the eastern part of the bay – *Figure 10*. The selected watersheds have a considerable importance for the dynamics of the regions and for a better understanding of the gap between rural and urban areas and socioeconomic concerns in the area.

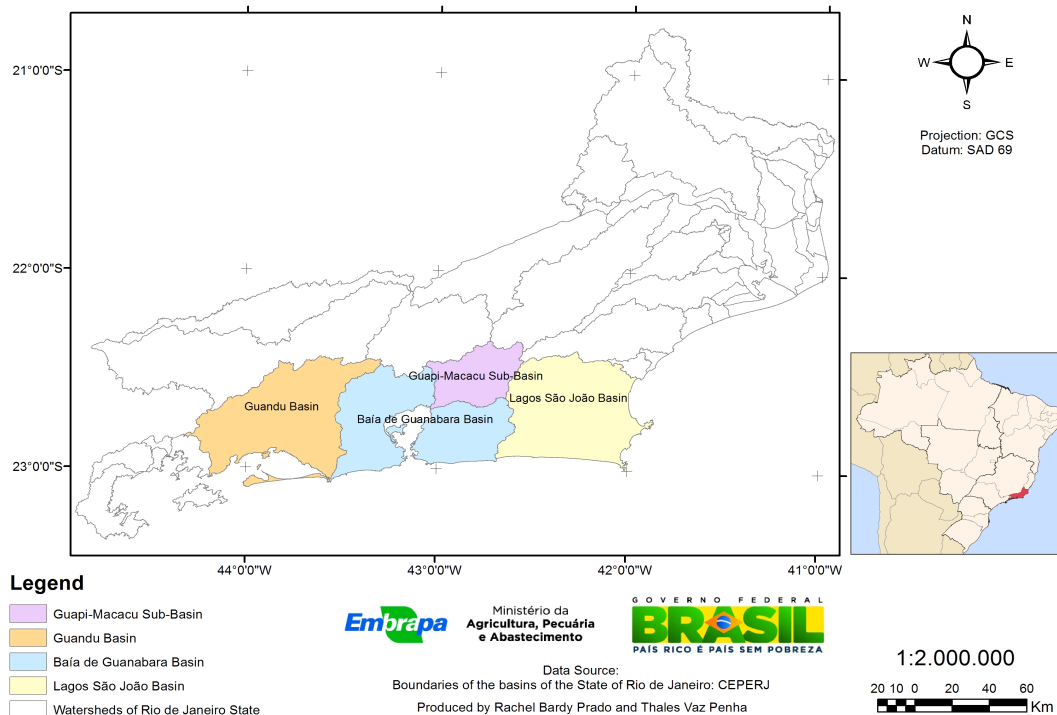


Figure 10 - Selected basins for Water Governance Assessment

4.1 Selected basins: Location and general overview

4.1.1 Guapi-Macacu (sub basin of the Guanabara Bay Hydrographic region)

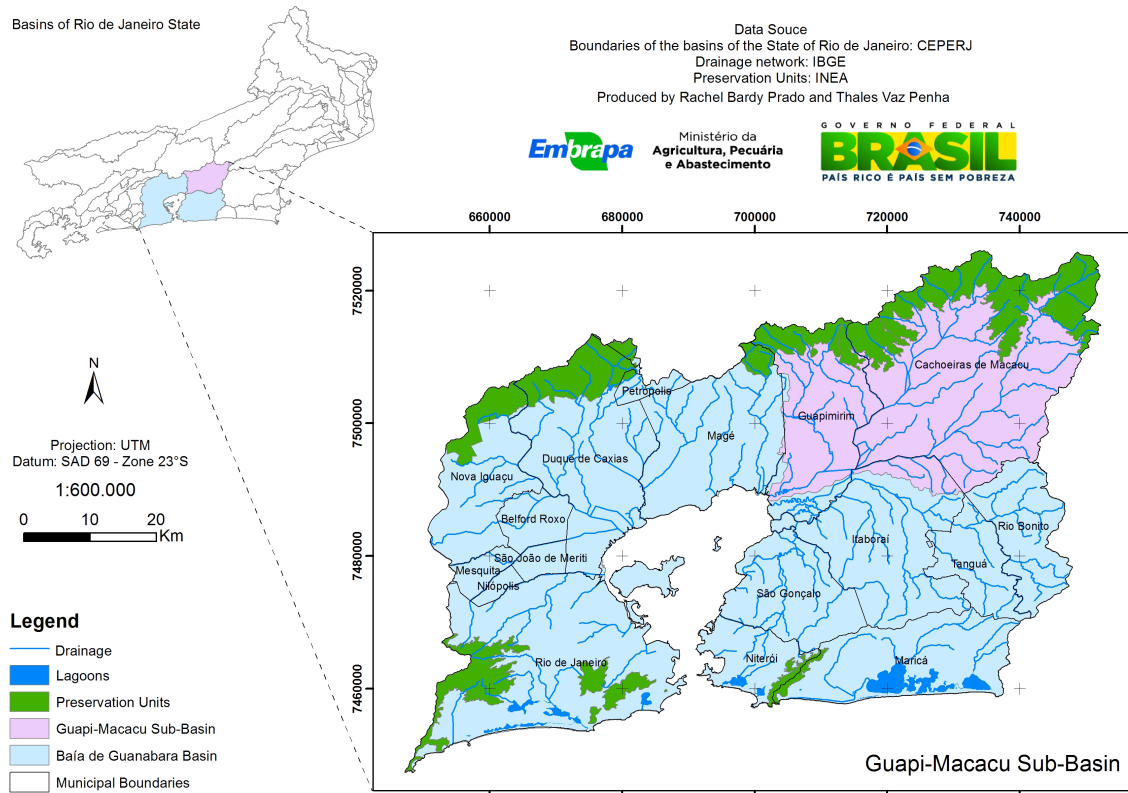


Figure 11 - Guapi-Macacu Sub-Basin

The Guapi- Macacu is a sub basin located in the northeastern part of the Guanabara Bay basin complex. The territories of this catchment have an extension of 1.263 km² and a drainage area of 1.640 km². It limits in the north and northwest with the Serra dos Orgãos; in the northeast with the Serra de Macae de Cima; in the east with the Serranas of Botija and and Monte Azul and in the south with the Serras of Sambe and Garcias. The source of the Macacu River is located in the mountainous range Serra dos Orgãos at an altitude of 1700 m.a.s.l and goes through a distance of 74 km before it joins the Guapiaçu River. Due to this joint the basin receives its name and its waters feed the Imunana Channel that was

built in 1954 and changed the course of the Macacu River. The channel conducts the waters of the Guapi-Macacu River to the Guapimirim River. The water that is collected in this channel is treated in the ETA (treatment plant) of Laranjal with a flow over 500 l/s. This system is called Imunana-Laranjal and supplies water to Niteroi, São Gonçalo, Itaboraí and the Paquetá Island. The CEDAE and the subsidiary Aguas de Niteroi provide the treatment and distribution. The Imunana channel receives a water flow that represents approximately 1/4 of the entire contributing area to the Guanabara Bay, and therefore the most important source of the region in water quantity (Dantas, Almeida, & Lins, 2007). The municipality of Cachoeiras de Macacu has 90% of its territory in this basin; Guapimirim has 95% and Itaboraí 12%.

The basin provides water for approximately 2,5 Million habitants and is also determinant for other purposes such irrigation and industrial uses. It is important to understand the strategic relevance of this area for water supply in the downstream municipalities. Several years ago, important cities like Niteroi or São Gonçalo suffered water scarcity problems and they currently depend on the water supply of the Guapi-Macacu watershed.

In recent years, there are significant economic development factors that have put the eastern region of the Guanabara Bay in the middle of the scope, particularly since the announcement in 2006 of the installation of Petrobras' megaproject COMPERJ. The petrochemical complex is the biggest investment of its kind in Brazil (US\$ 8,4 billions) and consists on the establishment of a first-generation petrochemical refinery (Basic Petrochemical Unit) and an integrated second-generation group of production units (Associated Petrochemical Unit). The refinery will be able to process 150.000 barrels²⁵ of heavy petroleum per day (Petrobras, 2009) as well as high added-value sub-products such as raw material for PET plastic bottles²⁶. The envisaged industrial growth near the

²⁵ These are extracted in the Campos Basin (Marlim field) and will produce ethylene, benzene, p-xylene, e propane. Some 40% of the refinery production will be commercialized at first hand, including to the overseas market. (Sistema FIRJAN, 2012)

²⁶ According to FIRJAN there is planned to transform part of the petrochemical raw materials into thermoplastic resins. The principal thermoplastic resins to be produced will be polypropylene (850,000 tons/year), polyethylene (800,000 tons/year), polyethylene terephthalate (800,000 tons/year). Businesses that may be attracted cover a wide range, notably including industries that will consume the thermoplastic resins, intermediary consumer industries for plastic materials, support industries for COMPERJ, downstream industries within the productive chain and finally those activities associated with the income-effect (salaries, profits, tax revenues etc.) generated by the aforementioned industries. (Sistema FIRJAN, 2012). This activities will considerably increase the water resources demand and increase the environmental pressures due to the characteristics of the water discharges in and unexistent sanitation system. This could be one clear example of the contradictions of the sustainable economic growth.

COMPERJ is not restricted to plastic production²⁷ but extends to all civil works related to the building and operation phases and the expansion of the third sector -consuming goods and services-. The complex is located in the northern side of Itaboraí limiting directly with the municipalities of Guapimirim and Cachoeiras de Macacu. The COMPERJ operations should begin 2012; its economic impact could reach up to 23 municipalities and by the start-up in 2015 generate annual revenues of US\$7,2 billions. (Sistema FIRJAN, 2012).

Other important infrastructure projects confirm a clear economic boom in this area. On the first hand, the Guapiaçu Dam project that will be located directly in the Guapi-Macacu to supply municipalities from this watershed, others surrounding the area and COMPERJ operation. Its construction has been recently approved through the collective agreement between INEA, SEA and Petrobras and will be financed by the petrochemical company (US\$210 Million)(Governo do Rio de Janeiro, 2012). The authorities argued that the dam is necessary to guarantee the constant water supply in coming years. The Inmunana-Laranjal is actually reaching its limit operation and minimum flow levels have been reached in dry seasons. Nevertheless, this project has generated great debate and social mobilization among local population that will be affected because more than 400 families will be dismantled and 28 kilometers of productive lands will be reclaimed to farmers in the region (Botelho, 2009). On the second hand, the Metropolitan Road Ring System, which will surround the metropolitan region and connect various municipalities from the harbor of Itagüi (Steel Production Axis) with other production axes like the COMPERJ region. Other related project is the Maricá Harbour, which will be the entrance point for this part of the bay.

In this watershed the riparian zones are considered an environmental protection area²⁸ –EPA- (APA in Portuguese) thanks to the efforts of different institutions in

²⁷ According to the environmental impact assessment (RIMA) from Petrobras, the COMPERJ will attract approximately 720 plastic industries and generate more than 200.000 work places.

²⁸ In Brazil, the areas as parks and environmental reserves receive the official name of *Conservation Units* according to what is established in the National Law 9.985/2000. This are created to protect the ecosystems, the biodiversity and the natural resources such as water and soils. There are two kinds of conservation units: 1) Integral Protection: allows the indirect use of its natural resources, that means everything that does not involve consume, collection, damage or destruction of the natural resources. It is not permitted to live in these areas (e.g. ecologic Station, biologic reserve, national/state/municipal parks, natural monuments, wild life refuge). 2) Sustainable use: allows that people live among these areas as long as they use the natural resources in a sustainable way. Several rules must be followed in order to guarantee the protection and conservation of theses areas (e.g. environmental protection area (APA), relevant ecologic interest area, rainforest (national/state/municipal), fauna reserve, sustainable development reserve, and particular reserve of natural

preserving the rainforest region. Macacu APA includes all the territories that are located next to the banks of all water bodies (rivers, lakes, springs) in this basin and was established in order to spread good soil and water management practices among the population and prevent further bad practices in the region. In the rivers Macacu and Guapiaçu, there is a 150 meters protected area in both sides, through their whole longitude (from headwater until the river mouth in the Guanabara Bay) (Viana, Zini Antunes, and Copello, 2011).

4.1.2 Guandu

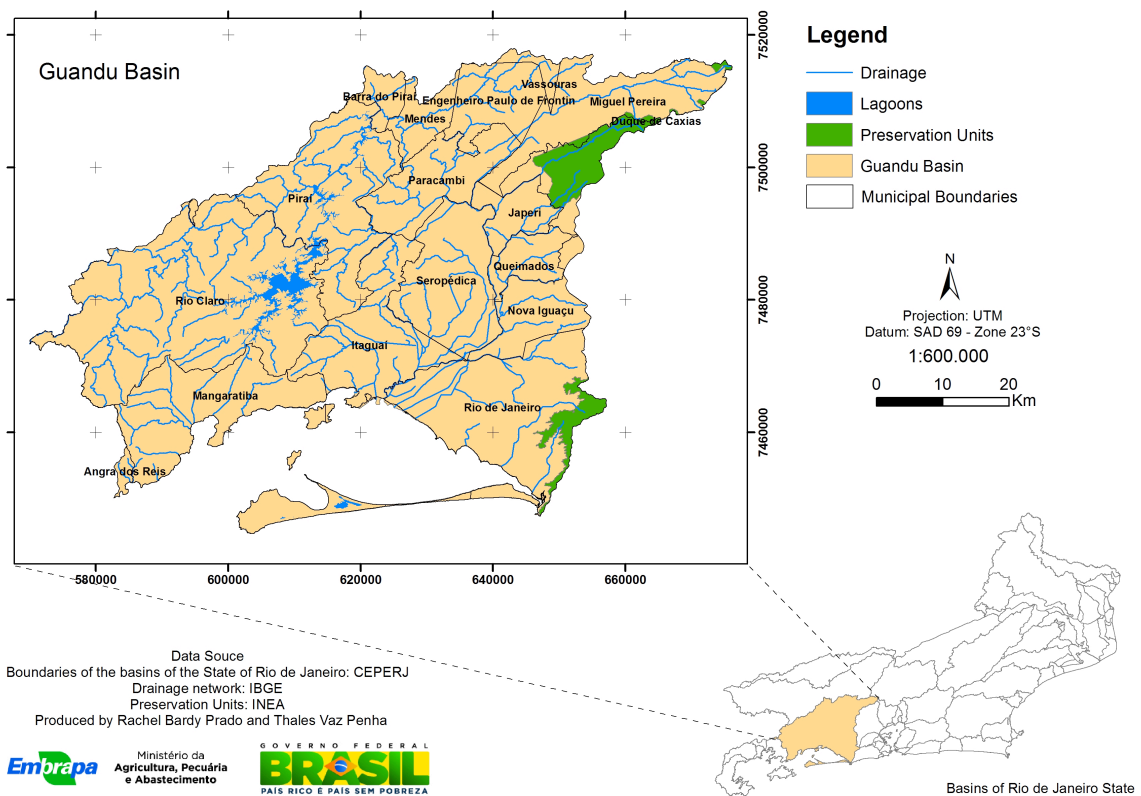
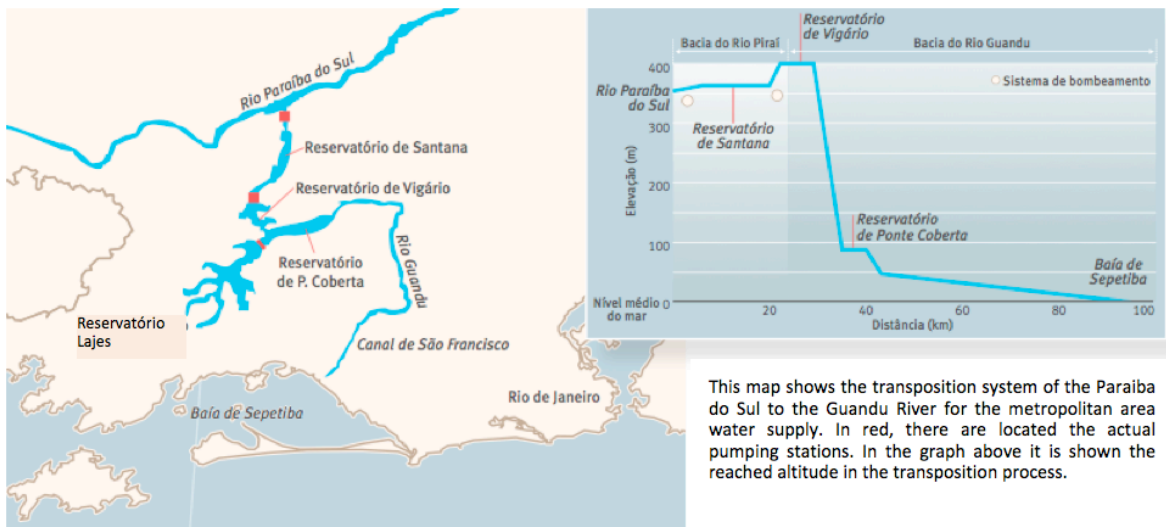


Figure 12 - Guandu Basin

The Guandu watershed is located in an area that encompasses the territories next to the Paraíba do Sul river by the north side and the metropolitan area of Rio de Janeiro by the southern part. The Paraíba do Sul forms a hydrographic region itself and constitutes one of the most important rivers of the Southeastern Atlantic region²⁹(CEIVAP, 2011). Indeed, this river is closely related to the Guandu region because of the water resources transposition from the Paraíba do Sul River (up to 160m³/s) to the Guandu River to cover the metropolitan water demands of the city of Rio de Janeiro. This resources were initially diverted for energy production before 1940 by the energy concessionary LIGHT, through the transposition of Serra do Mar of Paraíba do Sul River and collecting in Santa Cecilia (Lameira et al., 2010). The Guandu River was the channel used by the LIGHT, when the Paraíba-Vigário complex was built -including Santa Cecilia and Vigario pumping stations and its reservoirs- *Figure 8* (Mussi Molisani, Lacerda, & Kjerfve, 2007).



**Figure 13 - Paraiba do Sul - Guandu Transposition System
(Mussi Molisani et al., 2007).**

²⁹ The southeastern Atlantic region constitutes the most important economic and industrial pole in Brazil. The Paraíba do Sul River goes through the States of São Paulo, Rio de Janeiro and Minas Gerais and supplies water for approximately 14 million people. The total drainage area is 62.074 km² and includes 184 municipalities: 39 from São Paulo, 57 from Rio de Janeiro and 88 from Minas Gerais.

As the demand of the city rapidly increased, the planning process for water supply began around 1950 taking approach of this complex but also of the water supply network that was gradually built in the region. The Lajes Subsystem (Lajes Reservoir and Fontes Nova hydroelectric plant) constitutes today a strategic water supply reserve for the metropolitan region. These preliminary facts are determinant to understand the strategic importance of this hydrographic region.

With an area of 1.385 km², it is formed among others by the rivers Guarda and Guandu Mirim, which represent almost 70% of the basin area. The basin has been affected by several anthropic interventions such as river rectification due to the infrastructure works (hydroelectric and pumping stations, sanitation networks) (Lameira et al., 2010). Intensive agricultural have also contributed to the degradation of riparian forests near the water bodies. Due to the importance of the ecosystem preservation and natural vegetation regeneration for water sustainability, the federal authorities established already in 1965 -Brazilian Rainforest Code-, that this region should be recognized and protected as a Permanent Preservation Area. (Salamene, Francelino, Valcarcel, Lani, & Sá, 2011)

The relevance of the metropolitan area of Rio de Janeiro has increased its resources demand and this situation is not only affecting the urban area but other neighbor watersheds in the state, which are “water suppliers” for downstream regions. All the surrounding region of the Guanabara Bay has become the focus for state policies and municipal efforts to satisfy these demands.

