

# Challenges of multi-level water governance at micro-watershed level – A case from Rio de Janeiro, Brazil

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**Abstract.** The micro-watershed level can be a promising unit for the integration and coordination of water management functions that affect sustainable water use and livelihoods of local communities such as farmer groups. Recent projects in the state of Rio de Janeiro in Brazil have advocated interventions at this level. However, micro-watersheds are still not adequately incorporated in the multi-level governance systems of water and related ecosystems in Brazil. Further, a complex landscape of non-local actors and higher-level policies interact and determine resource use patterns at the micro-watershed level. This paper maps stakeholders and shows their influence areas on key water issues using the example of micro-watersheds in Rio de Janeiro. It also highlights the key challenges arising from the governance practice and the institutional framework related to micro-watersheds.

## 1. Introduction

Problem-solving of water issues at local watershed level is promoted as a part of effective participatory water governance and integrated approaches of water management [1]. Often, micro-watersheds exhibit relatively uniform hydrological and ecological conditions as well as strong modes of local level decision-making [2]. They are thus promising for the management of water issues and the application of measures aiming at improving local life quality and ecological conditions and have been generally preferred as scale of intervention for watershed management [3,4]. Small territories are easier to manage when compared to large watersheds while results are easier to measure. Further, due to stronger social cohesion within micro-watersheds, communities might engage more easily in the implementation of new techniques for natural resources preservation, thus resulting in a better integration of needs and interests of local groups [5]. At the same time, it might be challenging for micro-watersheds to fit and relate to the already complex set of a basin management framework and other associated administrative levels (district, provincial and national) [6]. Problems of policy overlaps, fragmentation and the lack of accountability can emerge at the local level. This is especially true in countries with a complex, multi-level water governance system such as Brazil where water governance is still in a ‘state of flux’ and undergoing constant regulatory changes and institutional uncertainty [7]. Further, the issue of coordination and collaboration becomes even more important at a (micro) watershed level where water-related issues such as ecosystems management, agriculture and health are directly related to water governance [8].

In Brazil, micro-watershed programs have been widely implemented since the early 1980s in the

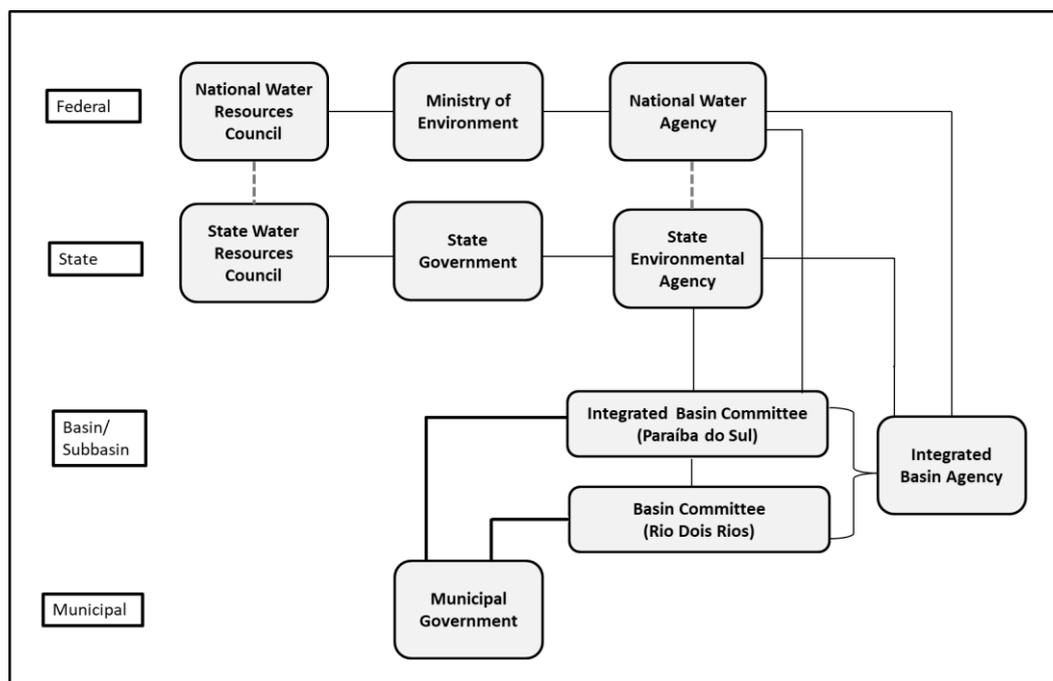


South and Southeast, and lately also in the Northeast [9,10]. The federal government has a micro-watershed program with a focus on providing information about good agricultural practices for water and soil conservation. However, this program consists of local projects with low impacts on communities and little integration while stronger programs are carried out by some state governments often supported by international donors [9]. Key characteristics of such programs are related to stakeholder participation, the combination of income-generation with conservation technology, and the incorporation of multi-sectoral and multi-institutional approaches [10]. Since 2006, the state of Rio de Janeiro has implemented a micro-watershed program which provides long-term support to small family farmers (78.000 small farmers) with the transition to eco-friendly productive systems [11].

