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

ANALYSIS OF GOVERNANCE POTENTIALS AND CONSTRAINTS FOR DECENTRALIZED RURAL SANITATION SOLUTIONS IN RIO DE JANEIRO

THESIS TO OBTAIN THE DEGREE OF

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FOCUS AREA "ENVIRONMENTAL AND RESOURCES MANAGEMENT"

DEGREE AWARDED BY COLOGNE UNIVERSITY OF APPLIED SCIENCES

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SAN LUIS POTOSÍ, MÉXICO AUGUST 2015

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PROYECTO FINANCIADO POR:
PROYECTO "INTERGRATED ECO TECHNOLOGIES AND SERVICES FOR A SUSTAINABLE RURAL RIO DE JANEIRO" (INTECRAL)

PROYECTO REALIZADO EN:

ITT EN COOPERACIÓN CON EL PROGRAMA RIO RURAL

CON EL APOYO DE:
DEUTSCHER AKADEMISCHER AUSTAUSCH DIENST (DAAD)
CONSEJO NACIONAL DE CIENCIA Y TECNOLOGÍA (CONACYT)

LA MAESTRÍA EN CIENCIAS AMBIENTALES RECIBE APOYO A TRAVÉS DEL PROGRAMA NACIONAL DE POSGRADOS (PNPC - CONACYT)

Erklärung / *Declaración*

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Estoy de acuerdo con una publicación posterior de mi tesis de maestría en forma completa o parcial por las instituciones con la intención de exponerlos en el contexto del trabajo investigación de las mismas.

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ABSTRACT

This study undertakes an institutional assessment of decentralized wastewater treatment solutions applicable in rural areas of the state of Rio de Janeiro in order to identify governance potentials and constraints of the Brazilian rural sanitation sector. The results apply on a case study, conducted within the INTECRAL project in a rural settlement, Barracão dos Mendes, in the municipality of Nova Friburgo, with the purpose to identify necessary procedures for the implementation of a pilot wastewater treatment solution.

The Brazilian sanitation sector experiences multiple structural deficits and challenges to be approached. Rural areas are important water and food supplier and require sanitation measures to prevent environmental and health hazards. In spite of a great number of environmental laws and a sound legal framework for the water and sanitation sector, there are numerous obstacles, which impede the successful implementation of the Brazilian sanitation policies.

This work undertakes an analysis of the legal and institutional settings on federal, state, river-basin (Paraíba do Sul River Basin) and municipal levels. The results apply on the lower case-study level in the municipality of Nova Friburgo within the Rio Dois Rios river basin. The study defines the major challenges of the Brazilian rural sanitation sector and subsequently, for the regional case study level, and proposes recommendations and incentives for the future improvements. Given that Brazil lacks an integrative rural sanitation policy, this study provides an overall picture of the Brazilian sanitation sector.

Key-words: rural sanitation in Brazil, institutional assessment, decentralized rural sanitation solutions, wastewater treatment

RESUMEN

Para este trabajo se realizo el presente análisis institucional de soluciones descentralizadas en el tratamiento de aguas residuales aplicables en zonas rurales del Estado de Rio de Janeiro en Brasil, con el propósito de identificar los potenciales y limitaciones de gobernanza del sector de saneamiento rural brasileño. Los resultados obtenidos parten del estudio de caso llevado a cabo dentro del proyecto INTECRAL en el asentamiento rural de Barracão dos Mendes, en el municipio de Nova Friburgo, con el propósito de identificar los procedimientos necesarios y obtener una solución implementada para el programa piloto en el tratamiento de aguas residuales.

Al experimentar un múltiple déficit y un claro desafío estructural, el sector de saneamiento brasileño necesita ser abordado. Como punto de partida para este análisis se destaca la importancia de las zonas rurales como importantes proveedores de agua y alimentos, los cuales requieren medidas de saneamiento como forma de prevención de riesgos potenciales ambientales y de salud. A pesar de la existencia de un gran número de leyes ambientales y un marco jurídico solido para el sector de agua y saneamiento, también existen numerosos obstáculos que impiden la implementación exitosa de estas políticas.

La presente tesis lleva a cabo un análisis de los marcos legales e institucionales a nivel federal, estatal, municipal y más en específico a nivel de la cuenca del rio Paraíba do Sul. También los resultados se aplican al caso de estudio en el municipio de Nova Fiburgo en la cuenca del Río Dois Rios. El estudio define los principales retos del sector de saneamiento rural en Brasil y posteriormente en el nivel de estudio de caso regional, proponiendo recomendaciones e incentivos para el futuro progreso. Puesto que Brasil carece de una política de saneamiento rural integral, este estudio pretende proporcionar una visión en conjunto del sector de saneamiento en Brasil.