4.1.3 Lagos São João

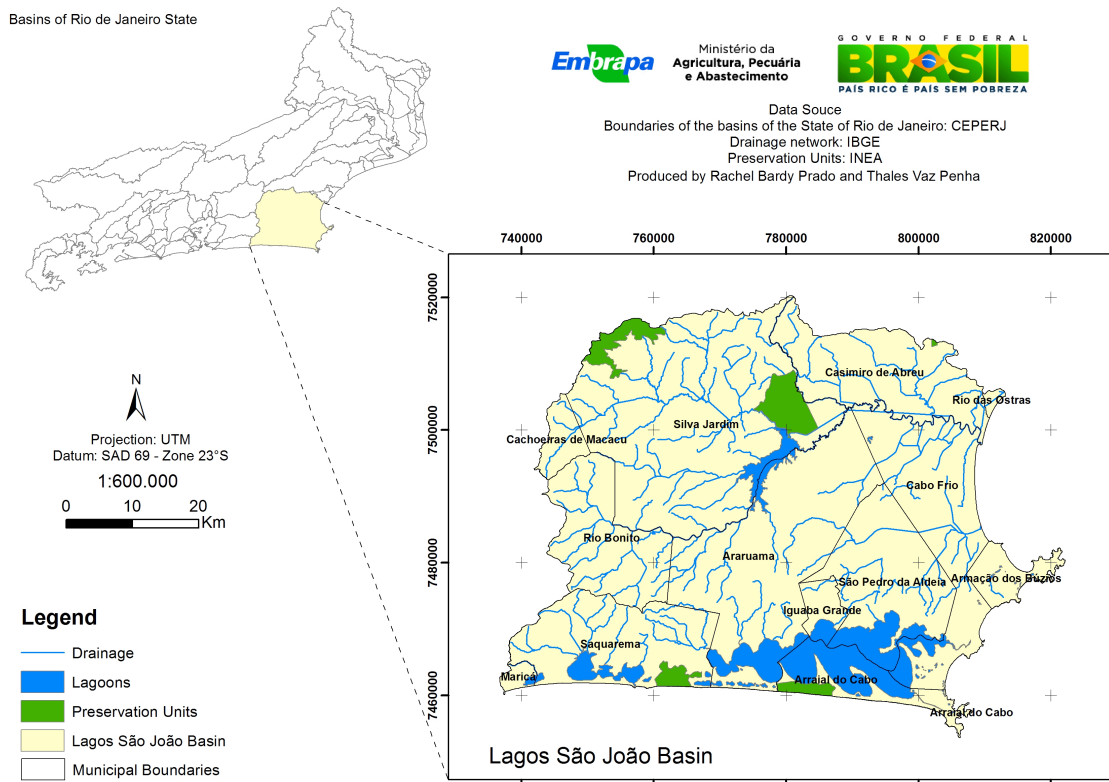


Figure 14 - Lagos São João Basin

The Lagos São João hydrographic region is located in the southeastern part of Rio de Janeiro State, limiting in the north with Macae basin, in the northeast with the Imboassica lagoon, at the northwest and west with the Guanabara Bay basin, in the southeast with the Maricá lagoon basin and in the south and east with the Atlantic Ocean. This region known as the Lagos Region, well-known touristic region in Brazil, includes several important water bodies that reach an area of 3.825 km², which corresponds to approximately 8% of the Rio de Janeiro state territories. The most important lagoon is the Araruama (220 km²) which is the largest hypersaline coastal lagoon in permanent state in

the world, followed by the Saquarema (24 km²), Jaconé (4 km²) and Vermelha (2,5km²) (Consórcio Intermunicipal Lagos São João, 2012).

The São João river is the main water source for human consume in the region and the second in importance in the whole state (Völcker, 2007). The water spring is located in the Serra do Sambê in the municipality of Cachoerias de Macacu, going through Silva Jardim to be stored in the Juturnaiba Reservoir (up to 10 Mio m³). This river has suffered several anthropic interventions that have significantly affected the natural ecosystems and aquatic populations.

During the 70's, the Juturnaiba Reservoir (before it was a lagoon) was built in order to guarantee water availability for the agricultural projects that were envisaged. The areas were under great pressure caused by the massive deforestation for coal production purposes, extensive pasture plantations and civil works (roads, drainage canals). These interventions were attractive for experienced rice farmers from Rio Grande do Sul who settled in the area during the 80's, leasing big terrains and benefiting from the large expanse of plains and drainage canals for irrigation of rice. The uncontrolled use of pesticides in agriculture changed the components of the soil, which leached by rain into the São João River and caused fish kills. The saline wedge as well as the actual process of irrigation provided the concentration of salts in the poor soils, rich in sulfur and not suitable for rice production (Völcker, 2007).

Although the agro-industrial rice project failed, the environmental consequences of the rectification³⁰ of São João River were disastrous: the river length was reduced and the riverbed got deeper and wider in order that the waters were directed downstream in the shortest path and with the greatest possible speed. The riparian forests partially disappeared and wetlands affected the marginal rivers, removing important breeding and feeding areas for fish. After several years the ecosystems have been gradually restored but the efforts continue to preserve this watershed region. In fact, since 2002 it is recognized as the São João-Mico Leão Dourado Environmental Protection Area.(Bidegain & Völcker, 2003)

³⁰ According to Bidegain and Völcker, this rectification was done under the worldwide trend based on the dogma of "reorganization or recovery of lands". The works were carried out by the extinted National Department of Civil Works and Sanitation (DNOS) in 1974. In personal interview with Claudio Völcker it was possible to understand the devastating consequences in the fishing activity of local population.

It is important to note that this region attends the demands of a fixed population of approximately 520.000 people but must meet a higher performance for a non-fixed population (1,2 Million) during high seasons and holidays. The historical evidence of the participatory processes and the consolidation of efficient watershed institutions are closely related to environmental pressures that were related to the Araruama lagoon and to inefficient water supply and sanitation services. Today, the region is supplied by two private concessionaries: Aguas de Juturnaiba (part of Aguas do Brasil group) and Prolagos.

4.2 Biophysical environment

4.2.1 Climate

Guapi-Macacu:

The climate of this region is classified as humid warm tropical with an average temperature of 18°C during almost all year. The region between the Bay and mountainous region of Serra dos Orgãos presents high precipitation (150mm in average) due to evaporation and rapid formation of clouds (Petrobras, 2009).

Guandu:

The watershed region presents a humid tropical climate, with annual average temperatures ranging from 20°C and 27°C and high precipitation levels during mostly all year (1000mm-2300mm annual average). The higher temperatures and rainfall levels are higher in the plains and the slopes of the Serra do Mar. In the dividers and the reverse of it (Lajes reservoir region, the municipalities of Rio Claro and Piraí) the temperatures fall and dry periods become larger. The natural vegetation of the region encompassed by the basins of Guandu, the Guandu Mirim and Guarda consists on a dense rain forest vegetation and mangroves which are remnant of Atlantic Forest biome (Comitê de Bacia Hidrográfica dos Rios Guandu da Guarda e Guandu-Mirim, 2010).

Lagoas São João:

The region presents a high climatic diversity varying between tropical and semiarid. The precipitations are very heterogeneous due to changes of air masses that hover over the area throughout the year as well as varied relief and diverse marine upwelling that

occurs on the shores of Cabo Frio and Arraial do Cabo. During the summer the predominant Equatorial Continental air mass, while the rest of the year the prevailing is the Tropical Atlantic air mass. Cold fronts (Polar Atlantic Fronts) often pass through the region especially during the spring. (Pereira & Primo, 2005)

4.2.2 Hydrology and water uses

Guapi-Macacu:

After the Guapiaçu river joins the Macacu river, it connects with the Guapimirim to flow into the Guanabara Bay (under the name of Guapi-Macacu). The principal tributaries of the Macacu river by the left side are rivers: São Joaquim, Bela Vista, Bengala, Soarinho, das Pedras, Pontilhão e Alto Jacu; by the right side are rivers Duas Barras, Cassiano e Guapiaçu. Before reaching the Guanabara Bay, Macacu River received in the past the waters from Caceribu River. Nowadays, after the construction of the Imunana-Laranjal Channel, the Caceribu flows independently to the Bay. As explained before, the main uses are for human water supply, irrigation for agriculture (main crops: maize, yam, manioc and fruit trees such as guava and banana), and for livestock production (Fidalgo, Pedreira, Abreu, Barroso de Moura, & Godoy, 2008). The industrial consume will considerably increase in the coming years.

Guandu:

The water bodies belonging to this hydrographic region are mainly the rivers Guandu, Guarda and Guandu-Mirim together with its tributaries. It includes the water springs of the Riberião das Lajes, the transposed waters from Paraíba do Sul River and Piraí, the tributaries of the Riberião das Lajes and the San Francisco Channels until the river mouth in the Sepetiba Bay. The predominant uses in this region are for water supply (85% of its daily demand) and for energy production (25% of its daily demand) in the metropolitan region as well as for industrial use (mainly metallurgic companies).

Lagoas São João:

This region is subdivided in five defined sub-basins: Saquarema, Jaconé and Jacarepiá Lagoons and the reefs between the lagoons and the sea; Araruama lagoons, the geographical feature of Cabo Frio and the Massambaba reefs; Una river and Cabo de Búzios; São Joao river its tributaries and Juturnaiba reservoir; river of das Ostras and the

microbasins of Iriri, Salgada, Itapebussus Lagoons. The main uses of the water bodies are: water supply for the population and small industries, irrigation, fishing, mining and salt production (Pereira & Primo, 2005). The touristic sector is the most dynamic and therefore, the different lagoons and rivers are place for recreational and leisure activities such as aquatic sports.

4.2.3 Vegetation and land uses

Guapi-Macacu:

In the areas of this watershed, predominate the grazing areas, followed by natural vegetation in an advanced stage of regeneration (dense forest), occupying respectively 43.6% and 42.4% of its total area. The mangrove is concentrated at the mouth of the river Macacu at the confluence of the river basin Macacu to Guanabara Bay, constituting Permanent Preservation Area (APP) and is included in the Area of Environmental Protection and Ecological Station Guapimirim Guanabara. The agricultural production areas are concentrated along major roads and rivers and in accessible places (Pedreira, Fidalgo, & Abreu, 2009).

Guandu:

In the past, the region presented an intense and disorganized agricultural occupation, which contributed to an advanced environmental degradation. According to Salamene *et. al* (2011), a recent study related to Guandu's region land use, shows that the Permanent Preservation Area of this basin (934, 4 ha) presents the following characteristics: native vegetation 13,3% from which just 7,2% corresponds to native rainforest in advanced state of ecologic succession; anthropic land use (agriculture, livestock, exposed soil, urban-industrial) correspond to 75%, being livestock production the most representative 38,3%, followed by urban-industrial occupation with 15,2%; the cultivated plains correspond to 11% of the area, being mostly invasive species.

Lagoas São João:

The vegetation of this region is distributed in mosaic form and the different types of forests are distributed on slopes and depending on the soil depth and orientation of the slopes (east, west). This is a consequence of massive forest cut down in the 70's due to the coal sector boost. The remaining native vegetation belongs to the Atlantic Rainforest

ecosystem. The land use in this group of basins is characterized by the presence of human settlements (cities, towns and villages), agricultural areas and pastures and remnants of different types of native vegetation, including high altitude grasslands, forests, marshes, flooded fields, pastures and sandbanks. The main agricultural activities correspond to livestock, fish breeding, aviculture and horse raising. The main crops are citric fruits, sugar cane and rice (Comitê de Bacia Hidrográfica de Lagos São João, 2012).

4.3 Socioeconomic aspects

4.3.1 Demographic facts

Guapi-Macacu:

The Guapi-Macacu sub water basin represents one of the most important water catchments located near the Guanabara Bay. Together with the Caceribú water basin, it supplies water for more than 2,5 million habitants in the Rio de Janeiro State (Hwa & Hora, 2009). The water basin mainly supplies water for the municipalities of São Gonçalo, Niteroi (and part of the Paquetá Island), Itaboraí, Cachoeiras de Macacú, Guapimirim and Rio Bonito. The population density of the municipalities where the basin is located (Cachoeiras de Macacu, Guapimirim) is considerably lower than the benefited population downstream (São Gonçalo, Niteroi, Itaboraí). *Table 6.*

Table 7 - Municipalities in the Eastern Guanabara Bay Region (Guapi-Macacu)

MUNICIPALITIES		POPULATION					HDI
NAME	WATERSHED COMMITTEE	URBAN	%	RURAL	%	TOTAL	2000
	T= Total member P= Partial member	Source: IBGE, Censo Demográfico 2010 http://www.censo2010.ibge.gov.br/painel/					Source: IDH,2000
São Gonçalo	T	998.999	100	0	0	998.999	0,782
Niteroi	T	487.562	100	0	0	487.562	0,886
Itaboraí	T	215.412	98,8	2.596	1,19	218.008	0,737
Guapimirim	T	49.746	96,6	1.737	3,37	51.483	0,739
Cachoeiras de Macacu	T	46.944	86,5	7.329	13,5	54.273	0,752
Rio Bonito	P	41.259	74,3	14.292	25,7	55.551	0,772
TOTAL	6	1.839.922	92,7	25.954	7,3	1.865.876	0,778

Most of the population is concentrated in urban centers, except in Rio Bonito, where still 25% of the population lives in rural areas. All municipalities in this basin are part of the watershed committee of the hydrographic region of the Guanabara Bay (eastern part). One of the main characteristics of the basin area (1.256 km²) is that it still has an important and preserved area of the Atlantic rain forest that remains in the whole State. Due to this fact, the water quality is still good but the sanitation infrastructure is almost inexistent. This will be discussed in the next section. Regarding to the Human Development Index –HDI³¹- the only city that presents an outstanding level of development is Niteroi, score that elevates the general average.

Guandu:

The Guandu watershed is the most significant water source for the metropolitan region of Rio de Janeiro. From the three selected regions this is the most densely populated. In *Table 7* it is possible to identify the most important urban centers that are supplied: Rio de Janeiro, Nova Iguaçu, Queimados and Itaguaí concentrate more than 7 million people. There is a very low percentage of rural population (0,86%) in this area. There is an average HDI of 0,76 being Rio de Janeiro the best positioned in all the basin with 0,84 and Japeri the worst with 0,72.

³¹ There is no more recent data different than the HDI that was published for each municipality in Brazil in 2000. The HDI is a way of measuring development levels by combining indicators of life expectancy, educational attainment and income. It references both: social and economic development. sets a minimum and a maximum for each dimension, called goalposts, and then shows where each country stands in relation to these goalposts, expressed as a value between 0 and 1. To have a reference HDI 2011: the highest HDI in the world is Norway with 0,943. Until 0,79 it is considered “very high” (UNDP, 2012)

Table 8 -Municipalities in the Guandu water basin

MUNICIPALITIES		POPULATION					HDI
NAME	WATERSHED COMMITTEE	URBAN	%	RURAL	%	TOTAL	2000
	T= Total member P= Partial member	Source: IBGE, Censo Demográfico 2010 http://www.censo2010.ibge.gov.br/painel/					Source: IDH,2000
Rio de Janeiro	P	6.320.446	100	0	0	6.320.446	0,842
Nova Iguaçu	P	747.563	98,9	8.694	1,15	756.257	0,762
Queimados	T	137.962	100	0	0	137.962	0,732
Itaguaí	T	104.209	95,5	4.882	4,48	109.091	0,768
Japeri	T	95.492	100	0	0	95.492	0,724
Barra do Pirai	P	91.957	97	2.821	2,98	94.778	0,781
Seropédica	T	64.285	82,2	13.901	17,8	78.186	0,759
Paracambi	T	41.722	88,5	5.402	11,5	47.124	0,771
Mangaratiba	T	32.120	88,1	4.336	11,9	36.456	0,79
Vassouras	P	23.199	67,4	11.211	32,6	34.410	0,781
Pirai	P	20.836	79,2	5.478	20,8	26.314	0,776
Miguel Pereira	P	21.501	87,3	3.141	12,8	24.642	0,777
Mendes	P	17.701	98,7	234	1,3	17.935	0,775
Rio Claro	P	13.769	79	3.656	21	17.425	0,737
Engenheiro Paulo de Frontin	T	9.523	71,9	3.714	28,1	13.237	0,753
TOTAL	15	7.742.285	89	67.470	166	7.809.755	0,769

Lagoas São João:

The most populated municipality is Cabo Frio, with 140.486 inhabitants in the urban center and 45.741 in the rural side. This is the highest rural population of all other municipalities in the watershed region. Maricá, Araruama, São Pedro da Aldeia and Saquarema are also important municipalities, which concentrate more than 500.000 habitants (*Table 8*). From the selected regions this is the one that has less population living in the area. Nevertheless, the significant supply demands come from non-fixed population (tourists) during high seasons and holidays.

Table 9 -Municipalities in the Lagos São João water basin

MUNICIPALITIES		POPULATION					HDI
NAME	WATERSHED COMMITTEE	URBAN	%	RURAL	%	TOTAL	2000
	T= Total member P= Partial member	Source: IBGE, Censo Demográfico 2010 http://www.censo2010.ibge.gov.br/painel/					Source: IDH,2000
Cabo Frio	T	140.486	75,4	45.741	24,6	186.227	0,792
Maricá	P	125.491	98,5	1.970	1,55	127.461	0,786
Araruama	T	106.486	95,1	5.522	4,93	112.008	0,756
São Pedro da Aldeia	T	82.148	93,5	5.727	6,52	87.875	0,78
Saquarema	T	70.456	94,9	3.778	5,09	74.234	0,762
Rio Bonito	P	41.259	74,3	14.292	25,7	55.551	0,772
Cachoeiras de Macacu	P	46.944	86,5	7.329	13,5	54.273	0,752
Casimiro de Abreu	P	28.521	80,7	6.826	19,3	35.347	0,781
Arraial do Cabo	T	27.715	100	0	0,00	27.715	0,79
Armação de Búzios	T	27.560	100	0	0,00	27.560	0,791
Iguaba Grande	T	22.851	100	0	0,00	22.851	0,796
Silva Jardim	T	16.121	75,5	5.228	24,5	21.349	0,731
TOTAL	12	736.038	89,5	96.413	10,5	832.451	0,774

4.3.2 Infrastructure: water supply and sanitation

Guapi-Macacu:

In this region the water supply is “ensured” thanks to the high resources demand that come from the mountainous region of Serra dos Orgãos. There is a general perception of water abundance and generally low awareness from the population about the costs or treatment practices. This may lie on the fact that in some municipalities there is a fixed water tariff with no control about individual consumption. The water quality is good and meets the standards of the legislation. From the official statistics (*Table 4*), just 65% of the population receives water from the general network, 27% counts of an own well or water source, 7,9% has other sources—not specified- for of supply and only 0,1% stores rain water.

Table 10 - Water Supply in the municipalities of the Eastern Guanabara Bay Region

MUNICIPALITIES	WATER SUPPLY									
NAME	NUMBER OF HOUSEHOLDS	General Network connection	%	Well or spring on the property	%	Rain stored in tanks	%	Other water supply form	%	
Source: IBGE, Censo Demográfico 2010 http://www.censo2010.ibge.gov.br/painel/										
São Gonçalo	324.325	259.672	80,07	42.960	13,25	595	0,18	22.655	6,99	
Niteroi	168.390	164.786	97,86	2.859	1,70	98	0,06	1.512	0,90	
Itaboraí	69.062	18.750	27,15	43.330	62,74	64	0,09	7.278	10,54	
Guapimirim	15.694	8.768	55,87	5.354	34,11	7	0,04	1.612	10,27	
Cachoeiras de Macacu	17.808	13.310	74,74	2.523	14,17	0	0,00	2.005	11,26	
Rio Bonito	17.070	9.571	56,07	6.323	37,04	7	0,04	1.270	7,44	
TOTAL	612.349	474.857	65,29	103.349	27,17	771	0,14	36.332	7,90	

Regarding the sanitation services, the official data is very poor. Thanks to other sources of information (research interviews) it was possible to establish that although most of the population has sewage on its property, the wastewaters are normally conducted to the rivers without appropriated treatment. This is one of the main causes that contribute to the critical environmental and public health situation that faces the Guanabara Bay, which receives the polluted waters from different origins. The sanitation issues in this watershed (and in Brazil) are still the main challenge for the authorities and the communities. In municipality of Cachoeiras de Macacu, there are some projects related to the construction of a wastewater treatment plant and two monitoring stations (up to 22 US\$ Mio)³² in the urban center and districts. These investments will be a partnership between the state Government and the municipality and will mainly benefit the urban population. In municipalities like Itaboraí and Maricá, there are similar envisaged projects for the construction of sewage networks that are being sponsored by the COMPERJ.

³² Personal Interview, Municipality of Cachoeiras de Macacu.