This study analyzes the issue complexity and the actors influencing water governance at a typical micro-watershed, using the example of the state of Rio Janeiro in Brazil. The aim is to show how higher levels of water governance, together with local actors, are collaborating, competing and coproducing policies. The study also identifies integration challenges between water and ecosystems related issues at this vital water governance level. In Brazil, specific instruments and institutions for micro watershed governance do not exist as micro-watersheds do not represent an administrative level in the country's water resources institutional frameworks. Nevertheless, the National Water Law (NWL) allows for a high degree of decision-making for actors at the river basin level [12]. Decisions at this level impact micro-watershed since, according to the NWL, river basin institutions decide matters on subordinate levels, including the micro-watershed level [13]. While some topics are regulated through water-related legislation, farmers, agricultural stakeholders, and local authorities can shape land use and ecosystems issues. At the same time, state actors and municipalities need to coordinate with water stakeholders on key water-related issues such as water quality, water sharing, sanitation and supply and the protection of water bodies.

## **2. A typical set-up of stakeholders in a micro-watershed: example from the Rio Dois Rios River Basin**

A stakeholder mapping is presented in this section based on the analysis of official documents from state agencies, river basin committees and the municipality of Nova Friburgo. The mapping displays the stakeholder set-up related to the Rio Dois Rios (RDR) river basin and the Barracão dos Mendes (BDM) micro-watershed within the mountainous municipality of Nova Friburgo. The area is located inside the buffer zone of the Três Picos State Park, the major conservation unit of the state considered a biodiversity hotspot and one of the priority areas to conserve species of the Mata Atlântica forest [14]. In accordance with the NWL, which determines the river basin as the territorial unit for the implementation of the National Water Resources Policies (NWRP) [13], Rio de Janeiro State has its territory divided into nine hydrographic regions organized in river basin committees. The further division in micro-watershed units occurs due to the state program Rio Rural for Integrated Micro-Watershed Management (IMWM) aimed at reaching small farmers throughout the state and building micro-watershed committees (173 established as of 2016) responsible for the implementation of sustainable agricultural practices and the articulation of local communities [15]. This initiative has played a major role in building capacity and organizing civil society at the micro level due to a large number of micro-basin committees established in the region and the large scope of training received by communities and local farmer association members. An important achievement of the program is to support communities in articulating water and environmental related issues and the development of tailored measures to tackle them through strong participatory processes [16]. As for the water sector, the RDR river basin is nested within a complex political setting as presented in figure 1. This is due to the larger institutional framework of its upper basin Paraíba do Sul which crosses the states of São Paulo, Rio de Janeiro, and Minas Gerais. River basin plans, resolutions and investments are discussed, decided and planned in an integrated river basin committee and a basin agency with the support of state environmental agencies and the National Water Agency [7].



**Figure 1.** Mapping of institutions related to water resources management in the RDR river basin in the state of Rio de Janeiro. Modified from AGEVAP – Agency of the Paraíba do Sul Basin [17].

In the mapping presented in this section, micro-watershed stakeholders are divided into internal and external actors and categorized in types as ‘Water Users’ (WUs), ‘Civil Society’ (CS), and ‘Public Authority’ (PA) as to reflect the stakeholder’s classification in the NWL. Internal actors, as presented in table 1, refer to stakeholders that are permanently present and specifically address the micro-watershed. Farmers are themselves internal stakeholders often represented in small farmers associations. These associations also include other community members and have a representative and informative character as deliberative forums for community issues [15]. Small farmers associations are largely found in rural micro-watersheds in Rio de Janeiro State, where family farming is the predominant economic activity – 75% of the rural properties maintained by small family farms. Small farming establishments are responsible for most of the state's agricultural production. According to the Agricultural Census, farmers produce 68% of the beans, 75% of the manioc, 67% of the corn, 55% of the rice and 52% of the coffee [18].