Palabras clave: saneamiento rural en Brasil, análisis institucional, saneamiento rural descentralizado, tratamiento de aguas residuales

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LIST OF ABBREVIATIONS

AGENERSA - Regulatory agency for energy and sanitation of the State of Rio de Janeiro

AGEVAP - Agência da Bacia do Rio Paraíba do Sul (Water Agency of Paraíba do Sul)

ANF – Aguas de Nova Friburgo, Concessionaire for water supply and sanitation services of Nova Friburgo

APA - Área de proteção ambiental (Areas of Environmental Protection)

BNDES – Banco Nacional de Desenvolvimento Econômico e Social (Brazilian Development Bank)

CAR - Cadastro Ambiental Rural (Rural environmental registry)

CBH – Comite da bacia hidrografica (River basin committee)

CBH R2R - River Basin Rio Dois Rios

CEDAE - Companhia Estadual de Águas e Esgotos do Rio de Janeiro

CEIVAP - Comitê de Integração da Bacia Hidrográfica do Rio Paraíba do Sul I(ntegration Committee of the Hydrographic Basin of the Paraíba do Sul River)

CERHI - Conselho Estadual de Recursos Hídricos (State Council for Water Resources of the State of Rio de Janeiro)

CONAMA – Conselho Nacional do Meio Ambiente (National Environmental Council)

COOPETEC – Fundação Coordenação de Projetos, Pesquisas e Estudos Tecnológicos (Project Coordination, Research and Technology Studies Foundation)

EMBRAPA - Empresa Brasileira de Pesquisa Agropequária (Brazilian Corporation of Agricultural Research)

FAT - Fundo de Amparo ao Trabalhador (Workers Support Fund)

FECAM - Fundo Estadual de Conservação Ambiental e Desenvolvimento Urbano - Fund for Environmental Conservation and Urban Development

FGTS - Fundo de Garantia por Tempo de Serviço (Guarantee Fund for Employees)

FPM - Fundo de Participação dos Municípios

FUNASA - Fundação Nacional da Saúde (National Health Foundation)

FUNBOAS - Fundo de Boas Practicas

FUNDRHI – State Water Resources Fund

IBAMA – Instituto Brasileiro do Meio Amiente e dos Recursos Naturais Renováveis (Brazilian Institute of Environment and Renewable Natural Resources)

IBGE – Instituto Brasileiro de Geografia e Estadística (Brazilian Institute for Geography and Statistics)

ICMS-Verde or ICMS Ecológico – (Imposto sobre Operações relativas à Circulação de Mercadorias e Prestação de Serviços de Transporte Interestadual e Intermunicipal e de Comunicação) – is a Brazilian state tax on goods and services, which granted to municipalities for environmental conservation measures

INEA - Instituto Estadual de Ambiente (State Institute of Environment RJ)

IPPUR - Instituto de Pesquisa e planejamento urbano e regional, UFRJ (Institute for Urban and Regional Research and Planning, UFRJ)

LOA - Lei Orçamentária Annual (Annual Budget Law)

MLG – Multi Level Governance

MMP- Municipal Master Plan (Plano Diretor Municipal)

MTSC: Municipal Technical Sanitation chamber

NF – Nova Friburgo

OGU - Orçamento Geral da União (Federal Budget)

PES (PSA) - Payment for ecosystem services (Pagamento por Serviços Ambientais)

PLAMSAB NF – Municipal Basic Sanitation Plan Nova Friburgo (Plano Municipal de Saneamento Basico)

PLANASA – Plano Nacional de Saneamento (National Sanitation Plan) from 1971

PLANSAB – Plano Nacional de Saneamento Basico (National Basic Sanitation Plan)

PSAM - Programa de Saneamento Ambiental dos Municípios do Entorno da Baia de Guanabara (Environmental Sanitation Program for the Surrounding Municipalities of the Guanabara Bay)

PT - total number of inhabitants and population equivalents

RA – Regulating agency (Agencia Reguladora)

RJ – the state of Rio de Janeiro

SEA – State Secretary or Environment in the state of Rio de Janeiro (Secrataria do Ambiente/ RJ)

SEGRHI - Sistema Estadual de Gerenciamento de Recursos Hídricos (Water Resources Management)