Guandu:

According to data provided in *Table 10*, the water supply in this region is also good: 74% of the population is connected to the general network, 18% has a water source in its property and 8% has other form of water supply. The infrastructure is relatively good and the public company CEDAE is in charge of the water treatment in the region. Indeed, the Water Treatment Station ETA Guandu is in charge of supplying treated water for Rio de Janeiro, Nova Iguaçu, Itagüai, Queimados, Belford Roxo, Duque das Caixas, Nilópolis, São João de Meriti (the last four are not part of the Guandu hydrographic region). The ETA Guandu is the largest water treatment plant³³ in the world. It can treat 43m³ of water per second in a continuous operation according to the Guinness Records. The CEDAE is currently working in a project, which will go beyond their own record, increasing their capacity in 30% of the current operation (Nova CEDAE, 2012). One particular fact about the CEDAE is related to the ETE Alegría, a wastewater treatment plant that will supply the

³³ Conventional water treatment process: chemical coagulation, flocculation, sedimentation, filtration, disinfection, and PH correction.

MUNICIPALITIES		WATER SUPPLY							
NAME	NUMBER OF HOUSEHOLDS	General Network connection	%	Well or spring on the property	%	Rain stored in tanks	%	Other water supply form	%
Source: IBGE, Censo Demográfico 2010 http://www.censo2010.ibge.gov.br/painel/									
Rio de Janeiro	2.122.342	2.111.537	99,49	12.258	0,58	374	0,02	20.276	0,96
Nova Iguaçu	246.820	189.281	76,69	50.339	20,40	84	0,03	8.482	3,44
Queimados	42.162	34.831	82,61	6.521	15,47	14	0,03	843	2,00
Itaguaí	33.780	27.524	81,48	4.875	14,43	30	0,09	1.481	4,38
Japeri	28.332	23.640	83,44	3.548	12,52	28	0,10	1.193	4,21
Barra do Pirai	30.676	23.747	77,41	5.739	18,71	4	0,01	1.268	4,13
Seropédica	24.225	22.741	93,87	1.204	4,97	0	0,00	310	1,28
Paracambi	15.228	10.372	68,11	3.239	21,27	3	0,02	1.635	10,74
Mangaratiba	11.626	6.746	58,03	789	6,79	3	0,03	4.250	36,56
Vassouras	11.035	8.705	78,89	1.789	16,21	6	0,05	549	4,98
Pirai	7.930	6.543	82,51	1.114	14,05	2	0,03	289	3,64
Miguel Pereira	8.319	4.665	56,08	2.861	34,39	0	0,00	798	9,59
Mendes	6.161	3.902	63,33	1.864	30,25	0	0,00	400	6,49
Rio Claro	5.497	3.577	65,07	939	17,08	0	0,00	981	17,85
Engenheiro Paulo de Frontin	4.393	1.855	42,23	2.052	46,71	0	0,00	487	11,09
TOTAL	2.598.526	2.479.666	73,95	99.131	18,26	548	0,03	43.242	8,09

Table 11 – Water Supply in the municipalities of Guandu water basin

COMPERJ water demands. These are envisaged according to the CEDAE as follows:

2013 - Q= 500 l/s (43.200 m³/day)

2016 - Q= 1.000 l/s (86.400 m³/day)

2017 - Q= 1.500 l/s (129.600 m³/day)

As explained before, the watershed is constantly being pressured by the demands of other regions. Most of the water that goes through the basin municipalities is addressed to supply the demands of municipalities that are outside the basin. According to research interviews with the Guandu watershed committee, the population of minor municipalities is outside of the benefited area and there is still much to do regarding water resources management. In certain cases, it can be evidenced the low percentage of households that are connected to the general network and therefore not directly supplied from the CEDAE

under acceptable quality and quantity standards: Engenheiro Paulo de Frontin (42, 2%), Miguel Pereira (56%) and Mangaratiba (58%) amongst others.

In the rural areas, there is a low awareness level and there exists an evident disarticulation between the particular municipal efforts and the watershed institutions regarding sanitation or climate change impacts on water availability. Some consequences of this lack of effective management can be related to the water quality and environmental stress according to what Britto and Formiga explain:

“The Guandu River and its tributaries are heavily polluted due to irregular occupation processes along its banks and the non-existence of adequate sewage collection and treatment systems in the municipalities covered by the basin. The Guandu System has operated since 1955, but the law that created the Guandu River Environmental Protection area was passed only in 2002. Per day, to treat the water drawn in the Guandu System, CEDAE consumes, on average, 318 tons of chemical products (around 250 tons aluminum sulfate, 18 tons of chlorine, 30 - 40 tons of lime, 10 tons of fluoride), besides 100 kg of polymers. For some years, it has been noted that the system has suffered a certain degree of overload, leading to suspension of drinking water production on some occasions, due to poor quality arising from droughts or heavy rains.” (Britto & Formiga, 2008)

Lagos São João:

The Lagos São João balance of water supply and sanitation is very good thanks to the concessionaries Aguas de Juturnaiba (Silva Jardim, Saquarema and Araruama) and Prolagos (Armação dos Búzios, Iguaba Grande, São Pedro da Aldeia, Arraial do Cabo –just water supply- and Cabo Frio), which besides supplying drinking water to the population of the region, have built several wastewater treatment plants for sanitation services. This region has in general good reputation among institutional levels in the State thanks to numerous successful participatory processes that have lead to a coordinated consensus among different stakeholders. Nevertheless, there is still relatively low percentage of households that is connected to the general network (67%). The number of households that have an own well or spring in their property may influence this trend. However, the case of Maricá represents a marked difference regarding the general network connection in this municipality, one of the few in the region supplied by the CEDAE. According to different sources and research interviews, it is known that the state company has been inefficient in the region, the network is insufficient (therefore the number of households

connected to it is way too low compared to the region's average) and there are no sanitation services (1,38% of the urban households have this service)(COMPERJ, 2011). This situation has exacerbated the pressures in the rivers and water bodies of the region due to continuous contamination.

Table 12 - Water Supply in the municipalities of Lagos São João water basin

MUNICIPALITIES		WATER SUPPLY							
NAME	NUMBER OF HOUSEHOLDS	General Network connection	%	Well or spring on the property	%	Rain stored in tanks	%	Other water supply form	%
Source: IBGE, Censo Demográfico 2010 http://www.censo2010.ibge.gov.br/painel/									
Cabo Frio	59.198	41.270	69,72	12.362	20,88	106	0,18	5.705	9,64
Maricá	42.645	8.112	19,02	31.733	74,41	131	0,31	2.834	6,65
Araruama	35.726	31.918	89,34	2.502	7,00	88	0,25	1.299	3,64
São Pedro da Aldeia	27.648	24.293	87,87	622	2,25	73	0,26	2.755	9,96
Squarema	23.055	9.426	40,88	12.262	53,19	68	0,29	1.347	5,84
Rio Bonito	17.070	9.571	56,07	6.323	37,04	7	0,04	1.270	7,44
Cachoeiras de Macacu	17.808	13.310	74,74	2.523	14,17	0	0,00	2.005	11,26
Casimiro de Abreu	11.479	10.397	90,57	878	7,65	12	0,10	202	1,76
Arraial do Cabo	8.952	6.182	69,06	2.229	24,90	15	0,17	530	5,92
Armação de Búzios	8.865	7.235	81,61	293	3,31	34	0,38	1.450	16,36
Iguaba Grande	7.493	6.235	83,21	236	3,15	6	0,08	1.103	14,72
Silva Jardim	6.710	2.899	43,20	3.561	53,07	0	0,00	252	3,76
TOTAL	266.649	170.848	67,11	75.524	25,08	540	0,17	20.752	8,08

One interesting historic fact about the Região dos Lagos is the participation and control from the civil society, particularly when the private concessionaries began to participate in the region of the Araruama Lagoon. During 1998, Aguas de Juturnaiba and Prolagos assumed the service provision of water supply and sanitation. Nevertheless, the prime focus was to provide the water supply and leaving the investments for sanitation in second line (planned in the long term 15-20 years). This situation contributed to aggravate the eutrophication problem of the lagoon. As the water supply was extended to most of the population, the level of sewage duplicated in the first three years (from 600 l/s to 1800 l/s) (Pereira, 2007). Gradually, the amount of benthic algae that lied in the shores of the lagoon became an environmental problem for the population due to its decomposition and strong odors produced because of the presence of methane and

hydrogen sulfide gases. This situation had a considerable repercussion in the touristic flow in the region.

As the consortium started participating in 2000, different stakeholders persisted in order to modify the contracts of the concessionaries that privileged the increase of the water distribution without investments of short term in sewage treatment. According to Pereira (2007), who also was part of this decision-making process, a long process of discussion was necessary in order to define a non-conventional system of collection and treatment of sewers that privileged the demands of the region even representing a significant investment from the private companies. The strong participation and social control during the last decade, has significantly influenced the actual standards in water supply and sanitation in the Lagos region.

4.4 Institutional aspects

4.4.1 Watershed committee

Guapi-Macacu:

As explained before, this watershed is part of the Guanabara Bay hydrographic region. The creation process of the committee organization began already during 2001 under the initiative of different representatives of the civil society and water users. The state authorities supported this preliminary phase in which the pro-committee leadership was divided in two sub-regions: west and east where the Guapi-Macacu basin is located. On May 11th 2001 the eastern pro-committee group stakeholders³⁴ organized the first attempt to constitute a watershed committee and searched diligently for consensus between all other hydrographic regions around the Guanabara Bay. Therefore, after several efforts and meetings it was constituted the Watershed Committee of the East of the Guanabara Bay on November 13th 2003, which was approved in the State Council of Water Resources –CERHI-. Nevertheless, the expedition of an official decree lasted one

³⁴ It is relevant to mention that Claudia Barros (Águas de Niterói) and Dora Hees de Negreiros (Instituto Baía de Guanabara) have accompanied this process since the beginning and made valuable contributions for the aim of this research. The complexity of the committee historical background (from constitution process to the desired effective start up and concrete actions) has been clarified through the personal interviews with the above mentioned people.

year and a half and new demands from the state authorities were made in order to give green light to the “eastern initiative”. The constitution of the watershed committee of the Guanabara Bay hydrographic region and the Maricá and Jacarepaguá Lagoon systems entered in force through the State Decree N° 38.260 of September 16th-2005. It has three technical chambers: a) institutional and legal chamber, b) management, studies and projects chamber, c) education and mobilization chamber. The decree established six different sub regions that were supposed to be coordinated by an own subcommittee:

- I - Hydrographic sub region of the Maricá – Guarapina lagoon systems
- II - Hydrographic sub region of the Itaipu-Piratininga lagoon systems
- III - Hydrographic sub region of the eastern Guanabara bay side
- IV - Hydrographic sub region of the western Guanabara bay side
- V - Hydrographic sub region of Rodrigo de Freitas lagoon
- VI - Hydrographic sub region of the Jacarepaguá lagoon system

However, the eastern subcommittee was obliged to incorporate the other regions in a lapse of 18 months. The main problem of this short period of time was the impossibility of mobilizing different and numerous stakeholders in the entire region with lack of financial means. It is worth mentioning the significant role of the Instituto Baía de Guanabara and other stakeholders in the attempt of fulfilling the incorporation of the other areas. In spite of this, the process prolonged way too much and the consensus in the eastern region was affected due to the confusing beginning of the committee.

The State authorities have themselves numerous sanitation and environmental projects in the areas surrounding the Guanabara Bay. This has made the process more difficult, which is supposed to be also accompanied by the municipal governments and many do not even have a directive plan for water supply and sanitation in their municipalities. Until this year, different actors have continued the efforts (meetings, plans, envisaged actions) in order to create an effective participative management of water resources in the region but the process is still in a backward stage, taking into account that it began almost 11 years ago. It is remarkable that some members of municipal authorities of this sub basin are neither integrated nor interested in the issues related to the watershed committee³⁵. The “water parliament” is in this case an overwhelming stage

³⁵ This is the perceived atmosphere in some of the municipalities that were interviewed. Some people showed desmotivation regarding the unending “planning and discussing” meetings and the lack of results and concrete decisions. Some others showed notorious disinformation about the existence of a watershed institution, a common situation in municipal actors that due to the high rotation of delegates/government employee of the municipal government on duty.

that urgently needs to evolve to the executive phase, in which a legal entity (water agency) can use the resources from the water charging in the region. It is also difficult to understand the stage of the different resolutions and decision because of the lack of an effective communication mechanism (a web site for instance) that allows the understanding of the actual situation. Through other information sources, it was possible to establish that an official subcommittee of the eastern part of the Guanabara Bay was created on September 2011 under the frame of the existing Decree. (Prefeitura de Niterói, 2011) This was ratified through the CERHI-RJ Resolution No 63, of June 29 -2011. The establishment of this subcommittee is a “retake” of the original mentors of the committee, back in 2001. The increasing water pressures that have been originated since the COMPERJ project began and the recent water shortages in some municipalities have also lead to this decision. One of the most relevant aspects to accomplish is finally reaching a favorable environment to organize among all stakeholders, the establishment of the water agency.

Guandu:

The intervention area of the Guandu Watershed Committee includes the water springs of the Ribeirão das Lajes, the altered course waters from the Rio Paraíba do Sul and of Piraí, the tributaries of the Ribeirão das Lajes, the Guandu River and the São Francisco Channel, until the river mouth in the Sepetiba Bay, as well as the watersheds from Guarda and Guandu-Mirim Rivers. (AGEVAP, 2012) It was constituted through the State Decree N^o 31.178 of April 3rd-2002 and it is linked to the State Council of Water Resources –CERHI- and was the first legally established committee in the State.

Today it counts on the participation of 30 titular members: 12 representatives of the water users, 9 representatives of the organized civil society, and 9 representatives of the government (4 from the municipal executive level, 4 from the state level and 2 from the federal level). According to the most recent management report, the different stakeholders get together³⁶ for *plenary sessions* 5 times in the year (4 ordinary and 1 extraordinary session). During this sessions there were elected new members, several resolutions were approved (all are available on the web site) and numerous projects and programs –sustainable development, environmental education, payment for ecosystem

³⁶ There is a public attendance control of the members of the plenary and the technical chambers.

services- were discussed and approved. The *collegiate directorate*, integrated by 6 members, is in charge of the administrative management of the committee and is supposed to get together once every month. It has 4 technical chambers: a) management instruments chambers, b) studies and projects chamber, c) legal and institutional instruments, d) science, technology and education chamber, e) Piranema Aquifer – temporal chamber³⁷-. According to the Guandu Watershed Committee Director, Decio Tubbs, there has recently been established a measure to avoid absence to the meetings from members of the civil society. As some of them have to travel reasonable distances to go to the seat office of the committee in the Federal Rural University of Rio de Janeiro - UFRRJ- in Seropédica, the transportation costs will be reimbursed from now on.

Through the last decade the committee has been working on various management actions related to the integrated and participatory water resources approach in the Guandu watershed. Thanks to the conclusion of the Water Resources Strategic Plan in 2006, up to 65 priority actions were established. Some of the most important were the water availability increase, the identification of mitigation measures for reduction of pollutants in water bodies, depending on the current and projected demands, and propose actions for the implementation and consolidation of water resources management in the basin (Agência de Bacia do Comitê Guandu, 2011).

According to the magazine *Nas Aguas do Guandu* from April 2012, the slogan of the committee has been: “water, politics and citizenship walk together” and therefore, the mission of the directives focuses on the articulation, mobilization and training of the civil society in order to reach an effective decision-making culture between all stakeholders. There is still much to do in order to articulate the political power from the municipalities. In order to achieve this endeavor, it was launched the Municipal Environment Secretaries Forum on September 12th – 2011 in order to integrate the watershed priorities in the municipal agendas.

³⁷ The Piranema Aquifer Technical Chamber (CTAP) was set up temporarily for work-related matters to endeavor the Santa Rosa Treatment Residue Central and to give an assessment about this project. During 2011 were held 11 meetings.

Lagos São João

The watershed committee in this region was created on December 8th of 2004 by the State Decree N^o 36.722 and installed on February 23rd of 2005. The committee (CBHLSJ) corresponds to the hydrographic region IV and is administratively divided in three sub-committees: Araruama Lagoon subcommittee, Rio São João Subcommittee and Saquarema, Jaconé and Jacarepiá Lagoons subcommittee.

In the *Lagos* Region, the participative process began earlier compared with the other selected regions and the most relevant particularity is that it was first constituted a consortium between different actors that lately articulated the creation of a watershed committee. From this point of view, the process was very structured and today this former organism is the water agency entity.

In December 1999, just two years after the Water Law came into force, it was created the Intermunicipal Consortium of Lagos São João –CILSJ- with aim to preserve and recover the environmental conditions of the region in a sustainable way. The process started in January 1999 when the State Environmental and Sustainable development Secretary –SEMADS- developed studies in order to create the consortium. The output was a set of documents that were supposed to be the legal basis in order to facilitate the municipal law approval that was necessary to integrate the different municipalities in the consortium. Together with the State Foundation of Environmental Engineering –FEEMA- and the cooperation of the non-government organization Viva Lagoa and the company UNIMED, a lobbying period began, in which the goal was to gain allied partners: municipalities, regional companies, environmental NGO's, and local inhabitants and fishing associations. For this endeavor, the initiative counted with the support of a successful experience in the State of Espiritu Santo, with the advisory of the Santa María Watershed Consortium. Thanks to different events, even the neighbor municipalities Cachoeiras de Macacu, Silva Jardim, Casimiro de Abreu, Rio Bonito and Rio das Ostras were interested in participating on the consortium and consequently included (this was the first step for the inclusion of São João, Una and Das Ostras Rivers in the area of the consortium and future committee). (CILSJ, 2012)

After the establishment of the CILSJ, an intense preparation began in February 2001, for the launching of the committee. Three seminars were organized and intended to present the actual environmental diagnosis of each water basins. The outcome was the creation of a suitable context for the mobilization of different stakeholders in the region,

which also contributed with numerous technical-scientific research projects for the improvement of those preliminary diagnoses. Another important aspect was the creation of three Working Executive Groups: GELA, for the Araruama Lagoon; GELSA for the Saquarema and Jaconé Lagoons and; GERSA, for the São João, Una and Das Ostras Rivers. In June of this year, a defined Working Plan –with goals and objectives- was developed within the cooperation of the Planágua Project (SEMADS and GTZ, German cooperation agency) (Pereira & Primo, 2005).

The joint work of the Working Executive Groups during 2002 and 2003, the different projects and studies developed and the cooperation with different actors led to the successful creation of the watershed committee in 2004. Today is integrated by 18 governmental category members, 18 users category members, and 16 civil society members (2 vacancies to be filled) for a total of 34 titular members in the *plenary*. Three members of different stakeholder groups conform the *collegiate directorate*. The committee is integrated by 11 technical chambers: a) environmental education chamber; b) monitoring chamber; c) fishing and aquaculture chamber; d) zoning of multiple uses; e) Juturnaiba Dam chamber; f) drainage chamber; g) sanitation and drainage; h) management instruments chamber; i) micro basins chamber; j) communications and divulgations chamber; and k) mining in São João chamber.

This committee is probably the best “in praxis” example of the National Water Law implementation in the State, due to the structure of the committee, the active and gradual integration of different stakeholders, the effective interaction with private water consortiums and the several developed projects for the improvement of the environmental conditions of the basins. This is since 2010 led by the former CILSJ through a management contract that established this entity as the official water agency.

4.4.2 Watershed agency

Guapi-Macacu

The main obstacle for an effective action of the watershed committee has been the impossibility to execute the resources coming from the State Water Resources Fund – FUNDRIH- (around 11.5M Reais= 5M US\$ from 2008 to 2012)(INEA- Diretoria de

Administração e Finanças, 2012). The water agency constitution has not yet been able to concretize.

Guandu

One of the main actions of the basin plan was to guide the implementation of financial resources arising from charges for water use. This is the region that more financial resources collects, thanks to the high demand and the money received for the water charging (around 47M Reais= 22M US\$ from 2008 to 2012)(INEA- Diretoria de Administração e Finanças, 2012). These resources can be executed thanks to the existence of a water agency and a management contract. The management contract N° 03/2010 was celebrated between INEA and AGEVAP the Paraíba do Sul water agency. AGEVAP as executive office has the responsibility to administrate these resources mainly for the investment in the sanitation sector³⁸.