**Table 1.** Key internal actors in micro-watersheds in Rio de Janeiro State.

Type	Stakeholder	Org. level <sup>a</sup>	Accountability level	Role/Sector
WUs	Farmers	MW <sup>b</sup>	Self-accountability	Agriculture
CS	Communities	MW	Self-accountability	Farmers interests/Community representation
PA	Municipal Gov.	M <sup>c</sup>	Municipal Gov.	Management of water supply and sanitation/Integration of water resources and other local policies
	Municipal Environ. Council	M	Municipal Gov.	Environmental counseling with public participation

External stakeholders as presented in table 2 are those from outside the micro-watershed providing regulations, knowledge, orientation, technical assistance or resources for this level. They come from different administrative levels and sectors. The most relevant ones for water resources management are those from the water, agricultural and environmental sectors. Stakeholders from the agriculture sector are often state agriculture extension institutions involved in initiatives related to research and implementation of sustainable agricultural practices such as the Rio Rural program.

**Table 2.** Key external actors in micro-watersheds in Rio de Janeiro State.

Type	Stakeholder	Org. level	Accountability level	Role/Sector
WUs	Water utility	M	Public/private companies	Water supply and sanitation
CS	NGOs	M	Self-accountability	Environmental protection and education
	Agricultural school	M	Municipal Gov.	Agricultural education
	Universities	M	Private/State Gov.	Higher environmental education/research
	Inter-municipal consortia	M	Municipalities	Environmental and water resources protection
	Association of engineers and architects	M	Municipal residents	Infrastructure
	Industry Federation	M	State industry federation (public-private partnership)	Industry
PA	Civil Defense Department	M	State Civil Department	Local culture preservation
	Basin committees	RB <sup>d</sup>	State Gov.	Risk and disaster management
	Basin agency	RB	Local and Integrated River Basin Committee	Water resources management
	State Environmental Agency	S <sup>c</sup>	Integrated River Basin Agency	Water resources management
	State Agriculture Extension Agency	S	State Gov.	Environmental management
	National Agency for Research in Agriculture	N <sup>f</sup>	State Gov.	Technical assistance and rural extension
			Ministry of Agriculture, Cattle, and Supply	Technological innovation in agriculture

<sup>a</sup> Organizational level for the operation of the stakeholder.

<sup>b</sup> Micro-watershed.

<sup>c</sup> Municipality.

<sup>d</sup> River Basin.

<sup>e</sup> State.

<sup>f</sup> National.

### 3. Issue-influence analysis of different stakeholders on the micro-watershed level

In this part, we analyze the influence of different stakeholders on several major issues related to water governance at the level of micro-watersheds. Some of the issues, e.g. water source protection, are closely related to the core functions of water governance. Table 3 summarizes the result from this analysis, with the shaded stakeholders identified as the most influential ones with regard to the specific examined issues. The examined issues and stakeholders' influence are explained in the following.

**Table 3.** Stakeholders' influence on vital water management and related ecosystem issues in the micro-watershed level.

Level	Raw Water Quality	Allocation	Sanitation	Water Source Protection
Federal	Ministry of Environment standards	National Council/ National Agency of water use permits(for extraction)/ charges collection	Water Ministry of Cities/ Ministry of Health standards coordination/ support/ funding	Ministry of Environment FC standards
State	State Water Council/ State Environmental Agency/ Secretary of Health water use permits (for discharge)/ raw water quality monitoring	State Water Council/ State Environmental Agency water user registration		Secretary of Environment/ State Environmental agency riparian and aquifer protection/ rural environmental registry/ program of environmental regulation
River Basin	Basin Committee/ Basin Agency classification of water bodies	Basin Committee/ Basin Agency use priorities/ permission exemption/ charges values	Basin Committee/ Basin Agency punctual sanitation actions	Basin Committee/ Basin Agency preservation areas/ classification of water bodies
Municipal			Municipal Gov. sanitation plans/drinking water quality monitoring	Municipal Gov. protection areas

### 3.1. Raw water quality management

River basin committees and agencies can play a leading role in guiding river basins and micro-watersheds towards water quality standards determined by the Ministry of Environment. They have the task of classifying their water bodies in classes according to the status quo of the water quality. They also determine water quality levels to be maintained or achieved over time. Micro-watersheds are important for the participatory classification process. Local stakeholders participate in deciding quality goals for the different river parts and developing strategies that fit local needs and pressures. After the deliberation of the proposed classification, programs of actions are developed with details on planned actions, costs, and deadlines for implementation and priorities. In cases where the classification process cannot be carried out as described, freshwater bodies are framed in class 2 which allows uses for protection of aquatic communities, recreation, aquaculture, human consumption after conventional treatment, fishing, restricted irrigation, animal welfare, navigation and landscape harmony [19].