SP – State of Sao Paulo

UF - Fluminense Federal University

UFRJ - Federal University of Rio de Janeiro

UFRJ – Universidade Federal do Rio de Janeiro (Federal University of Rio de Janeiro)

WWT – Wastewater Treatment

WWTP – Wastewater treatment plant

WWTS - Wastewater treatment system

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PART I: INTRODUCTION AND PROBLEM DEFINITION

1 Introduction

1.1 Problem definition

Brazil is rich on water resources and holds over "12% of the planet's water supply"[1]. Nonetheless, it experiences strong water pollution along the high populated coastal areas as well as water deficit in the industrialized south-east and north-east regions.[2] Water pollution is remarkably high in the urbanized and industrialized areas, around large cities. Furthermore, agricultural areas are affected by pesticide load and the absence of sanitation facilities. The extreme urban and industrial water pollution occurs due to insufficient sewage collection and treatment. Countrywide only 52.5% of the urban sewage is collected and only 34% of the collected sewage is treated.[3]While in the most developed regions, such as the Southeast, around 56% of the sewage is collected and 33.6% is treated, whereas in the North of Brazil only 3.6% of the sewage gets collected and 0.1% is then treated. [4]

Although the pollution load by domestic wastewater is much lower in rural areas than in urban conglomerates, rural areas stay the indispensable food and water suppliers for urban centers. Rural areas are home to water springs, originating the rivers, and bringing water for irrigation of the fields, industrial and human consumption. Regrettably, most water is already contaminated before it gets to the irrigation areas and to the urban treatment plants.

The Brazilian government introduced a decentralized water resources management and integrated water management strategies for water supply and sanitation nationwide. Although an institutional and legal framework for the wastewater treatment in urban areas has been established and national water quality standards are set by law, it still lacks clear responsibilities for wastewater treatment in rural areas, which still present poor sanitation and public health conditions as well as diverse environmental problems. Since water supply in rural and remote areas is mostly provided by wells and is free of charge, the financing of water treatment facilities becomes challenging in order to allocate responsibilities and costs for initial investment and maintenance of water treatment plants.

1.2 Objectives

The subject of the study is to conduct an institutional assessment of decentralized wastewater treatment solutions applicable in rural areas of the state of Rio de Janeiro. Additionally, a case study developed within the INTECRAL[5] project is discussed, based on the current water and

[1]Formiga Johnsson (2014): Water Resources Management in Brazil. World Bank.
[2]Compare: Ibidem.
[3]Compare: Formiga Johnsson (2014): Water Resources Management in Brazil. World Bank
[4]Compare: Beviaqua Leonetti; Leao do Prado; Walter Bores de Oliveira (2011): P.
[5] Integrated Eco Technologies and Services for a Sustainable Rural Rio de Janeiro – INTECRAL project "is a jointly developed scientific cooperation supported by the German Federal Ministry of Education and Research (BMBF) and the State Secretariat of Agriculture and Livestock Project Rio Rural (SEAPEC-PRR). It aims to improve the competitiveness of the rural economic sector in due consideration of a sustainable watershed management, including environmental risk mitigation and protection of natural resources". INTECRAL was jointly developed by the Brazilian Rio Rural coordinating team with a proven research consortium of the Cologne University of Applied Sciences, the University of Leipzig and the Friedrich-Schiller-University of Jena. The tasks for research and development as well as the action plan were elaborated

sanitation legislation in RJ. The research is going to be based on the analysis of the legal and institutional settings on federal, state, river-basin (Paraíba do Sul River Basin) and municipal levels, in order to set procedures for a successful implementation of sanitation solutions in rural areas of RJ. The results of the analysis of governmental potentials and constraints for rural sanitation are going to be applied on the study area, in the community of Barracão dos Mendes /RJ, Municipality of Nova Friburgo.

The research is based on a multi-level governance (MLG) approach due to a complex multi-level and multi-stakeholder constellation of the water and sanitation sector in Brazil. MLG approach has a problem solving orientation through joint action with the main focus on the interaction between stakeholders on different governmental and non-governmental levels.[6] However, the aim of this study is not to outline the theoretic framework of MLG in the Brazilian sanitation sector, given that various theory based surveys for sanitation and water sector already exist. This work targets to undertake an institutional analysis, which aims to explain the interrelation of the existing institutions within the Brazilian sanitation sector; the rules, provided by the legal framework; and the processes, which emerge from the interaction between the existing stakeholders under the given legal framework. The analysis follows an applied and pragmatic approach in order to identify the existing deficits and potentials of the Brazilian sanitation sector and consequently, find room for improvements.