Lagos São João

As mentioned before, the executive entity is the CILSJ, which was put into force through the management contract N° 02/2010 between INEA and CILSJ. The consortium has leaded and implemented several projects financed with the water charging resources³⁹ (around 5.5M Reais=2,6M US\$ from 2008 to 2012). In addition to the responsibilities as executive secretary, the CILSJ is also denominated the Technical Support Office from the Committee. The different activities that this office develops are: (i) support for the Committee's operation and institutional communication, (ii) information management, planning and scientific research, (iii) communication, (iv) recovery projects and maintaining the ecological integrity of aquatic ecosystems and groundwater and land uses of multiple (v) technical assistance (vi) capacity building and training and (vii) fundraising (Pereira & Primo, 2005).

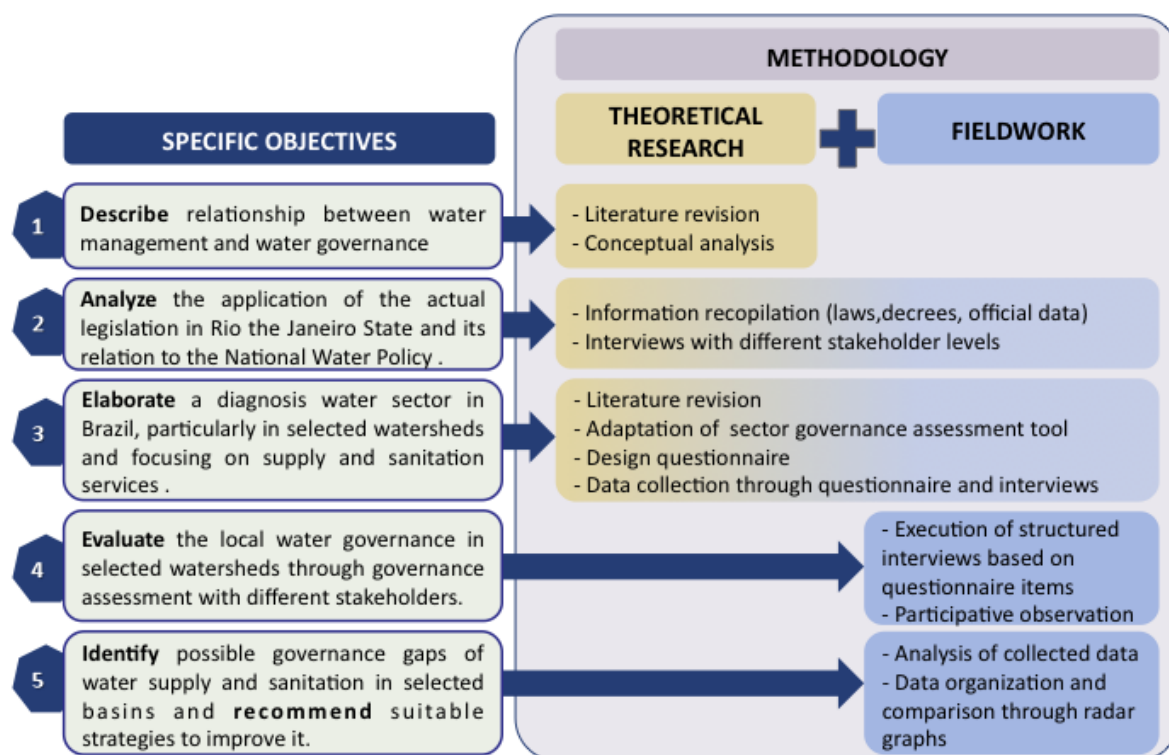
³⁸ A detailed example of the expenditures of these resources can be consulted in Annex A, page 1

³⁹ A detailed example of the expenditures of these resources can be consulted in Annex A, page 2

5 Methodology

The methods were selected according to the scope and limitations of a sector governance assessment and particular characteristics of the research project such as stakeholder availability, timeframe and resources.

Figure 15 - Research Methodology



5.1 Data collection

5.1.1 Secondary sources: literature, official data, laws and decrees

The theoretical research phase was useful to fulfill the specific objectives (1,2,3), which included to understand the conceptual framework, elaborate linkages between related topics such as water resources management and water governance and to get a closer overview about the institutional and legal context in Brazilian water sector.

Secondary data sources mainly covered: books, magazine and journal articles, working papers, international organizations' publications, governmental publications, official reports, laws, decrees, local journals and magazines, official web sites and multimedia materials amongst others. These sources were also useful to get to know several facts related to the selected watersheds such as biophysical environment, socioeconomic and institutional aspects.

5.1.2 Primary sources: Questionnaires, Structured Interviews, Participative observation

In order to accomplish the general objective of this thesis and compare the selected watersheds water governance situation, it was necessary to use a method to estimate the governance levels in each basin. The design of the sector governance assessment tool (governance criteria questionnaire) will be explained in the next section of this chapter.

The questionnaire constituted the main tool in order to gather information regarding governance issues from primary sources. Each interviewed stakeholder represented a valuable information source and contributed with different perspectives, opinions and viewpoints to understand complex issues. It is important to note that it is a valid attempt to put together different perspectives (through the evaluation scale in the questionnaire) and identify major gaps in the water resources management and governance of the selected watersheds.

The questionnaire was filled out together with the interviewees (except in few cases when the stakeholder received the questionnaire template via E-mail) and led in all cases to an open and semi-structured interviews about the topics included in the

questionnaire. All interviews were conducted in Portuguese language and extensive notes were taken during each of them. The interviewed fulfilled the questionnaire him/herself while the interviewer (researcher) took notes of any additional information during the discussion. This information has been systematically classified and analyzed through an iterative reading process. It has been displayed and related to the results of the water governance assessment tool.

Although the stakeholders were randomly chosen, it was taken into account their representativeness and relevance regarding water issues in their watershed. Therefore, there were selected several potential interviewees of all stakeholder groups taking as first reference the watershed committee members (which included decision-makers of the municipal, state, private and civil society levels). It is important to note that only organized civil society in form of non-governmental organizations have taken part of the assessment. At the beginning of this research, it was planned to interact also with non-organized civil society in order to collect information regarding water supply and sanitation services from end users. However, particular local situations as well as the inherent time restrictions in this research, motivated narrower range delimitation for the data collection.

In the three case study areas, there were interviewed municipal general secretaries, state environmental institutions technical staff, water supply and sanitation concessionaries technical and management staff, non-governmental organizations, water agencies and watersheds committee staff amongst others. In two of the studied watersheds it was possible to attend to general plenaries of the watershed committee and to technical chamber meetings. These were valuable experiences for participative observation that contributed to understand the intern dynamics in such institutions and the real implementation of the water policy.

5.1.3 Method for the sector governance assessment

5.1.3.1 Water Governance Assessment form: questionnaire design

Governance can be measured in the local level through several methodologies⁴⁰. In recent years there has been a significant growth in the types of methods and tools that can improve understanding of governance deficits and weaknesses and their relationship to development outcomes (Wilde, Narang, Laberge, & Moretto, 2009). It is worth mentioning that “local governance cannot be measured simply through quantifiable indicators, but must include the perceptions of the citizens and the government, and the relationships all actors have with each another.” (Bloom, Sunseri, & Leonard, 2007)

Due to the characteristics of this research, it was important to design a questionnaire that could be applied to different stakeholder levels that were directly involved with decision-making processes in the watersheds (local level) and that could be functionally analyzed in a short timeframe. Even if the majority of local governance measurement methodologies are though for a longer-term “assessment”, some were useful to choose different criteria that were relevant to assess the water governance issues in Brazil. According to Plummer & Slaymaker (2007), it is possible to adapt an existing framework or approach to a particular case study, in order to understand different governance dimensions in certain sector. In this case, the necessary criteria linkages between local governance and for governance in the water sector (focusing on performance in water supply and sanitation) were done in order to make a local water governance assessment.

A short-term measurement gives a general overview of the actual situation in a particular territory. The questionnaire or “Water Governance Assessment Form” (Annex B) is an adaptation of some elements of an existing tool called *Local Governance Barometer*⁴¹ (LGB). It was created in 2006 with an aim of achieving the following objectives:

- Ensure the participation of principal actors during the design of governance models as well as the collection, processing, and analysis of the information collected

⁴⁰ The main source used for the identification of a suitable method for the measurement of local sector governance is the UNDP – “A User’s Guide to Measuring Local Governance” which makes a comparison between 22 globally applied tools. (Wilde et al., 2009).

⁴¹ Developed by Pact and the Impact Alliance partners, SNV and IDASA with the support of USAID.

- Arrive at quantitative measures for good governance indicators to enable a comparative analysis between different situations, an understanding of the evolution of factors of governance, and evaluate the impact of interventions

The LGB was chosen among other methodologies⁴² because it was more time flexible, applied sector and context specific and it was possible to weight and measure different perspectives. The methodology developers were contacted in order to know if it was possible to use the core model –a set of universal and standardized criteria that is assessed- as a basis for this research as well as the software used to score an establish a “local governance index”. This methodology has several stages that require a special training in how to use it correctly. There is also a “computerization of the model” phase in which there is needed a special software that calculates the governance scores of the model. The developers of the methodology coincided in establishing the following obstacles for applying the LGB to this thesis research: getting training and accreditation to implement the LGB; designing the model and questionnaire (usually the most difficult and important element); willingness of all stakeholder groups to participate in the process (no subsequent follow up assistance would be possible); computerization of the model and time to implement the LGB.

According to Paul van Hoof⁴³, the LGB is “a very powerful tool as it brings stakeholders together to discuss complex issues around management (incl. corruption, lack of transparency, etc) and focuses on what they themselves can do to resolve their problems”. Since such “discussion level” regarding governance among the stakeholders will not be achieved under de scope of this thesis, the methodology cannot be used as a whole.

Nevertheless, significant inputs were provided and a suggested way to adapt the core model for the sector governance assessment of this dissertation. The “water governance

⁴² Other methodologies that were considerer are: Governance Index –Kemitraan Partnership- and MIDAMOS –Measuring municipal performance- (Wilde et al., 2009).

⁴³ Paul van Hoof is a Senior Advisor in the Local Governance Unit by Idasa, an African organization that works promoting sustainable democracy by building democratic institutions, educating citizens and advocating social justice in Africa. He kindly suggested how to adapt the core model based in a sub-criteria form applied in South Africa and contributed with significant inputs, documentation and case studies regarding different aspect of local governance assessments.

assessment form” used for this research is an adaptation of the core model that groups governance criteria in a questionnaire in which the interviewed should “assess” a particular ideal situation. The developed specific model for the Brazilian water sector has been elaborated taking into account the particular institutional characteristics of it and includes the following criteria: effectiveness, efficiency, transparency, rule of law, accountability, conflict resolution, awareness, participation, equity, mobilization and articulation. Each interviewed must score each sub-criterion, which are no more than ideal situations that should occur in a good governance context. The scores were calculated in excel:

Table 13 - Water Governance Assessment Scoring

SCORES	MEANING
0	Never occurs
25	Rarely occurs
50	Partially occurs
75	Mostly occurs
100	Always occurs
NA	No answer/No information

5.1.3.2 Data processing and analysis

The results are displayed through the *radar or star plot graphical method*.

“A star plot is a graphical data analysis technique for examining the relative behavior of all variables in a multivariate data set. The star plot consists of a sequence of equiv.-angular spokes (radii). Each spoke represents a different variable in the multivariate data set. An individual star plot examines the behavior of all such variables but only for a specified subset of the data .The total length of a given spoke is uniformly set to unity for sake of reference. The “data length” of a given spoke is proportional to the magnitude of the variable for the subset relative to the maximum magnitude of the variable across all subsets. Thus we are looking at the ratio of the “local” value of the variable to the “global” maximum of the variable. An interconnecting line cutting across each spoke at the “data length” gives the star plot its unique appearance and name. (National Institute of Standards and Technology, 1997)



Summarizing, this method is useful to present multivariable data with arbitrary number of observations and serves to observe distributions of three or more quantitative variables that are represented on axes starting from the center of the graph. The data distribution is presented using points connected by lines that form a shape encircling the data range. The data range includes the selected possible scores for the sub-criteria: never, rarely, partially, mostly, always and no answer. The more open the shape, the more polarized the data range. The more closed, the more homogenized the distribution is. A radar chart shows how a team has evaluated a number of organizational performance areas. It was chosen due because each radar/star plot chart shows how the stakeholders have evaluated different situations through a number of organizational performance areas.

6 Results and discussion

The fieldwork of this research was focused on data collection through a water governance assessment in three selected watersheds. The data collection execution was successful and 12 interviews were achieved among different stakeholders in each watershed. The following results based on a 36 interview sample, reflect the water governance perceptions in ten aspects –*governance criteria*- that influence governance levels: effectiveness, efficiency, transparency, rules and laws, accountability, conflict resolution, participation, awareness, equity, articulation/mobilization. In order to understand each aspect, please refer to Chapter 2- section 2.2.4.

As follows, some general facts about the assessment⁴⁴:

Table 14 - General Facts about the Water Governance Assessment

WATERSHED	INTERVIEWS	GENDER		STAKEHOLDER GROUP					Part of the Watershed Committee
				Civil Society	Federal level	State level	Municipal level	Private Sector	
GUAPI – MACACU	12	8	4	4	0	1	5	2	4
		67%	33%	33%	0%	8%	42%	17%	
GUANDU	12	6	6	4	0	3	4	1	10
		50%	50%	33%	0%	25%	33%	8%	
LAGOS SÃO JOÃO	12	6	6	5	0	3	2	2	11
		50%	50%	42%	0%	25%	17%	17%	

The gender indicator helps to establish a preliminary overview of women-men balance in decision-making processes. According to observations during the fieldwork, it was possible to see a balanced participation of women and men in water resources

⁴⁴ Further details about the interviewed can be checked in Annex C

management in Rio de Janeiro. Even if there is no particular policy or program⁴⁵ that promotes women participation in water resources management, the praxis shows that this occurs per se. For example, all interviewed in the state levels (INEA-SEA) were highly qualified technical female professionals, that know the context of the three researched basins and that have influence at policy level. In two different watershed committee plenaries, which were attended (Guandu, Lagos São João), women and men participation was very active.

The assessment was conducted using a single questionnaire for all stakeholders, in the attempt to achieve a general picture of the basins' governance status. It is important to note that a more representative stakeholder analysis would have been possible with a bigger sample size.

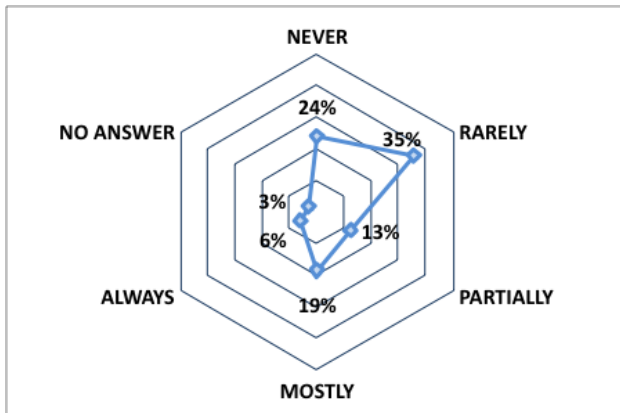
Since the general objective of this research states to focus on a water governance assessment, the high variety of opinions and perceptions were quantified through the questionnaire. All interviews included a parallel discussion on each "ideal situation", which permitted to enrich the research with significant qualitative information that was compiled and classified. These data have been analyzed and grouped according to the most relevant trends, described by each interviewed stakeholder as well as associated with the general results of the questionnaires.

As explained in the last section of Chapter 5, the results are displayed through the radar graphs method that helps to identify the perspectives' trends in each watershed. In the following pages, every criteria group of the assessment is displayed in a graph, explained and compared. The scale varies in every category but is the same to compare the three watersheds and takes into account the maximum value in every comparison. The gridlines interval is 10 and the range goes from 10 to 90 depending on the case. In the left side it is possible to see the plot that presents the distribution of the collected data in the questionnaires. In the right side, the qualitative information gained in every single interview, is grouped and related with the quantitative analysis presented in the graphs. The trends in each watershed region can be easily compared, thanks to the direction of the shapes/lines in every radar graph. When the shape sharply points a variable, a trend will be confirmed with a high percentage of the perceptions (the farthest from the center of the graphic).

⁴⁵ See questionnaire in Annex B, Criterion: Equity 5.4

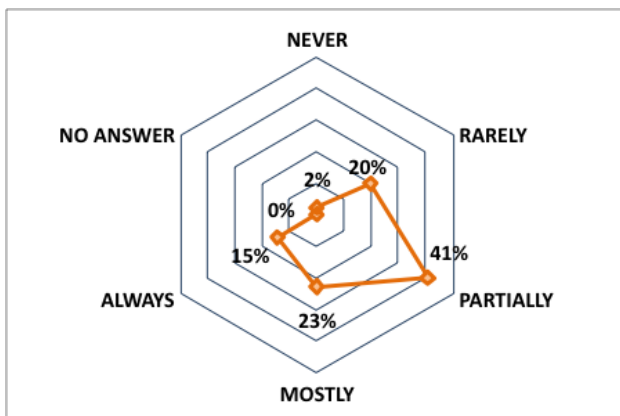
6.1 EFFECTIVENESS

GUAPI-MACACU



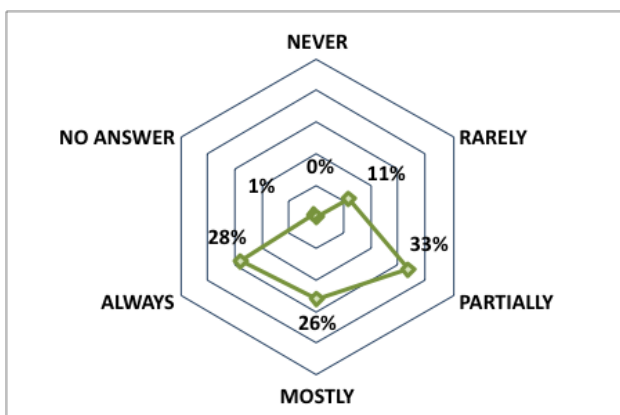
According to the interviewees, **water resources planning and management** RARELY (35%) or NEVER (24%) occur. **Planning** barely exists and management and implementation is not effective. **Municipal action** remains incipient. Actions do not point out real needs of the basin. **Water sanitation deficiencies** exist in the urban and rural levels. **Water supply** is good, thanks to the high water availability. There are legally accepted **water quality standards** and good coverage but only on urban level. **Watershed committee** is very disarticulated and the stakeholder groups are unconnected. Financial resources cannot be executed due to the inexistence of a water agency (lack of consensus to establish it).

GUANDU



Water resources planning and management PARTIALLY (41%) or MOSTLY (23%) occurs. **Planning** exists but there is still a high level of **bureaucracy** for the implementation. There is a high influence of the **state level**. Actions focus on the needs of the metropolitan region but **local action** remains in disadvantage (some municipalities are outside of the management area). **Water sanitation deficiencies** still continue particularly in rural areas. **Water supply** is good, thanks to the **quality standards** from ETA Guandu. There are legally accepted **water quality standards** and good coverage but only in urban level. **Watershed committee** is articulated and the actions are connected to water agency and all stakeholders.

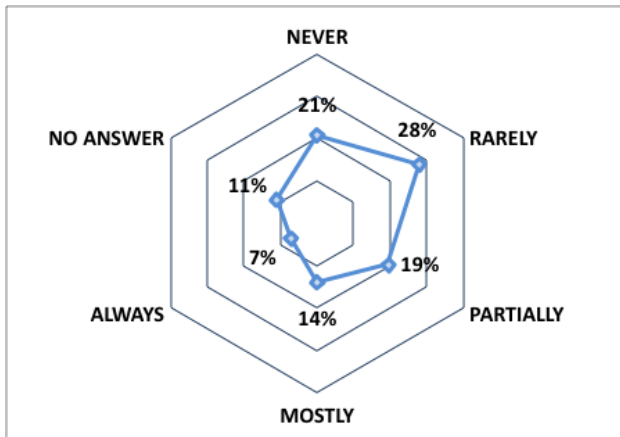
LAGOS SÃO JOÃO



Water resources planning and management PARTIALLY (33%) or ALWAYS (28%) occurs. It is worth noting that 26% think that this MOSTLY occurs. Planning and implementation are effective thanks to the actions of the **Water Agency (CILSJ)**, which focus on the needs of the basin (rural areas remain unattended). **Watershed committee** is very articulated; the stakeholders respect the institution, actively participate and conflicts are discussed among all parties. The priorities are focused in improving the **water sanitation deficiencies**, which should soon be covered up to 80%, especially in rural levels. **Water supply** is good because the **high water availability** but the concession contracts include only urban areas.