### 3.2. Water allocation

In rivers of the federal domain (i.e. states crossing rivers), the National Water Agency (ANA) has the responsibility of awarding water use permits for extractions and collecting charges. This can be also delegated to state agencies, provided the institutions are technically capable. Nevertheless, basin committees and agencies are important for micro-watersheds as they can determine priority water uses in river basin plans, make suggestions for permit-free uses and decide on water use charges. According to the NWL [13], certain water uses can be freed from water permits and charges. This includes following uses: small populations in rural areas; water use from diversions and impoundments of water; and catchments or discharges that are considered insignificant. This is an important deliberation, as it might allow for some micro-watershed communities to be exempt from water permits and charges. In Rio de Janeiro state, state institutions are particularly important for micro-watershed on the water allocation issue since the state require family farmers to register as water users in order to be eligible for rural credits [20].

### 3.3. *Water supply and sanitation*

The water supply and sanitation sector in Brazil (officially described as only ‘basic sanitation’) includes services, infrastructure and operational facilities that cover water supply, sewage, urban cleaning, urban drainage, solid waste, and rainwater. Institutions at mainly the municipal and federal levels are responsible for providing sanitation and water supply services and financial support. Municipal governments are responsible for the elaboration and implementation of particular basic sanitation plans for the entire municipal areas as well as the decision about how to provide sanitation services (directly or delegated). It is also within the responsibility of the municipalities to find resources for elaboration and implementation of municipal sanitation plans. At the federal level, the Ministry of Cities and the Ministry of Health are responsible for setting standards for drinking water treatment and quality, coordinating, partly financing and supporting the development and implementation of sanitation plans in cities of small and medium size [21]. The state level does not seem to have much influence on sanitation, except through state water supply companies, when municipalities take these agencies under contract, as it is often the case in Rio de Janeiro state. Basin committees and agencies can also conduct some sanitation actions in rural areas since, according to the state law, up to 5% of collected revenues from water charges can be used for this purpose [20].

### 3.4. *Water source protection*

The NWL determines that basin plans should include priority areas for preservation of water bodies. Furthermore, through the classification of water bodies according to uses, plans for sustainable uses of areas surrounding water bodies can be developed [13]. In Rio de Janeiro, protection zones of riparian areas and aquifers are determined by state authorities in agreement with municipal authorities [20]. However, the main legal basis for the protection of water bodies is the federal Forest Code (FC) which regulates land use in rural areas and establishes legally binding Areas of Permanent Preservations (APPs). These APPs are forest preservation areas mainly aiming at protecting and conserving freshwater bodies. Moreover, the FC determines sustainable use of land in some vulnerable areas. Although standards are determined at federal level, the FC extends legislative authority for municipal governments to determine or expand further areas for protection, which should be undertaken in agreement with basin committees and the State Water Resources Council [22]. This current version of the FC is a result of a 2012 controversial reform. Main disagreement points were related to the reduction of the size of preservation zones in areas where farming settlements already exist, the loosening of land use restrictions in vulnerable areas, and changes concerning the definition of certain preservation areas. The new FC also introduced instruments that shall increase compliance with the law. In this regard, the two important novelties are the Rural Environmental Registry, a mandatory registry for rural owners with the aim of mainstreaming the environmental status of private rural properties, and a Program of Environmental Regulation that foresees several measurements to recover and preserve damaged areas detected in the registry [23]. The implementation of both policy instruments is mainly the responsibility of state authorities. With the new instruments, the FC has

increased states responsibilities in the protection of source water bodies.

In summary, river basin level institutions are relevant for micro-watersheds and, in some cases, key players for all issues considered in the analysis. Responsibilities are shared among basin and state level institutions in issues concerning water allocation and water source protection. Municipalities and federal level institutions are mainly responsible for water supply and sanitation, and can also determine protection areas for source water bodies.

#### **4. Challenges for water resources governance of micro-watersheds in Rio de Janeiro**

We highlight in this part key challenges that are likely to undermine the capacity of the legal and institutional water frameworks to function at the micro-watershed level. This is based on the earlier outlined analyses of stakeholders and underlying legislative frameworks, as well as on qualitative research via interviews with key experts during a field visit to RDR river basin and via secondary literature.