The institutional analysis focuses on simple and structured regulatory terms, such as structure, composed by stakeholders and rules, and processes, which explain the interrelations between the stakeholders and the influence of the rules on the stakeholders. The structure is defined as an arrangement of relations between the sanitation sector stakeholders on different governmental and non-governmental levels. The rules are provided by the Brazilian sanitation legal framework on federal and state levels and define the scope of action for the respective stakeholders. The resultant processes are analyzed in order to explain the interaction between rules and stakeholders and offer alternatives for a practical course of action.

The institutional analysis is divided in two parts: an abstract and pragmatic analysis of the sanitation stakeholders and of the existing sanitation legal framework in Brazil (on federal, state and municipal levels). And the analysis of a specific local case for a rural sanitation project in the state of RJ. Both parts provide a similar set-up and structure including a case driven descriptive analysis of the sanitation sector stakeholders and the legal framework. This work is intended to be a recommendation for the sanitation sector policy, comprising the identified constraints and potentials.

The main challenges of the study are:

- To identify the responsible institutions for rural sanitation (Brazil / RJ/NF)
- To find overlapping of policies and responsibilities as well as uncovered sectors for sanitation solutions in Brazil and RJ

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in collaboration with additional German institutions and enterprises, for whose carrying out the PRR provided 2.98 billion Euro funds for specified and common actions. Sources: http://www.tt.fh-koeln.de/research/projects/researchprojectsintecral/; http://intecral-project.web.fh-koeln.de/about-the-project/background

[6] Compare: Benz (2005): Governance in Mehrebenensystemen. Taken from Hooghe& Marks (2001): Types of Multilevel Governance.P.2.

- To identify governance potential and constrains of the sanitation sector on national, state, river basin and municipal levels
- To apply the analysis results on a case study in a rural settlement in the state of Rio de Janeiro and to identify the necessary procedures for the implementation of a pilot wastewater treatment solution

1.3 Project context and case study description

The applied rural sanitation research is undertaken within the framework of the projects INTECRAL[7] RIO RURAL[8] and focuses on a specific rural community, Barracão dos Mendes within the municipality of Nova Friburgo, Rio de Janeiro. The community of 1300 inhabitants does not provide a sewer infrastructure, so untreated wastewater contaminates rivers and ground water. The case study aims to find feasible recommendations for sustainable decentralized water treatment and reuse solutions, suitable to the socio-economic conditions of rural areas of Rio de Janeiro in order to improve water quality and achieve associated environmental, sanitary and agricultural benefits in the investigation area.

The case study, based on a previous survey within the INTECRAL-Project, focuses on decentralized wastewater treatment solutions (cluster solutions), reliable for small low-income communities with population from 500 to 1500 inhabitants, lacking a sewer infrastructure. The project aims to reflect the applicability of the proposed decentralized collective wastewater treatment and reuse solutions from the institutional and legal perspective as well as from the operation and maintenance model perspective with the objective to improve the sustainable management of water resources.

1.4 Structure of the thesis

This work is divided into three blocks in order to provide an integral analysis of governance potentials and constraints for the Brazilian rural sanitation: The first part contains the definition of the problem, the project description and the objectives of the study. In the second part, the entire concept of the Brazilian sanitation sector is discussed, given that Brazil does not have an integrative rural sanitation policy. This part outlines the legal framework and the analysis of the institutional setting for urban and rural sanitation to provide a holistic understanding of the potentials and constraints of the rural sanitation sector. The analysis of the institutions related to rural sanitation is undertaken on federal, state, river basin (Paraíba do Sul River Basin) and municipal levels. The outcome of the analysis are the constraints of the Brazilian rural sanitation sector, followed by the subsequent potentials and recommendations. In the third part, the case study project in Barracão dos Mendes, Nova Friburgo, RJ, is analyzed using the same structure of stakeholder identification on municipal and integrated river basin level (Rio Dois Rios River Basin).