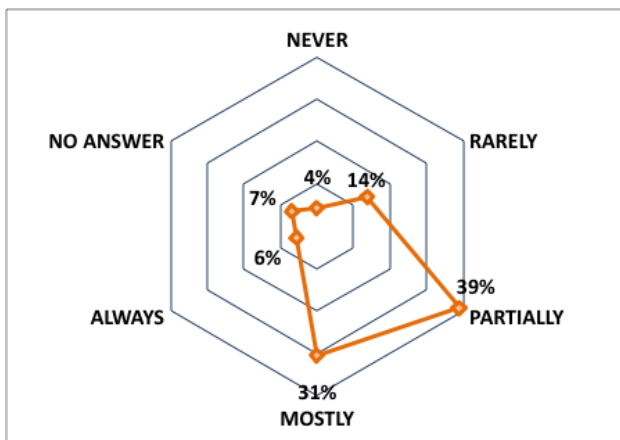
6.2 EFFICIENCY

GUAPI-MACACU



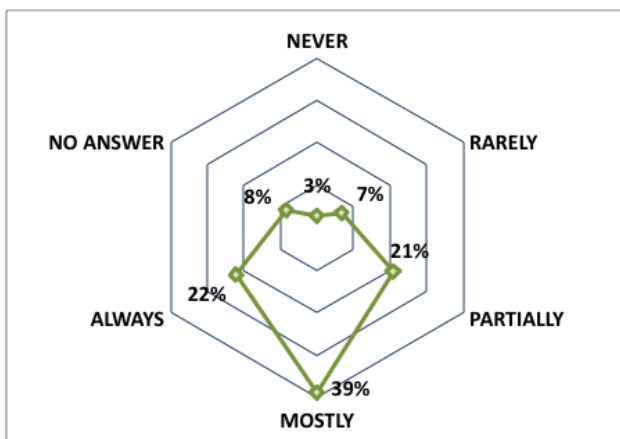
The perspectives' distribution regarding efficiency is very **polarized**. The institutions are not working coordinately and some are **not economically efficient** (e.g.: municipal autarchy AMAE is not financially sustainable for WSS but Águas de Niterói is very efficient). **Water leaks** levels and clandestine connections still remain high (except in Niterói). **Programs and actions** for water sanitation are planned for the urban levels (mainly motivated by **economic interests**). Rural areas remain unattended due to the high installing costs for **sewage network**. Municipal authorities and private users are **not fully aware** about the importance of working together with watershed committee and executing the FUNDRHI resources.

GUANDU



The institutions are **PARTIALLY** (39%) or **MOSTLY** (31%) working **coordinately and efficiently** but further articulation between municipal levels is needed. The ETA Guandu from CEDAE has own WSS budget to attend Rio de Janeiro City needs. **Water decontamination** needs to be intensified and **water leaks** levels and clandestine connections still remain high (CEDAE needs to improve actions for basin area). **Programs and projects** recently began to be implemented because the FUNDRHI funds were newly released. Municipal authorities, private users and civil society are **aware** about the importance of deliberating together with watershed committee.

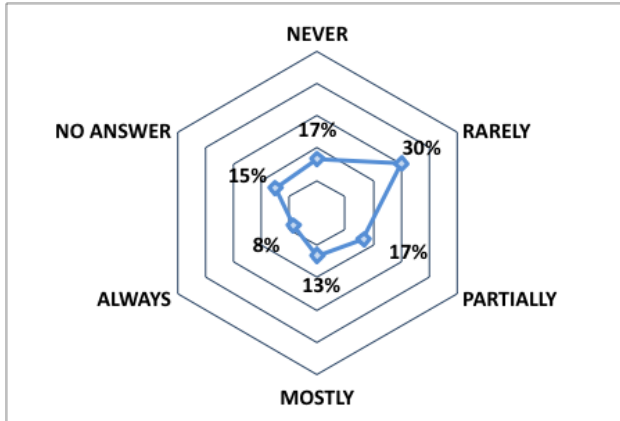
LAGOS SÃO JOÃO



The institutions are **MOSTLY** (39%), **ALWAYS** (22%) or **PARTIALLY** (21%) working **efficiently** and coordinately. The private concessionaries have his own budget and action plans (5 years) for WSS. They work with the watershed committee and the different stakeholders in an articulated way. **Water leaks** are solved promptly. **Separated water sanitation network** needs to be built. **Programs /projects** have actively being implemented (FUNDRHI funds) but the resources are not enough because this region has not many water users and the demand increases in seasonal periods. In general, all stakeholders assume responsibilities well but improvements are desired the watershed committee.

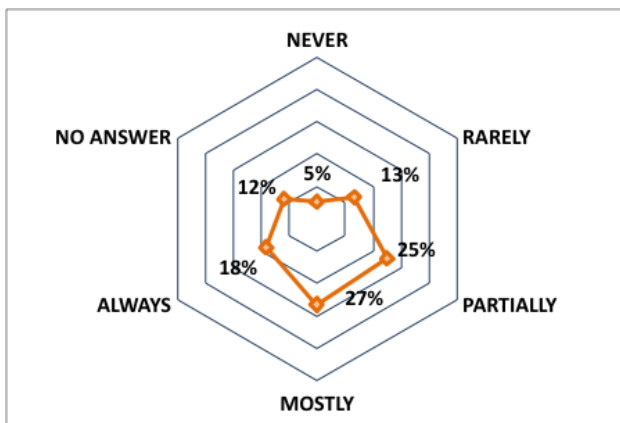
6.3 TRANSPARENCY

GUAPI-MACACU



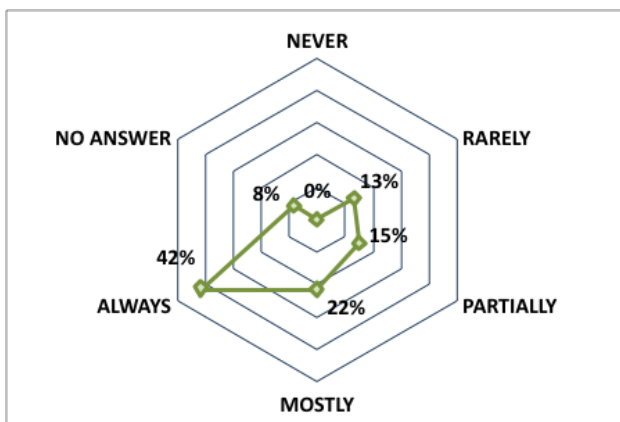
Transparency regarding watershed issues occurs RARELY 30%, NEVER 17% and PARTIALLY 17%. 15% of the interviewees have no answer for this question. **Information** exists but it is inaccessible for all stakeholders (population –common users-). **Service companies** (public or private) give basic information concerning prices, water quality and water use in the bill. Concrete information about **watershed committee projects**, proposals, auditing etc. is not available (there is still not a structured web site) Transparent **decision-making** regarding financial resources allocation does occur (there are no water agency, nor released resources to execute). NGO's are welcome to participate and actively involve in the watershed issues.

GUANDU



Transparency regarding watershed issues is perceived MOSTLY 27%, PARTIALLY 25% and ALWAYS 18%. **Information** exists and it is usually accessible for all stakeholders. **Service company** (CEDAE) give basic information concerning prices, water quality and water use in the bill. Concrete information about **watershed committee projects**, proposals, technical chambers etc is available in the web site and through informative journals. Transparent **decision-making** regarding financial resources allocation occurs through the water agency. **NGO's integration** contributes for transparent management but they mostly represent the interests of Rio de Janeiro and not those from the basin region.

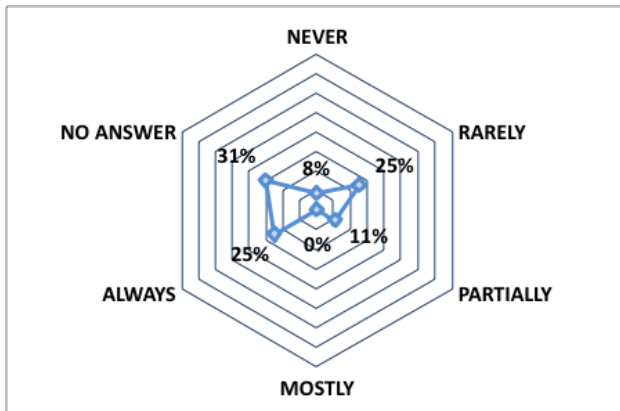
LAGOS SÃO JOÃO



Transparency regarding watershed issues is perceived ALWAYS 42%, MOSTLY 22% and PARTIALLY 15%. **Information** is available for all stakeholders and general users. **Concessionaries** provide basic information concerning prices, water quality and water use in the bill and additional data in their web sites. Concrete information about **watershed committee projects**, proposals, meetings, technical chambers etc. are available in the web site of the committee. Transparent **decision-making** regarding financial resources allocation occurs through the CILSJ. **NGO's integration** is very important since the committee was founded and 15 actively participate and contribute in decision-making processes.

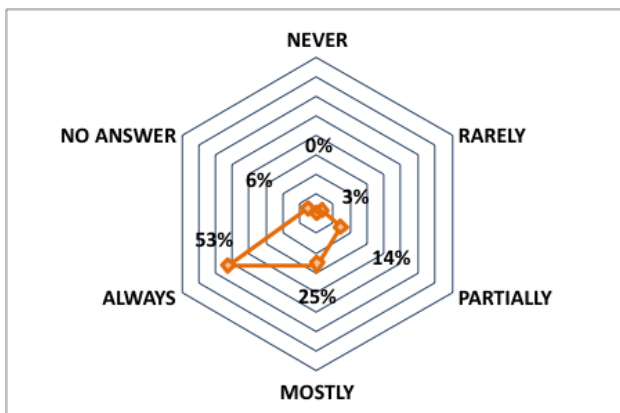
6.4 RULE OF LAW

GUAPI-MACACU



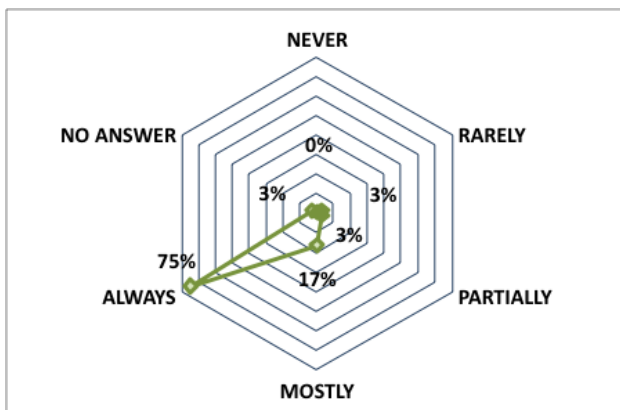
Good practices related to resources allocation, **accurate management of financial** resources in the basin region and **legally accepted decision-making** are three topics where 31% of the interviewees could not answer. In contrast to this trend, 25% think that this **ALWAYS** happens. This **contradiction** reflects the high level of **disinformation** regarding the watershed institutional arrangements that need to be established to execute FUNDHRI money. According to the law municipalities should receive financial support from the watershed resources for their own **directive WSS plan**. Private management has a good financial sustainability (Águas de Niterói) but in the basin region lack of financial resources is evident.

GUANDU



Good practices related to **resources allocation** and accurate **management of financial resources** in the basin region, occur **ALWAYS** (53%) or **MOSTLY** (25%). **Decision-making** is also coordinated among all stakeholders according with the rules of the watershed committee. All the **meetings and plenaries** are documented and available to the public through the web site. **Joint actions** with municipal levels are improving in order to execute water sanitation projects in the region

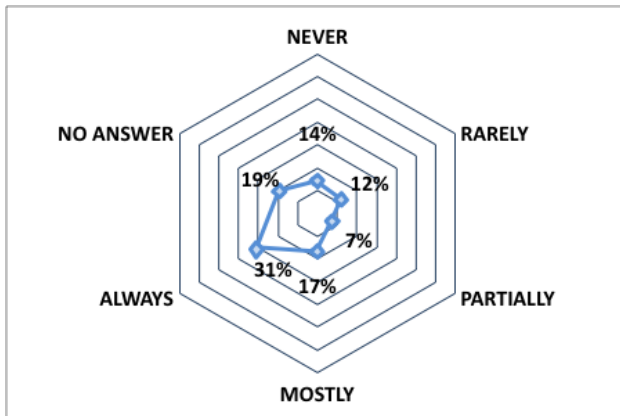
LAGOS SÃO JOÃO



Good practices related to **resources allocation** and accurate **management of financial resources** in the basin region, occur **ALWAYS** (75%) or **MOSTLY** (17%). **Decision-making** is also coordinated among all stakeholders according with the rules of the watershed committee and with the close interaction of the water agency. All the **meetings and plenaries** are documented and available to the public through the web site. **Joint actions** with municipal levels are improving in order to increment water sanitation networks. For the major part of the interviewees the legal framework has successfully permitted a good decision-making space in the basin.

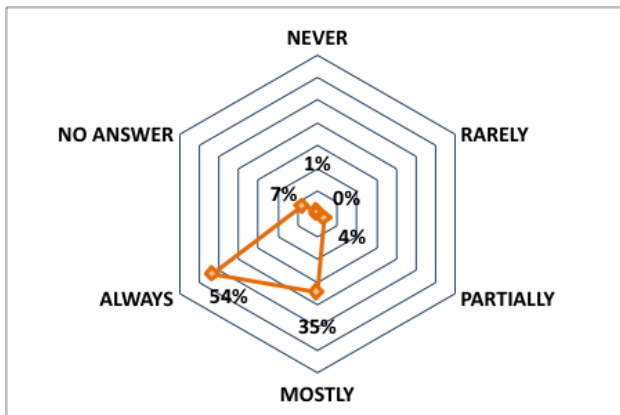
6.5 ACCOUNTABILITY

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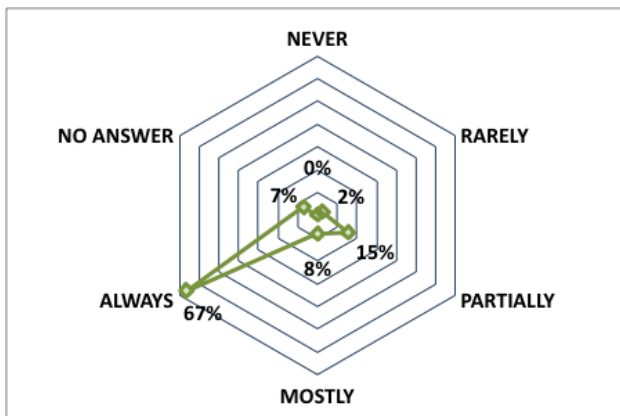
Accountability perceptions are also **polarized** but show a shapely distribution pointing ALWAYS (31%). **Financial management** occurs according to the national law but when answered, it was related to municipal finances and not to the basin institutions (because they do not function in the proper way). **Supervision** for federal, state and municipal levels regarding water management in the basin is supposed to happen. **State institutions** influence basin decisions and in the general case of the Guanabara Bay, levels overlap. Some actors stated that INEA controls everything related to water issues. **Public audits** do not exist according to most of the interviewed. No concrete strategies are defined in the watershed committee due to the failures on its implementation. Minorities seldom participate.

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Accountability perceptions are pointing ALWAYS (54%) and MOSTLY (35%). **Financial management** occurs according to the national law and is accompanied by federal levels. **Supervision** regarding water management enhances the interaction of all levels including the ANA and state supervision of the national and state audit courts. **State institutions highly** influence hydrographic region decisions. **Concrete strategies** are defined in the watershed committee between all stakeholders and information channels are being fortified, since the AGEVAP recently began to execute the FUNDRHI financial resources in the basin. There are good perspectives about the successful implementation of projects.

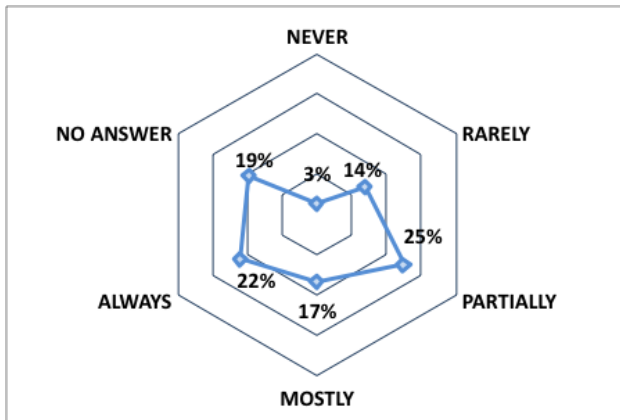
LAGOS SÃO JOÃO



Actions and water management are perceived as **accountable** in this watershed region: ALWAYS (67%), PARTIALLY (15%). **Social accountability** has been determinant in this region in which organized and not **organized civil society** have participated and appropriated the water management transitions since years. However, it is still difficult because even in a collegiate space (committee), decisions are at the end taken under the influence of few people. **Control** in this basin is more a responsibility of the **water agency**, which has been so active, that often other stakeholders confuse it with the committee.

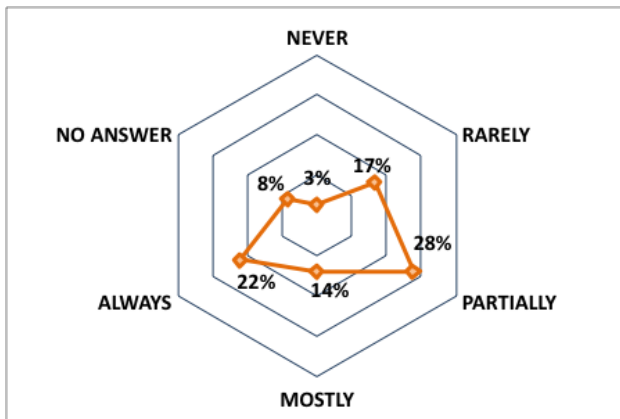
6.6 CONFLICT RESOLUTION

GUAPI-MACACU



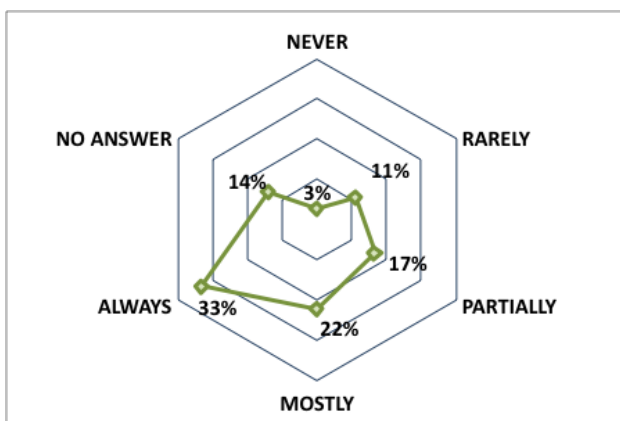
There is **no defined trend** regarding conflict resolution since each stakeholder has different experiences, which are not necessarily articulated to integrated water resources management. Mechanisms to **manage customers' complaints** related with WSS services, no **political or economic privileges** to some stakeholders or impartial conflict resolution **attending multiple uses** are aspects that **PARTIALLY** (25%) or **ALWAYS** (22%). However, 19% of the interviewees did not have an answer for these questions. Regarding direct conflict resolution in basin areas, some interviewees stated that **communitarian leaders** help to accomplish this, particularly in rural areas. Mechanisms to complain exist, but its effectiveness depends on the WSS services' company and on customers' awareness.

GUANDU



The perceptions' distribution shows that good conflict resolution **PARTIALLY** (28%), **ALWAYS** (22%) or **RARELY** (17%) occurs in this basin. There exist several mechanisms –email, regulation offices, - media to **manage customers' complaints** (WSS services). **Political or economic privileges** are being minimized but economic interests influence political actions. Impartial conflict resolution is one of the priorities of the activities developed in the watershed committee. **Multiple uses priorities** are trying to be attended, particularly in the municipalities located in the basin. There are some municipalities that interact closely than others in the watershed committee but many shared their experience for this evaluation.