##### *4.1. Planning*

The NWRP establishes two important planning instruments: Water Resources Plans and Classification of Water Bodies. River basin plans are able to detect water- and ecosystem-related problems at the micro-watershed level and in some cases set them as priority issues. However, implementation gaps exist often due to lack of technical and financial capacities as it is the case in the RDR river basin and some of its micro-watersheds in remote rural areas. This also applies to the Classification of Water Bodies. Currently, only the Guandú river basin which supplies the metropolitan region of the state has carried out the classification [24]. In other cases, actions suggested in river basin plans are not implemented due to the lack of engagement of stakeholders that might not be willing to make concessions or have funds allocated [7, page 79]. This implementation gap influences measures that can be taken at micro-watershed level.

##### *4.2. Funding*

Water charges can be a valuable economic instrument to fund watershed protection and small sanitation projects in micro-watersheds in Rio de Janeiro, as established by state legislation. However, the level of charges raised varies largely in the different basins. Two main challenges were identified related to water charges in Rio de Janeiro: i) lack of agility and flexibility in the application of collected funds; ii) lack of awareness for rational water use in regions with chronic water shortages [25]. A further challenge in Rio de Janeiro concerns the political instability and the use of water resources revenues to pay other government debts [26]. In addition, water charges can only be collected from registered water users. Due to lack of awareness regarding the charges and lack of trust towards public authorities, registration still poses a hurdle for many small farmers.

##### *4.3. Policy coordination, integration and overlaps*

Integration and coordination of water resources policy with other policy areas is a further challenge. In Rio de Janeiro, this is especially the case concerning issues related to protection of water bodies. The determination of protected areas is a mutual task for basin agencies through basin plans and state environmental agencies which by law can determine riparian and aquifer protection zones. Further, municipalities can also determine protection areas within its directory plans. The coordination of programs beyond these policy instruments is also a challenge. As an example, the State Program of Conservation and Revitalization of Water Resources called PROHIDRO and its subprogram PRO-PSA for payment of ecosystem services are appealing for small farmers in micro-watershed as they foresee payments for the protection of water-related services and others [20]. The micro-watershed level is used in the program as a reference unit to determine the projects locations; however, projects are not always developed or implemented with the involvement of river basin institutions.

Another example concerns policy overlaps between water and ecosystems governance. Brazil's FC delegates the responsibility of setting protection areas for water bodies for state institutions and

municipalities while river basin agencies are also required by the NWL to determine protection areas. The classification of water body presents an ideal policy instrument to integrate the different mandates and stakeholders.

#### 4.4. Capacity of local institutions

Although river basin committees have broad important powers of deliberation and suggestion of issues and measures, the means of implementation are limited. Lack of resources and technical capacity hinder projects implementation for protection of water sources and sanitation projects. Further, a single RBC in the State of Rio de Janeiro is entitled to represent several sub-basins with no further coordination instances at lower levels. The representation of rural communities through small farmers association seems to be very low. In the RDR river basin, only one community is represented in the committee. Capacity is also a problem for municipalities.

### 5. Conclusion

The Rio de Janeiro case shows that, in the complex system of multi-level water and ecosystems governance, the micro-watershed might not be used effectively as an independent governance unit since much of the policy areas are defined by higher levels. Stakeholders at the higher basin or administrative levels retain much of regulatory and allocative powers according to the current water governance system and rarely choose to delegate them to micro-watershed levels. At the same time, the micro-watershed is utilized as a project and policy implementation level, while some state or donor programs choose to empower this level. In such cases, it is difficult to sustain participatory policymaking at this level considering the lack of financial and technical capacities of local institutions. Further, the diverse landscape of external actors with mandates to shape decisions on various issues related to micro-watersheds can negatively influence the ability of communities to co-produce governance arrangements for local issues. Such risk might be even higher in case of weak municipal or corrupt organizations or the lack of representation of community associations. Further, other problems exist such as policy overlaps and lack of coordination among stakeholders from different sectors (e.g. water and eco-systems) working on related or similar issues. Finally, the negligence of micro-watershed can lead to increased water and ecosystem related problems of rural communities and small farmers who often make an important contribution to the regional economy through agricultural production. In order to avoid this in the state of Rio de Janeiro, some large-scale projects with donor involvement (e.g. Rio Rural) have been advocating and supporting the important level of micro-watersheds.

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