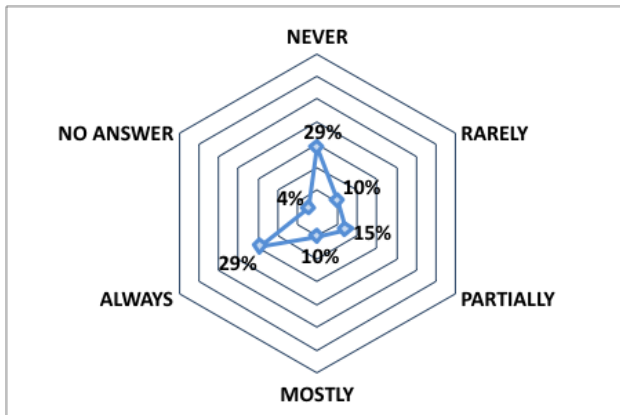
LAGOS SÃO JOÃO



The perceptions' distribution shows that good conflict resolution **ALWAYS** (33%), **MOSTLY** (22%) or **PARTIALLY** (17%) occurs in this basin. Mechanisms to **manage customers' complaints** (WSS services) exist and action is very successful due to the good **customer relationship management and information channels** that the concessionaries have. **Political or economic** aspects do not give special **privileges**. According to the interviewees, many politicians in the region are **committed** with the joint action in the committee but municipal participation in this evaluation was the lowest of all basins.

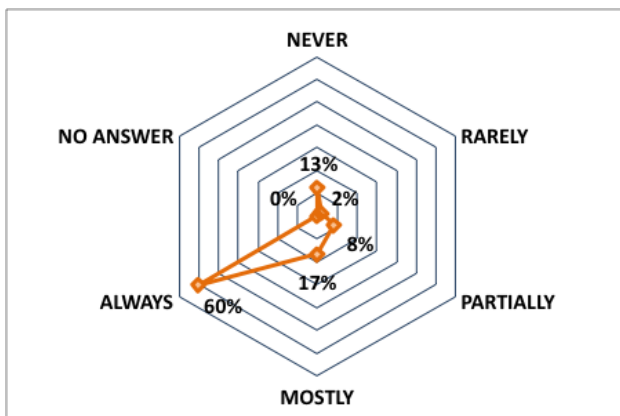
6.7 PARTICIPATION

GUAPI-MACACU



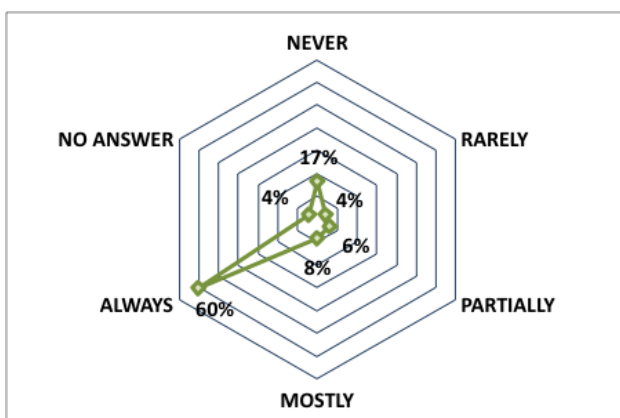
This indicator relates with the **direct participation** of the interviewees in the watershed institutions such as the **state council** or the **basin committee**. Since several actors do not actively participate or belong to these organizations, the distribution is very polarized: 29% NEVER participate and 29% ALWAYS participates in meetings and water resources planning activities (due to the **active participation of NGO's** that were interviewed). **Non-participation** of actors is related with high bureaucracy, slow decision-making and low quorum. **Non-organized civil society** does not actively participate but most active groups come from the urban area.

GUANDU



Direct participation of the interviewees in the watershed institutions such as the **state council** or the **basin committee** is high: 58% ALWAYS participate and 19% MOSTLY does. Only 13% of the sample does not act in those instances. Many assist meetings and plan activities in the technical chambers. There is an **active participation of NGO's** but mainly those from the city of Rio. This is a concern, because the needs of the basin itself have to be claimed. **Non-organized civil society** does not actively participate. There is strong presence of the **state authorities** in the decisions taken in the watershed committee due to the strategic importance of the region but **local actors** have been lately increasing their participation.

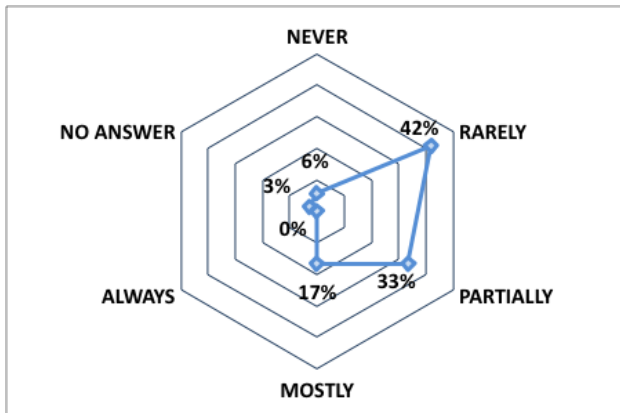
LAGOS SÃO JOÃO



Direct participation of the interviewees in the watershed institutions such as the **state council** or the **basin committee** is high: 59% ALWAYS participate. 18% NEVER does. This may lie in the fact that not many own a chair in the **state council** but they are active in the watershed committee. Many assist to meetings and plan activities in the technical chambers. There is an **active participation of NGO's** and other **international actors** that sponsor basin projects. In spite of this, **rural levels of participation stay backward** and still many local governments do not understand the **role of the water agency**, which is just related with financial issues. Some actors state that before FUNDRHI money was released, there was more participation but now it is vice versa.

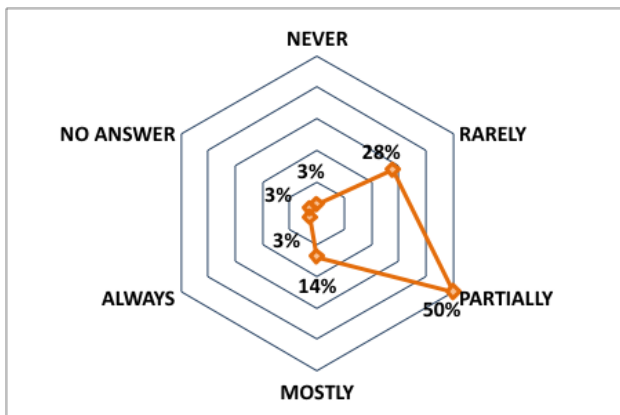
6.8 AWARENESS

GUAPI-MACACU



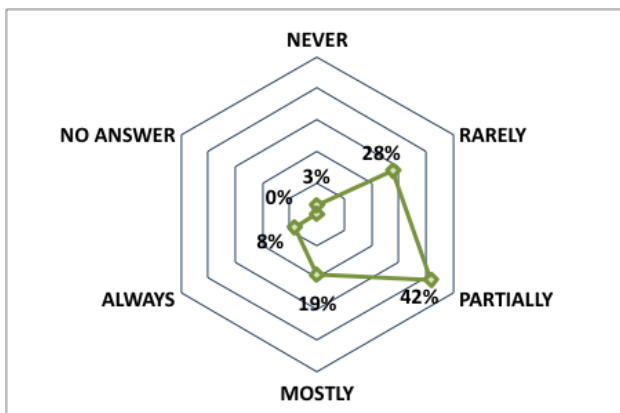
Citizen's low awareness regarding their rights and duties toward water resources institutional initiatives particularly influenced the distribution of the perceptions in this section. 42% think that it RARELY occurs while 33% consider it is PARTIALLY happening. Municipal interviewed relate awareness just with the spent water quantity and its relation with water tariffs. Environmental education programs that strength awareness toward water resources management, water uses and responsibilities are still missing. NGO's are well prepared and represent the general interest of the citizens, for example through common actions with local population in protected areas.

GUANDU



Citizen's awareness regarding their rights and duties toward water resources institutional initiatives influenced the distribution of the perceptions in this section: 54% think that it PARTIALLY occurs while 26% consider it is RARELY happening. There are few environmental education programs that attempt to strength awareness toward water resources management, water uses and responsibilities. NGO's are well prepared but often represent the general interest of the citizens from Rio de Janeiro.

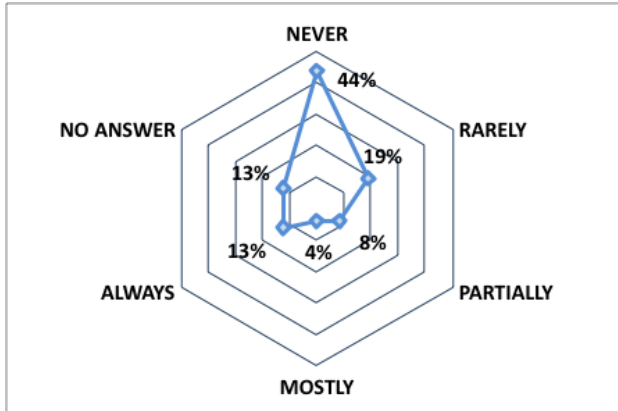
LAGOS SÃO JOÃO



Citizen's awareness regarding their rights and duties toward water resources institutional initiatives, occur PARTIALLY 42% or MOSTLY 21% according to the interviewees. This indicator needs to improve since there are several initiatives for environmental education that strength awareness toward water resources management, water uses and responsibilities. According to the CILSJ interviewed, this should settle down the "legal concepts" into a language in which citizens can understand the integrality of water resources. NGO's are very well prepared, active in decision-making processes and represent the general interest of the region.

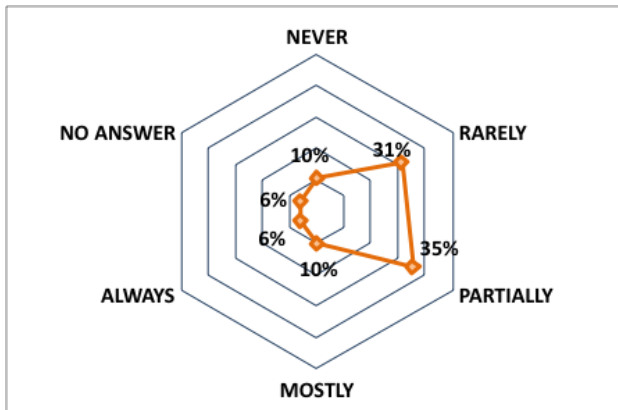
6.9 EQUITY

GUAPI-MACACU



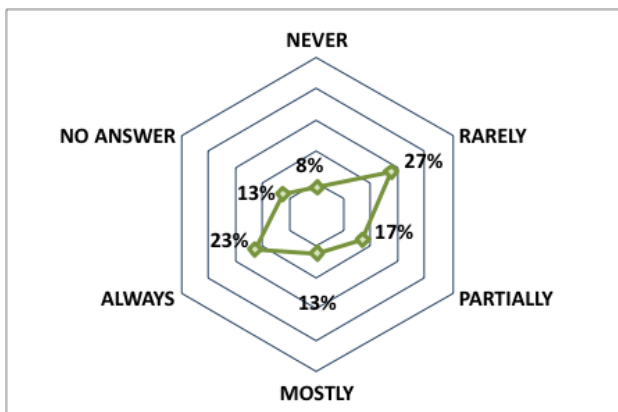
Equal access of water supply and sanitation services in high and low income groups, **budget plans** to reach marginalized sectors and **disparities' minimization** between rural and urban levels are aspects that NEVER 44%, or RARELY 19% occur in this basin. The disparities between high and low-income groups persist and the main efforts from the municipal authorities are conducted to water sanitation investments in the urban areas. The **rural areas lie backwards** because the financial sources come from federal sponsorships (Cities Ministry) and are restricted to urban level (e.g. envisaged sanitation investments in Cachoeiras de Macacu). There is no particular pro-women policy/program but 8 of 12 interviewed were "water-issues" committed women.

GUANDU



Equity regarding **equal access of water supply and sanitation services** in high and low income groups, **budget plans** to reach marginalized sectors and **disparities' minimization** between rural and urban levels are aspects that PARTIALLY 37%, or RARELY 33% occur in this basin. This may reflect the disparities that exist within the population's needs in the basin region (particularly in rural areas) and the benefited metropolitan region area. The **watershed committee** is giving priority to these areas, working together with municipal governments and promoting projects that enhance the application of technologies for **rural basic sanitation**.

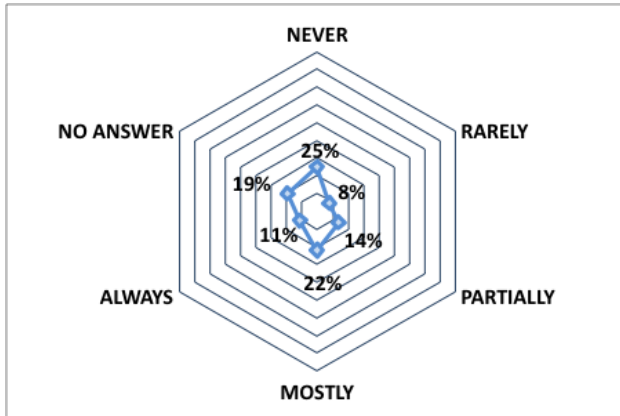
LAGOS SÃO JOÃO



Equity regarding **equal access of water supply and sanitation services** in high and low income groups, **budget plans** to reach marginalized sectors and **disparities' minimization** between rural and urban levels are aspects that RARELY 30%, ALWAYS 37%, or PARTIALLY 18% occur in this basin. Most of the perceptions related to the **rural & urban disparities** were not very positive. Although WSS services are good in the urban levels, the concessionaries contracts are only for these areas and there is no official policy to close this gap. PROLAGOS will probably implement "**social tariffs**" program for low-income population. The CILSJ leads projects that prioritize **empowerment of rural women**.

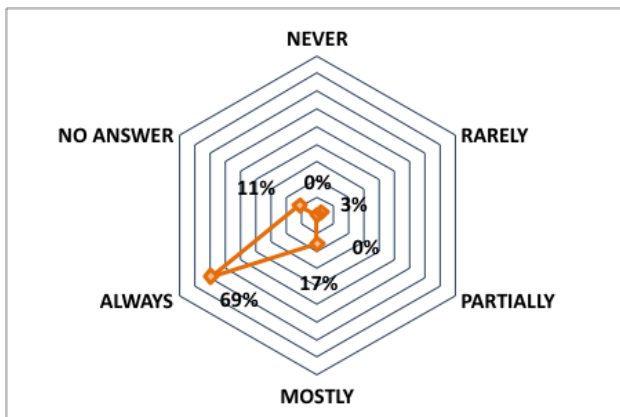
6.10 ARTICULATION/MOVILIZATION

GUAPI-MACACU



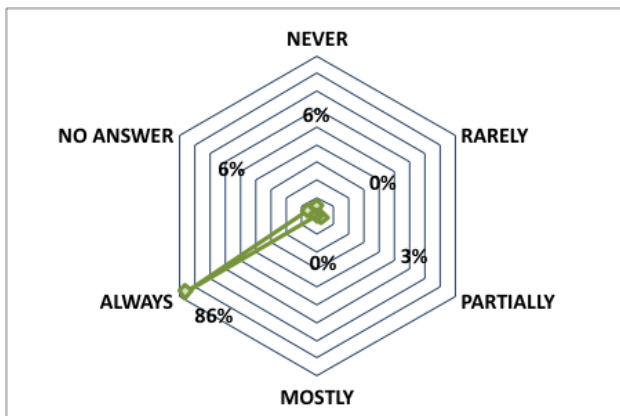
This criterion is based on the **articulation of policy instruments** and implementation through concrete projects or programs in these areas: **water resources planning and management, payment for ecosystem services** and **ecosystem preservation and conservation**. As the graphic shows, the perceptions are very polarized: NEVER 25%, MOSTLY 22% and NO ANSWER 19%.

GUANDU



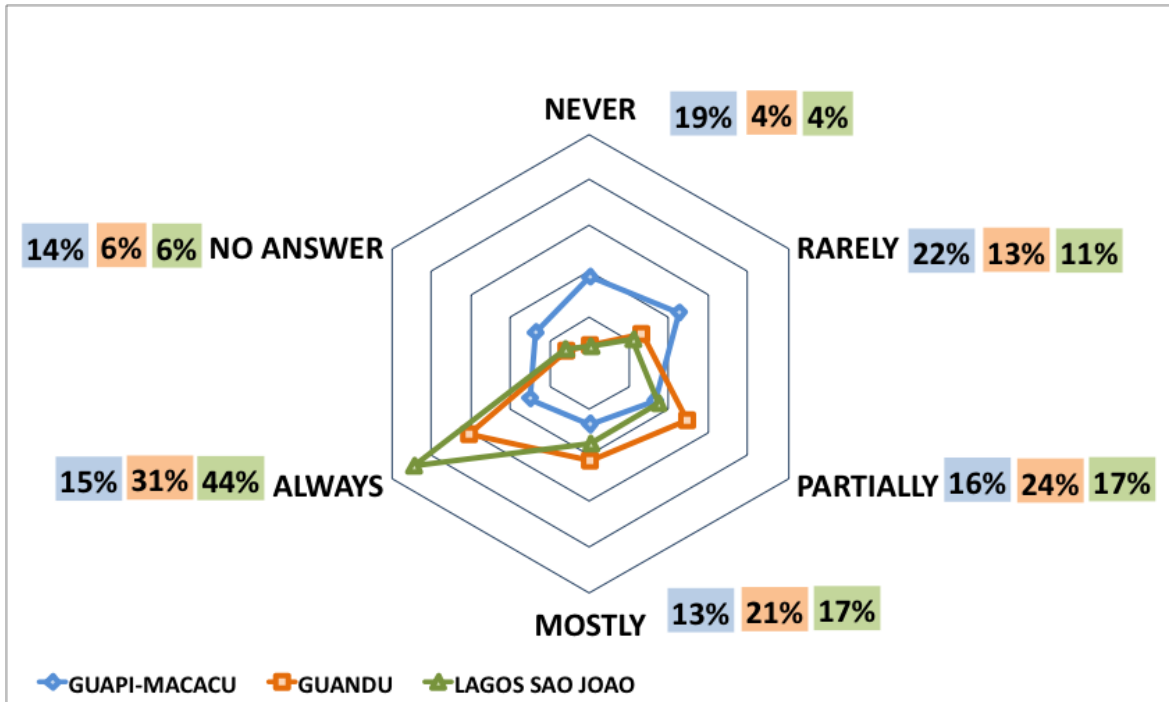
Concrete projects or programs in these areas: **water resources planning and management, payment for ecosystem services** and **ecosystem preservation and conservation**. The general perceptions show clear distribution: ALWAYS 67% and MOSTLY 21%. In the Water Resources Strategic Plan there are more than **65 actions** envisaged until 2025. Relevant actions: *Productor de Águas e Florestas* (US\$ 54.927,76) a PES project for rural producers for the Atlantic Forest conservation; **river decontamination** (Poços-Queimados and Ipiranga) and **increased sanitation** treatment for domestic sewage. There is a strong action from the state level SEA for sanitation projects: *Pacto pelo Saneamento, Sena Limpa* and support for municipal sanitation plans (Law 11.445).

LAGOS SÃO JOÃO



Concrete projects or programs show an effective implementation of the water management instruments. As the graphic shows, the perceptions are very homogenized: ALWAYS 85% and PARTIALLY. This hydrographic region has developed interesting projects such as *FUNBOAS*, a **good practices incentives** fund that works with rural communities under a micro basin basis for: **rural sanitation practices, benefited agricultural production and water springs protection**. There are also several monitoring programs for aquifer conservation and good practices related to **wastewater treatment** (Wetland in Águas de Juturnaiba), which are also connected to community-based sustainable projects.

Summarizing, the general water governance perceptions of all watershed regions are grouped and compared after calculating all scores in every case:



The results of the water governance assessment in the three watersheds reflect the consequences of the previous described basin contexts in chapter 4.

It is possible to identify that the best perceived governance level is in Lagos São João, in which most of the answers pointed out that ideal situations ALWAYS (44%), MOSTLY (17%) and PARTIALLY (17%) occurred. A very low percentage pointed to NEVER (4%) or NO ANSWER (6%). These facts reveals a good implementation of the water policy and its instruments, good interaction with WSS services concessionaries and right execution of the financial resources (FUNDRHI) coming from the water charging at big users level. Also it is possible to argument that this basin counts with informed and in most of the cases, committed stakeholders that actively participate in the watershed committee. However, it is important to note that these results are a consequence of a participation process that began 10 years ago. Some of the interviewed stakeholders argued that even if the general perceptions about the management in this region is good, there are still many things to improve particularly in the areas of water sanitation and ecosystems conservation.

The second best ranked basin is Guandu in which most of the answers pointed out that ideal situation ALWAYS (31%), PARTIALLY (24%) occur. A lower percentage considers that ideal situations MOSTLY (21%) or RARELY (13%) occur. Similar as in Lagos São João, a very low percentage pointed to the options NEVER (4%) or NO ANSWER (6%). This watershed region receives more pressures than the others, since it is the main water supply for the metropolitan region. Nonetheless, the FUNDRHI resources are also supporting different initiatives, to improve the water sanitation deficits and strength institutional capacities and stakeholder dialog in the watershed committee. It is important to note that this watershed committee works closely together with the public services company CEDAE, in charge of the administration of the ETA Guandu. In the case of this region, the CEDAE treats water for the metropolitan region and the efforts of the ETA Guandu have been historically focused on the water supply and sanitation for this area. The cooperation and joint projects have been crucial in order to give priority to the municipalities (in particular rural areas) in the basin region but this trend must be maintained and enforced under the frame of the watershed committee.

The region with lowest scores is Guapi-Macacu (as sub-watershed form the Guanabara bay hydrographic region). As seen in the single criteria evaluation, most of the times there was a very polarized distribution of the scores, which do not permit to establish a marked trend in the stakeholders' perceptions. This reflects a low level of cohesion regarding water resources management issues, political constraints and high demand pressures due to increasing economic activity. These aspects are consequences of the watershed committee institutional incipience in the region. The answers pointed that ideal situations occur as follows: RARELY (22%), NEVER (19%), PARTIALLY (16%), ALWAYS (15%), NO ANSWER (14%), MOSTLY (13%). In this case study, there were significant differences in the perceptions and level of information of each interviewed stakeholder.

As explained before, CEDAE is a state owned utilities company that serves approximately 70% of the municipalities of Rio de Janeiro State (Barros, 2008) and is the predominant utilities' company in the whole state. In the case of Guandu, the company accomplishes the objective of supplying the metropolitan region but in case of Niteroi⁴⁶ or the Lagos Region, the evidence is not very favorable for the state-owned company. Historically, the investment bottleneck was much larger and more evident in these municipalities, whose sanitation services were previously the responsibility of the state

⁴⁶ Niteroi is a good example and it is one of the benefited municipalities of the water resources of Guapi-Macacu.

utility (CEDAE). Some of the relevant causes for the no renovation of the concession contracts to the CEDAE were operation and commercial inefficiencies, indebtedness and political influence in the administration as well as chronically insufficient investments. (Vargas, 2005)

In the next table, it will be available a general comparison between the water governance levels in each basin, showing the predominant trend with its percentage in each governance criterion. In addition, it is provided the state of art of each relevant analyzed sub-criteria.

Table 15 - Water basin comparison

GOVERNANCE CRITERIA	GUAPI-MACACU	GUANDU	LAGOS SÃO JOÃO
1. EFFECTIVENESS	RARELY 35%	PARTIALLY 41%	PARTIALLY 33%
Water resources planning	To improve	Good	Good
Municipal action	To improve	To improve	To improve
Water supply	Good	Good	Good
Water quality	Good	Good	Good
Water sanitation infrastructure	Incipient improvement	To improve	Improving
Watershed committee and planning	Incipient improvement	Good	Very good
2. EFFICIENCY	RARELY 28%	PARTIALLY 39%	MOSTLY 39%
WSS institutions performance	To improve	To improve	Good
Programs and actions	To improve	Good	Good
Budget/Funding for WSS	To improve	Good	Good
Stakeholders cooperation	To improve	Good	Good
3. TRANSPARENCY	RARELY 42%	MOSTLY 27%	ALWAYS 30%
Informed water users	To improve	To improve	To improve
Transparent WSS actions	To improve	Improving	Good
Information about water basin planning	To improve	Good	Good
4. RULE OF LAW	RARELY/ALWAYS 25%	ALWAYS 53%	ALWAYS 75%
Evidence of good practices	To improve	Improving	Improving

Watershed committee fund's execution	No improvement	Good	Good
Decisions according to water law	To improve	Good	Good
5. ACCOUNTABILITY	ALWAYS 31%	ALWAYS 54%	ALWAYS 67%
Financial management	To improve	Good	Good
Supervision from other levels	Improving	Good	Good
State institutions influence	Improving	Good	Good
Public audits	To improve	To improve	To improve
6. CONFLICT RESOLUTION	PARTIALLY 25%	PARTIALLY 28%	ALWAYS 33%
Solved customer complaints	To improve	Improving	Good
No Political or economic privileges	Improving	Improving	Improving
Multiple uses	Improving	Good	Good
7. PARTICIPATION	NEVER/ALWAYS 29%	ALWAYS 60%	ALWAYS 60%
Regular meetings	To improve	Good	Good
Watershed Committee members	To improve	Good	Good
Watershed Council members	To improve	Good	Good
Different sectors participation	To improve	Good	Good
8. AWARENESS	RARELY 42%	PARTIALLY 50%	PARTIALLY 42%
Conscious citizens	To improve	To improve	Improving
Environmental Education	To improve	Improving	Improving
9. EQUITY	NEVER 42%	PARTIALLY 35%	RARELY 27%
Budgetary plans for marginalized sectors	To improve	Improving	Improving
Decreasing disparities between rural and urban gap in WSS	To improve	Improving	Improving
10. ARTICULATION/MOBILIZATION	NEVER 25%	ALWAYS 69%	ALWAYS 86%
Projects Water Resources Planning (focus WSS)	Improving	Very good	Very good
Projects Payment for Ecosystem Services	To improve	Very good	Very good
Projects related to preservation and conservation	Improving	Good	Very good

In the next table, it will be possible to see few examples of current actions that under the explanation of (Lemos & Agrawal, 2006) are contributing mechanisms to the water sector governance in the selected cases. These hybrid “environmental governance” examples enhance the stakeholder dialog and participation in common issues. These initiatives are the engine for a successful integrated water resources management in which common concerns and demands are solved among different actors. Although the case of the concessionaries and the political or technical decisions rarely depend on the directly affected –end water services users-, the participation and awareness toward WSS dynamics has been continuously increasing in all studied areas.

Table 16 - Multipartner Governance Mechanisms

WATERSHED	CURRENT ACTIONS CLASSIFIED UNDER THE SCOPE OF MULTIPARTNER GOVERNANCE MECHANISMS		
	PUBLIC-PRIVATE PARTNERSHIP	PUBLIC-SOCIAL PARTNERSHIP	CO-MANAGEMENT
GUAPI – MACACU	None	None	Sub- watershed committee (early stage)
GUANDU	None	<u>Productor de Água e Floresta (PES):</u> Recover degraded areas and promote conservation of the Atlantic Forest in rural properties through payment for ecosystem services.	Watershed committee + Watershed agency
LAGOS SÃO JOÃO	<u>Aguas de Juturnaiba PROLAGOS</u> Concessionary contracts between the state and private companies for water supply and sanitation.	<u>FUNBOAS:</u> Instrument of Participative Environmental Management Program in Micro watersheds, part of the Watershed Committee Plan of Lagos São João. Stimulates the synergistic action of the partner institutions (INEA, Rio Rural, Municipal Secretaries, Watershed Committee, Associação Mico Leão Dourado, Rural producers, WWF-Brazil). Proportions incentives for environmental services to those who directly or indirectly conserve natural resources.	Watershed committee+ Watershed agency

7 Conclusions and recommendations

This research project strived to give a complete overview of water governance in selected watersheds of Rio de Janeiro, through a theoretical and legal framework revision as well as through a specific case study analysis. After analyzing the particular context of each studied watershed and the results presented in Chapter 6, interesting approaches came out. It was possible to determine that there are in general, appropriate institutional and legal conditions for water governance in the state of Rio de Janeiro. The implementation of these legal precepts is a challenge that has been led by INEA and the articulated institutions such as the watershed agencies AGEVAP and CILSJ. The mere execution of decisions related to water resources is not an isolated process but strictly depends on how the stakeholder – dialog takes place in the watershed committees. That is why both, the watershed committee and the water agency belong to a successful planning and implementing of water resources.

The attempt of this research was to identify most relevant situations that affected water governance. The results aim to motivate the discussion toward the problem drivers and the positive strategies that have improved governance in some of the analyzed cases. In some extend, the overview of successfully implemented actions (FUNBOAS, Productor de Agua), represents a benchmarking exercise that helped to identify that best practices can also been achieved in micro contexts. These are of particular relevance for watersheds located in rural areas.

After analyzing the current situation, it is evident that an intensive integration and participation of different sectors is required. As many issues are responsibility of the municipal level, a higher participation and awareness is unavoidable. A close interaction between municipal level authorities and water management institutions is a key factor to formulate functional actions in this sector. The water management institutions count on the know-how and technical expertise to support municipalities in this endeavor. Another aspect that needs to be taken into account is the effective monitoring of water resources, as a tool to improve the level of information for effective decision-making. It is also

important to promote a higher flow of information regarding water resources (in particular water supply and sanitation issues and good practices) and advocate environmental education programs. In order to reach this objectives there might be some suitable pathways that can help to improve water governance and water management.

Microwatersheds management

The IWRM main principle is basin as management unit. This has been the key factor for successful management of water resources but it has been being adopted gradually during the last years. When issues are addressed locally and taking into account the particular context they can be solved promptly. Nevertheless, it is very important to establish the connections with the community and big users that has a direct relation or interdependence with the basin. Social and economic aspects should be closely linked to the sustainable water resources management. This can be better addressed in the micro level. As Michael Völcker explained in a personal interview: “we cannot think about cooperative water management or environmental education if the population does not have the basic needs covered. Joining environmental and social issues is a sustainability challenge”.

Rural sanitation solutions and Community empowerment

One of the main problems is still the deficiency in the water sanitation infrastructure, particularly in most of the rural areas of important water basins. This is a major challenge and requires the empowerment of communities at the local level. Today, there exist numerous solutions for the local level that are affordable and could easily be sponsored by municipal governments or watershed institutions. Nevertheless, it is not only a matter financial availability but also about motivated individuals that are committed with the basins and the environment and contribute to the sustainability of these initiatives. The awareness and commitment should be the result of common governmental actions that focus on environmental education. As rural areas are not commercially nor operational attractive, the solutions for sanitation problems should be the result of empowered communities that can also receive support and retribution from the government levels.

Private sector participation: the good partnerships

This research constitutes a good example of successful integration of the private sector in the water supply and sanitation services sector. Through the Lagos São João and Niteroi experiences it can be assumed that combination can work well with a good legal framework and active civil society that claims for the demands of the community. Effective cooperation between socially responsible private actors can result on universal and good quality service provision. It is important to be aware about the tariffs that the end users pay and how fairly implemented. A further study could conduct a research focused on the direct end water users-relationship to water governance with focus on supply and sanitation.

Processo	Projetos	Valor do Projeto		Liberado INEA 2010	Liberado INEA 2011	Total Liberado INEA	Recursos Comprometido a liberar FUNDRHI	Status
		Valor FUNDRHI	Contrapartida					
Região Hidrográfica II - Guandu								
E07/506181/2009	Produtores de Águas	40.000,00		35.000,00		35.000,00	5.000,00	Em Andamento
E07/502383/2010	Convênio FUNASA e Prefeitura de Paracambi	2.839.703		944.139,74	1.895.563,26	2.839.703,00	-	Liquidado
E07/101252/2008	Contratação de Assessoria Jurídica	58.650,00		24.437,50		58.650,00	-	Liquidado
E07/100551/2008	Impressão de 500 exemplares do PERH	148.500,00		148.500,00		148.500,00	-	Liquidado
E07/501000/2010	Curso de Capacitação Serviços Ambientais	3.200,00		3.200,00		3.200,00	-	Liquidado
E07501720/2010	Curso Avançado de Licitações e Contratos Administrativos (Elizabeth Machado)	2.115,00		2.115,00		2.115,00	-	Liquidado
E07502399/2010	Contratação de Serviço de Alimentação p/ I Workshop do Comitê Guandu	4.390,00		4.390,00		4.390,00	-	Liquidado
E07/503636/2010	Carta Convite (Operacionalização da SEC EXEC Guandu).	98.330,31		98.330,31		98.330,31	-	Liquidado
E07/502841/2010	Contrato de Gestão com a AGEVAP - 1º ano	1.711.652,00		711.957,32	999.694,68	1.711.652,00	-	Liquidado
E07/000246/2010	Estudo de concepção e projeto básico do sistema de esgotamento sanitário do distrito Sede e Engenheiro Pedreira - Japeri	700.000,00		700.000,00		700.000,00	-	Liquidado
E07/000.129/2010	Obras do Sistema de esgotamento sanitário Municipal de Pirai	2.846.379,88		2.846.379,88		2.846.379,88	-	Liquidado
E-07/503.964/2009	Projeto avaliação da qualidade ambiental do Reservatório de Tocós	114.158,70			114.158,70	114.158,70	-	Liquidado
E07/506173/2009	Despesas da Diretoria Colegiada (Diárias). Antigo Contratação de Agência de Viagens E07/506173/2009	75.000,00			75.000,00	75.000,00	-	Liquidado
E07502211/2011	Produtores de Águas e Florestas (Recursos Arrecadados em 2010)	200.000,00			200.000	200.000,00	-	Liquidado
E07/500688/2009	Comunicação Social	229.491,88			229.491,88	229.491,88	-	Liquidado

ANNEX A Source (Texeira, 2010)

Processo	Projetos	Valor do Projeto		Liberado INEA 2010	Liberado INEA 2011	Total Liberado INEA	Recursos Comprometido a liberar FUNDRHI	Status
		Valor FUNDRHI	Contrapartida					
Região Hidrográfica VI - Lagos São João								
E07503234/2010	Contrato de Gestão com a CILSJ - 2º ano	205.600,00			137.066,67	137.066,67	68.533,33	Em Andamento
E-07/506799/2009	Impressão de material gráfico de educação ambiental	4.819,38		4.819,38		4.819,38	-	Liquidado
E07 503234/2010	Contrato de Gestão com a CILSJ - 1º ano	172.036,58		114.691,06	57.345,52	172.036,58	-	Liquidado
E07509243/2010	Programa de Monitoramento - 2008	139.712,81		139.712,81		139.712,81	-	Liquidado
E07509243/2010 E07510084/2010	Programa de Monitoramento - 2009	300.000,00		300.000,00		300.000,00	-	Liquidado
E07509348/2010	FUNBOAS - 2008	69.856,40		69.856,40		69.856,40	-	Liquidado
E07509457/2010	Programa de Educação Ambiental - 2008	69.856,40		69.856,40		69.856,40	-	Liquidado
E07101947/2008	Projeto de Renaturalização do Rio São João - 2008	76.842,04			76.842,04	76.842,04	-	Liquidado
E07501087/2011	FUNBOAS - 2009	100.000,00			100.000,00	100.000,00	-	Liquidado
E07504439/2011	Programa de Fortalecimento da Pesca Artesanal - 2009	100.000,00			100.000,00	100.000,00	-	Liquidado
E07501096/2011	Ampliação do Banco de Dados da Bacia SIG - 2009	80.000,00			80.000,00	80.000,00	-	Liquidado
E07502701/2011	Programa de Educação Ambiental e Comunicação Social do CBH Lagos São João - Ano Base 2009	150.000,00			150.000,00	150.000,00	-	Liquidado
E07509452/2010	Programa de Comunicação e Divulgação - 2008	62.870,76		62.870,76		62.870,76	-	Liquidado
E07/510605/2010	Programa de Zoneamento dos usos Múltiplos - 2009	100.000,00		100.000,00		100.000,00	-	Liquidado

ANNEX B

WATER GOVERNANCE ASSESSMENT FORM

NAME:

SEX	
a	Fem
b	Male

STAKEHOLDER GROUP	
a	Civil society
b	Federal institution
c	State institution
d	Municipal institution
e	Private sector
f	Other

AGE GROUP	
a	0-21
b	21-29
c	30-39
d	40-49
e	50-59
f	<60

WATERSHED	
a	Guapi- Macacu
b	Guandu
c	Lagos São João

GOVERNANCE CRITERIA			IDEAL SITUATION					DOESN'T HAPPEN ← -- → ALWAYS HAPPENS					I DON'T KNOW
								0%	25%	50%	75%	100%	
1.1	EFFECTIVENESS	1.1.1	Planning and management of water resources among this watershed, reflects its priorities in terms of water supply and sanitation.										
		1.1.2	Planning and management actions are clear for stakeholders the watershed region.										
		1.1.3	Planning and management actions respond adequately to the development priorities of the different municipalities that are part of the watershed.										
		1.1.4	Planned activities in the watershed have been implemented and the goals have been achieved in terms of water supply and sanitation.										
		1.1.5	According to your point of view, the citizens are in general, satisfied with the delivered services related to water supply and sanitation.										
		1.1.6	Drinking water has been supplied to all the municipalities that are located in the										

			watershed.							
		1.1.7	The water is clean and of good quality, responding to the required patterns established in the legislation.							
		1.1.8	Planning and management of water resources among this watershed are being done in accordance with what is stipulated by the watershed committee.							
GOVERNANCE CRITERIA			IDEAL SITUATION	DOESN'T HAPPEN ← -- → ALWAYS HAPPENS					I DON'T KNOW	
				0%	25%	50%	75%	100%		
	If needed, justify or clarify the answers given above.									
1.2	EFFICIENCY	1.2.1	The institutions related to water resources planning and management in this watershed, perform well. This means, they achieve the defined goals in the committee, actions are monitored and not accomplishment has some consequence.							
		1.2.2	Programs and actions are implemented and take into account the users' needs in terms of water supply and sanitation.							
		1.2.3	The budget assigned in this watershed for water resources planning and management, is realistic and adequate in order to attend the demands.							
		1.2.4	Problems like water leaks are solved promptly.							
		1.2.5	Disputes and reclamations between/ from users are solved promptly.							
		1.2.6	The cooperation regarding to water resources planning and management, between state, municipal and private levels is of good quality and benefits the watershed interest.							
	If needed, justify or clarify the answers given above.									
2.1	TRANSPARENCY	2.1.1	The water users of this watershed are informed about their rights and about the							

			quality of the service that they receive.							
		2.1.2	The institutions related to water supply and sanitation in this watershed region give actual information to their citizens, related to water resources management, projects and problems in the basin.							
		2.1.3	Information about water resources planning and management in this watershed, financial resources, proposals and reports are released in some way to all citizens.							
		2.1.4	Decision-making processes regarding to resource allocation for water supply and sanitation in the watershed, are transparent and the information related to this matters are available to the public.							
		2.1.5	Non-governmental organizations or other kind of civil society representation are welcomed to know and share the information related to water resources planning and management in the watershed as well as to participate in different projects and programs							
GOVERNANCE CRITERIA			IDEAL SITUATION	DOESN'T HAPPEN ← -- → ALWAYS HAPPENS					I	
				0%	25%	50%	75%	100%	DON'T KNOW	
	If needed, justify or clarify the answers given above.									
2.2	RULES AND LAWS	2.2.1	There are evidences of good practices in relation with resources allocation for water x planning and management in this watershed (water supply and sanitation).							
		2.2.2	All the watershed's committee expenses are according to the budget and to the financial regulations of the local governments.							
		2.2.3	The decisions are taken according to the legal framework and the established procedures.							
	If needed, justify or clarify the answers given above.									

3.1	ACCOUNTABILITY	3.1.1	The financial and assets management of the watershed committee attends the regulations established in the national water resources law.									
		3.1.2	There exists supervision from federal, state and municipal authorities regarding the planning and management of water resources in this watershed.									
		3.1.3	There exist public auditing related to resources investment in the watershed committee.									
		3.1.4	The water resources planning and management strategies are defined in the watershed committee counting with the participation of different stakeholders.									
		3.1.5	The state authorities participate in the decisions related to water resources in this watershed.									
		3.1.6	The information source of the institutions that perform in the water resources planning and management in this watershed is of good quality.									
		3.1.7	The decisions related to the water resources planning and management, are taken in public, respecting the opinion of opposition and minorities.									
	If needed, justify or clarify the answers given above.											
GOVERNANCE CRITERIA			IDEAL SITUATION					DOESN'T HAPPEN ← -- → ALWAYS HAPPENS		I DON'T KNOW		
								0%	25%		50%	75%
3.2	CONFLICT RESOLUTION	3.2.1	There exist mechanisms to manage customers complaints related with water supply and sanitation services and the citizens use them effectively.									
		3.2.2	The political or economic aspects do not drastically interfere or privilege any stakeholder group in the water resources planning and management processes.									
		3.2.3	The conflict resolution related to water resources in this watershed is done in an impartial way, attending the multiple uses demand of the resource.									
	If needed, justify or clarify the answers given above.											

4.1	PARTICIPATION	4.1.1	Regular meetings occur among citizens and these enable them to participate and communicate their needs and opinions in relation with water resources in this watershed.						
		4.1.2	The institution that you represent has a representative in the watershed committee.						
		4.1.3	The institution that you represent has a representative in the State Council of water resources. – RJ (CERHI-RJ).						
		4.1.4	The different sectors of society (public and private, urban and rural) participate in the water resources planning and management in this watershed.						
	If needed, justify or clarify the answers given above.								
4.2	AWARENESS	4.2.1	The citizens are conscious about their rights and prerogatives related with water resources and are able to reclaim them in a constructive way.						
		4.2.2	The institutions that act in the water resources planning and management in this watershed, are active and effective in providing environmental education for their citizens, specially regarding to their rights and responsibilities among water resources						
		4.2.3	Non-governmental organizations are well prepared and represent the citizens' interests.						
	If needed, justify or clarify the answers given above.								

			0%	25%	50%	75%	100%	
5	EQUITY	5.1	Water supply and sanitation services are given in an equitable way among all citizens (high and low rent)					
		5.2	Budgetary plans are being implemented in order to attend the most					

			marginalized sectors of the population.						
		5.3	The water supply and sanitation service disparities between urban and rural areas have been minimized.						
		5.4	There exists some successful policy, program, project or strategy related with genre equity (women) related with water resources.						
	If needed, justify or clarify the answers given above.								
6	ARTICULATION/ MOVILIZATION	6.1	<p>There are projects related to water resources planning and management that have been currently implemented (focus on water supply and sanitation).</p> <ul style="list-style-type: none"> • Name: • Leading institution: • Partners: • Budget: • Objective and or benefited population: 						
		6.2	<p>There are current programs related to Payment for ecosystem services</p> <ul style="list-style-type: none"> • Name: • Leading institution: • Partners: • Budget: • Objective and or benefited population: 						
		6.3	<p>There are current programs or projects related to preservation and conservation of areas of aquifer recharge, headwaters or riparian forests.</p> <ul style="list-style-type: none"> • Name: • Leading institution: • Partners: • Budget: • Objective and or benefited population: 						
	If needed, justify or clarify the answers given above.								

ANNEX C – Interviewed stakeholders and results records

GUAPI – MACACU INTERVIEWED STAKEHOLDERS				
#	INTERVIEWED NAME	POSITION	INSTITUTION	STAKEHOLDER LEVEL
1	Gabriela Viana	Consultant	Instituto Bioatlântica	CIVIL SOCIETY
2	Nicholas Locke	Director	REGUA- Reserva Ecológica de Guapiaçu	CIVIL SOCIETY
3	Pablo Azevedo Ferraiz	Technical Advisor	Secretaria Municipal de Agricultura, Prefeitura Cachoeiras de Macacu	MUNICIPAL LEVEL
4	Thabta Matos Da Mata	Technical Advisor	Prefeitura Cachoeiras de Macacu	MUNICIPAL LEVEL
5	Marcos Medeiro	Director	AMAE, Cachoeiras de Macacu	MUNICIPAL LEVEL
6	Marlene Rodriguez	General Secretary	Secretaria Municipal de Agricultura, Prefeitura Guapimirim	MUNICIPAL LEVEL
7	Reinaldo Guedes Ferreira	General Secretary	Secretaria Municipal de Meio Ambiente, Prefeitura Itaboraí	MUNICIPAL LEVEL
8	Ana Luiza Dias	Environmental Department Manager	Schincariol, Cachoeiras de Macacu	PRIVATE SECTOR
9	Ninon Machado de Faria Leme Franco	Executive Director	Instituto Ipanema	CIVIL SOCIETY
10	Dora Hees De Negreiros	Director	Instituto Baía de Guanabara	CIVIL SOCIETY
11	Claudia Barros	Corporate Social Responsibility Advisor	Águas de Niterói	PRIVATE SECTOR
12	Fatima de Lourdes Casarin	Water Management Support/PES	Secretaria de Estado do Ambiente (SEA)	STATE LEVEL

WATERSHED	GUAPI - MACACU											
INTERVIEWED CODE	1	2	3	4	5	6	7	8	9	10	11	12
GENDER	F	M	M	F	M	F	M	F	F	F	F	F
EFFECTIVITY												
1.1.1	25	25	25	50	50	25	100	0	0	25	75	0
1.1.2	25	25	25	25	0	25	25	25	0	0	25	25
1.1.3	25	25	75	0	25	25	50	25	0	0	50	0
1.1.4	25	50	75	50	25	25	0	NA	0	25	25	NA
1.1.5	25	75	25	50	50	25	25	0	0	25	75	0
1.1.6	0	75	75	75	75	0	25	0	0	50	100	100
1.1.7	0	75	75	75	75	50	50	100	25	75	100	100
1.1.8	0	75	75	50	25	25	75	NA	25	0	75	0
EFFICIENCY												
1.2.1	0	25	75	50	50	25	25	NA	25	0	75	0
1.2.2	0	25	25	50	50	25	25	NA	25	50	100	25
1.2.3	0	25	25	0	0	NA	NA	NA	25	50	25	0
1.2.4	0	50	75	0	100	100	50	75	NA	0	100	0
1.2.5	0	75	25	25	100	50	50	25	25	0	75	NA
1.2.6	25	75	75	50	50	75	50	NA	50	0	75	25
TRANSPARENCY												
2.1.1	25	50	25	0	25	75	25	25	50	NA	100	50
2.1.2	0	0	25	25	75	25	25	75	NA	50	75	0
2.1.3	0	0	25	0	75	25	50	50	NA	25	0	NA
2.1.4	0	0	25	25	25	25	50	NA	NA	75	50	NA
2.1.5	100	50	25	25	100	100	NA	75	NA	50	100	75
RULE OF LAW												
2.2.1	NA	50	25	50	100	100	NA	25	NA	25	100	100
2.2.2	NA	25	25	25	25	NA	NA	NA	NA	0	100	100
2.2.3	NA	50	25	25	50	100	NA	NA	0	0	100	100
ACCOUNTABILITY												
3.1.1	NA	25	75	75	25	NA	NA	NA	0	0	100	75
3.1.2	100	100	75	75	25	75	50	100	100	50	100	100
3.1.3	100	NA	25	NA	100	NA	NA	NA	100	0	0	NA
3.1.4	0	NA	75	75	100	100	50	NA	0	0	100	100
3.1.5	75	25	75	100	100	100	NA	100	100	100	100	100
3.1.6	75	NA	75	50	25	75	50	25	0	0	75	0
3.1.7	50	25	25	0	100	25	NA	NA	100	0	100	100
CONFLICT RESOLUTION												
3.2.1	100	25	75	50	100	75	50	75	NA	NA	100	NA
3.2.2	50	25	25	100	100	100	NA	NA	NA	0	75	50
3.2.3	50	50	75	25	50	25	NA	50	100	50	75	100
PARTICIPATION												
4.1.1	75	50	25	50	100	0	50	NA	25	50	100	25
4.1.2	0	0	75	100	100	100	100	0	0	100	100	100
4.1.3	0	0	25	0	0	NA	0	0	0	0	100	100
4.1.4	75	50	75	50	0	25	75	0	100	50	100	100
CONCIENTIZATION												
4.2.1	25	50	75	25	25	25	25	NA	50	25	25	25
4.2.2	75	50	25	50	50	25	50	0	25	75	50	25
4.2.3	75	75	25	50	25	75	50	0	50	50	50	25
EQUITY												
5.1	0	100	25	0	100	25	50	0	0	0	100	0
5.2	0	100	25	0	25	0	NA	NA	0	0	50	0
5.3	0	100	25	50	50	75	NA	NA	0	0	75	25
5.4	0	100	25	0	25	0	NA	NA	0	25	0	0
ARTICULATION/MOBILIZATION												
6.1	50	0	25	75	100	0	NA	NA	50	75	75	100
6.2	0	0	25	0	100	0	NA	NA	0	75	0	100
6.3	50	50	75	75	50	0	NA	NA	25	75	75	NA

GUANDU INTERVIEWED STAKEHOLDERS				
#	INTERVIEWED NAME	POSITION	INSTITUTION	STAKEHOLDER LEVEL
1	Ninon Machado de Faria Leme Franco	Executive Director	Instituto Ipanema	CIVIL SOCIETY
2	Decio Tubbs	Committee Director	Committee Guandu/ UFRJ	CIVIL SOCIETY
3	Nelson Rodrogues dos Reis Filho	NGO Director	OMA-BRASIL	CIVIL SOCIETY
4	Daniel Shimada Brotto	Teacher/Researcher	Universidade Veiga de Almeida	CIVIL SOCIETY
5	Eloisa Torres	Superintendent	Secretaria de Estado do Ambiente (SEA)	STATE LEVEL
6	Elaine Gonçalves de Arruda Assis	Environmental Education Superintendent	Secretaria Municipal de Meio Ambiente de Paracambi	MUNICIPAL LEVEL
7	Ricardo Luiz Nogueira de Souza	Environmental Director	Secretária Municipal do Ambiente, Seropédica	MUNICIPAL LEVEL
8	Glaucia Freitas Sampaio	Participative Water Management Director	INEA	STATE LEVEL
9	Michelle Fernanda dos Santos Oliveira	General Secretary	Secretária Municipal do Ambiente, Japerí	MUNICIPAL LEVEL
10	Madalena Sofia Avila Cardoso de Oliveira	General Secretary	Secretária Municipal do Ambiente - Barra do Piraí	MUNICIPAL LEVEL
11	Sebastiana Maria Bonfim Cesario	Superintendent	INEA, Superintendência Regional Baía de Sepetiba - SUPSEP	STATE LEVEL
12	Jose Luiz Governo de Souza	Consultor PJ- Relações Governamentais	ThyssenKrupp	PRIVATE SECTOR

WATERSHED CODE	GUANDU											
INTERVIEWED CODE	1	2	3	4	5	6	7	8	9	10	11	12
GENDER	F	M	M	M	F	F	M	F	F	F	F	M
EFFECTIVITY												
1.1.1	75	100	25	75	50	50	50	75	50	100	75	75
1.1.2	25	25	25	100	25	50	100	50	50	75	50	75
1.1.3	50	25	50	75	25	25	100	25	50	75	50	50
1.1.4	25	50	50	50	50	25	75	50	50	75	50	50
1.1.5	0	50	50	0	25	25	75	25	25	50	50	50
1.1.6	25	50	75	100	25	50	75	50	25	50	75	75
1.1.7	50	75	100	100	75	75	75	25	100	75	100	75
1.1.8	50	100	50	100	50	50	100	50	50	100	50	50
EFFICIENCY												
1.2.1	50	50	50	75	25	25	50	50	0	75	50	50
1.2.2	75	75	75	25	50	50	75	100	50	75	50	50
1.2.3	75	NA	75	0	75	50	100	75	50	75	50	50
1.2.4	NA	NA	75	0	25	25	50	25	75	50	25	75
1.2.5	100	50	50	NA	50	25	NA	50	50	75	25	75
1.2.6	75	50	50	75	75	50	100	75	50	75	25	50
TRANSPARENCY												
2.1.1	75	NA	75	75	25	50	NA	100	25	75	75	50
2.1.2	50	75	50	0	50	25	100	50	25	75	50	50
2.1.3	75	75	100	NA	0	25	75	NA	50	75	NA	50
2.1.4	50	100	75	NA	25	25	100	0	50	100	NA	50
2.1.5	50	100	75	75	75	25	100	100	75	100	100	50
RULE OF LAW												
2.2.1	NA	25	50	100	100	50	50	100	75	75	100	50
2.2.2	50	100	75	100	100	75	100	100	100	100	100	75
2.2.3	100	100	75	100	100	NA	100	100	75	100	75	75
ACCOUNTABILITY												
3.1.1	50	100	75	100	100	75	100	100	NA	100	100	100
3.1.2	100	100	100	100	75	100	75	100	75	100	50	100
3.1.3	100	100	75	NA	NA	100	NA	100	100	NA	NA	0
3.1.4	75	75	100	100	100	100	100	100	75	100	100	100
3.1.5	100	75	75	100	100	100	100	100	75	100	100	100
3.1.6	75	50	75	75	75	75	75	75	75	100	75	75
3.1.7	100	100	75	100	75	75	75	75	75	100	75	100
CONFLICT RESOLUTION												
3.2.1	NA	50	50	NA	0	25	50	100	25	50	100	75
3.2.2	NA	25	25	50	50	75	75	100	25	100	50	50
3.2.3	100	75	50	100	25	50	100	75	50	100	75	50
PARTICIPATION												
4.1.1	100	75	75	100	50	25	100	100	75	100	50	75
4.1.2	100	100	100	100	100	100	100	100	100	100	100	100
4.1.3	100	100	0	100	100	0	0	100	0	100	100	0
4.1.4	100	50	75	100	75	50	75	100	0	100	75	100
CONCIENTIZATION												
4.2.1	50	25	25	50	0	25	50	25	25	25	50	50
4.2.2	75	NA	25	100	25	50	50	50	50	75	50	50
4.2.3	75	50	50	25	50	50	75	50	25	75	50	50
EQUITY												
5.1	0	100	25	25	50	25	50	75	25	50	50	50
5.2	0	NA	25	25	25	25	50	75	25	50	50	50
5.3	75	25	50	25	25	50	25	25	50	25	50	50
5.4	0	0	75	0	NA	50	100	100	75	50	NA	50
ARTICULATION												
6.1	75	100	100	100	100	75	100	100	NA	100	100	100
6.2	75	100	100	100	100	75	100	100	NA	100	100	100
6.3	25	100	75	NA	100	75	100	100	NA	100	100	100

LAGOS SAO JOAO INTERVIEWED STAKEHOLDERS				
#	INTERVIEWED NAME	POSITION	INSTITUTION	STAKEHOLDER LEVEL
1	Fatima de Lourdes Casarin	Water Management Support/PES	Secretaria de Estado do Ambiente (SEA)	STATE LEVEL
2	Eloisa Torres	Superintendent	Secretaria de Estado do Ambiente (SEA)	STATE LEVEL
3	Glauca Freitas Sampaio	Participative Water Management Director	INEA	STATE LEVEL
4	Felipe Vitorino	Sanitation Coordinator	Aguas de Juturnaiba	CIVIL SOCIETY
5	Natalia Ribeiro	Technical Coordinator	Consórcio Intermunicipal Lagos São João	CIVIL SOCIETY
6	Claudio Michel Völcker	Director	Organização Ambiental para o Desenvolvimento Sustentável	CIVIL SOCIETY
7	Ricardo Machado	Technical Advisor	Secretaria Municipal de Ambiente Prefeitura de Araruama	MUNICIPAL LEVEL
8	Ezequiel Moraes	Environmental Secretary	Secretaria Municipal de Ambiente Prefeitura de Silva Jardim	MUNICIPAL LEVEL
9	Denise Spiller	Technical Coordinator	Consórcio Intermunicipal Lagos São João	CIVIL SOCIETY
10	Sival Silva Lima	Representative ALA	Associação Livre dos Aquicultores - Rede Solidária da Pesca	MUNICIPAL LEVEL
11	Arnaldo Villa Nova	General Secretary	Associação De Defesa Da Lagoa De Araruama Viva Lagoa	CIVIL SOCIETY
12	Paula Medina	Executive Director	Prolagos	PRIVATE SECTOR

WATERSHED CODE	LAGOS SAO JOAO											
INTERVIEWED CODE	1	2	3	4	5	6	7	8	9	10	11	12
SEX	F	F	F	M	F	M	M	M	F	M	M	F
EFFECTIVITY												
1.1.1	75	75	75	25	75	50	50	75	25	75	75	100
1.1.2	100	50	50	25	50	75	25	50	25	50	75	100
1.1.3	75	50	50	25	50	75	50	50	25	75	75	100
1.1.4	100	50	75	100	75	50	100	50	50	50	75	100
1.1.5	50	50	NA	50	50	25	50	50	50	25	75	75
1.1.6	100	50	50	50	25	75	75	75	75	25	75	100
1.1.7	100	100	75	100	100	100	100	100	50	100	100	100
1.1.8	100	100	50	100	75	50	100	100	50	50	100	100
EFFICIENCY												
1.2.1	75	50	50	75	75	75	100	75	50	75	75	100
1.2.2	25	75	100	75	75	75	50	75	50	50	100	75
1.2.3	0	100	75	100	25	100	50	50	25	75	50	50
1.2.4	0	100	25	50	NA	100	NA	50	75	NA	100	100
1.2.5	NA	75	NA	75	25	50	NA	50	50	75	75	100
1.2.6	100	100	75	100	75	75	75	75	75	75	75	100
TRANSPARENCY												
2.1.1	75	50	100	75	50	100	25	50	50	50	100	100
2.1.2	NA	75	75	75	75	100	25	25	75	NA	100	100
2.1.3	NA	25	NA	100	75	100	25	50	75	25	100	100
2.1.4	NA	50	75	100	75	50	100	25	50	25	100	100
2.1.5	75	75	100	100	100	100	100	100	100	100	100	100
RULE OF LAW												
2.2.1	100	100	100	100	75	100	75	75	25	75	100	100
2.2.2	100	100	100	100	100	100	100	100	75	NA	100	100
2.2.3	100	100	100	75	100	100	100	100	50	100	100	100
ACCOUNTABILITY												
3.1.1	100	100	100	75	100	100	100	100	100	50	100	100
3.1.2	100	100	100	100	50	100	100	100	100	NA	100	100
3.1.3	NA	NA	100	100	25	100	NA	NA	100	NA	100	100
3.1.4	100	100	100	100	25	100	100	100	50	75	100	100
3.1.5	100	100	100	100	50	100	100	100	75	100	100	100
3.1.6	75	100	75	50	50	100	50	75	50	50	100	100
3.1.7	100	100	75	50	50	100	100	100	50	50	100	100
CONFLICT RESOLUTION												
3.2.1	NA	NA	100	100	NA	75	50	0	75	NA	100	50
3.2.2	50	NA	100	25	25	100	75	50	75	25	100	100
3.2.3	100	75	75	25	50	100	75	100	50	75	100	100
PARTICIPATION												
4.1.1	100	75	100	75	75	100	0	75	25	100	100	100
4.1.2	100	0	100	100	NA	100	100	100	0	100	100	100
4.1.3	100	100	100	100	NA	0	0	100	0	0	0	50
4.1.4	100	100	100	100	50	100	100	50	25	100	100	100
CONCIENTIZATION												
4.2.1	75	50	25	25	50	75	0	25	25	25	50	50
4.2.2	100	50	50	50	50	50	25	75	50	50	75	100
4.2.3	25	75	50	50	25	50	50	25	25	75	75	100
EQUITY												
5.1	25	75	75	100	75	100	25	100	25	NA	100	100
5.2	25	50	75	75	25	100	50	NA	25	50	100	100
5.3	0	50	25	25	25	75	25	25	25	50	50	0
5.4	0	NA	100	50	100	100	0	NA	25	NA	50	NA
ARTICULATION												
6.1	100	100	100	100	100	100	100	100	100	100	100	100
6.2	100	100	100	100	100	0	NA	100	100	100	100	100
6.3	NA	100	50	100	100	0	100	100	100	100	100	100

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