[7] Compare: Massoud, M. A., Tarhini, A. & Nasr, J. A., (2009): P. 653

[8] RIO RURAL is a programme implemented by the State Secretariat of Agriculture and Livestock of Rio de Janeiro, with funding from GEF (2006-2011), the World Bank (2010-2018), federal and stage programmers and private sector. The programme promotes sustainable development in rural areas of the State of Rio de Janeiro, Brazil, with the objective of empowering family farmers, raising awareness about environmental issues and promoting their social and productive inclusion, so they can act as main partners in the sustainable management of natural resources and eco-friendly agriculture. Source: http://planetaorganico.com.br/site/index.php/micro-watersheds-of-rio-de-janeiro/

The analysis of the case study identifies constrains and potentials of the theoretical rural sanitation project in Barracão dos Mendes and delivers major findings and conclusions of the study. The second and the third parts are interrelated, build upon and complement each other.

1.5 Methodology

This study has problem centred and pluralistic approach and uses the pragmatic worldview. The institutional and legal framework analysis conducted within this study require multiple and concurrent mixed methods which include qualitative data evaluation. The data collection is carried out by semi-structured interviews with water resources management and sanitation experts on federal, state (RJ), river basin (Paraíba do Sul and Rio Dois Rios) and municipal (Nova Friburgo) levels. Additionally, a comprehensive analysis of the legal framework is undertaken in order to explain the framework of stakeholder actions within the Brazilian sanitation sector. Furthermore, the existing sanitation programs and actions will be studied and analyzed. The study is also going to include across databases interpretation.

A total of 24 semi-structured interviews were conducted on federal, state, river basin (Paraíba do Sul River Basin and its integrated river basin, Rio Dois Rios) and on municipal levels. Also civil society organizations working with rural sanitation as well as cross-level and indirect sanitation sector stakeholders and experts from the water and sanitation management sectors from research and academic institutions were consulted to provide a better holistic and complete overview over the sanitation sector, with a focus on rural sanitation, in Brazil and RJ.

Semi-structured interviews with following governmental and non-governmental institutions were undertaken within the framework of this study:

Federal and State Level	**Number of Interviews**
National Water Agency (AGENCIA NACIONAL DE AGUA) - - ANA	1
National Health Foundation (Fundação Nacional da Saúde) - FUNASA	1

State Level	**Number of Interviews**
State Institute of Environment (Instituto Estadual de Ambiente – INEA	1
AGENERSA - Regulatory agency for energy and sanitation of the State of Rio de Janeiro	1
State Council for Water Resources of the State of Rio de Janeiro – CERHI	1
National Health Foundation (Fundação Nacional da Saúde) - FUNASA	1
Program RIO RURAL	2
Program PSAM (Environmental Sanitation Program for the Surrounding Municipalities of the Guanabara Bay)	1

Municipal Level	Number of Interviews
Municipality of Nova Friburgo	1
Secretary of Environment and Urban Development of Nova Friburgo	1
Water supply and wastewater treatment service provider of Nova Friburgo “Aguas de Nova Friburgo”	1

River Basin Level Institutions	Number of Interviews
Water Agency of Paraíba do Sul – AGEVAP	2
River Basin Committee R2R	1
AGEVAP nucleus R2R	1

Cross-level and indirect Stakeholders	Number of Interviews
Areas of Environmental Protection – APA	1
State Nature Park “Tres Picos”	1

Civil Society Organizations	Number of Interviews
Project Coordination, Research and Technology Studies Foundation – COOPETEC	2
Instituto Terra de Preservação Ambiental” – ITPA	1
Instituto Trata Brasil	1

Experts of the Water and Sanitation Sector	Position
Rosa Maria Formiga Johnsson, PhD	Professor at UFRJ, former Director of Water and Land Management Department, RJ, inter alia
Francisco José Vela, PhD	WWTP project planning company “Aquarum”, SP

1.6 Scope and limitations

The theory-driven MLG-approach covers the high federal and state governance levels and often loses the focus on specific practical problems on lower levels. Consequently, the typical scientific multi-level governance approach would not satisfy the very specific and pragmatic requirements of this study. Therefore, a theory-based MLG analysis is not represented within this study, which is driven by a pragmatic and applied analysis of the institutional setting and legal framework of the sanitation sector in Brazil/RJ, devoid of theoretical background.

2 Definition of Rural Sanitation in Brazil

2.1 Rural Brazil

Rural Brazil is characterized by a diversity of ethnic backgrounds, religions, cultures, ecosystems, social and economic sectors, production systems and technology standards. Contemporary rural reality is a result of Brazils' economic, political and cultural history, based on concentration of land, wealth and on extensive use of natural resources. It is also a result of slavery, extermination of indigenous population and marginalization of rural families and women. However, rural Brazil is also strongly characterized by conflicts and social struggles of resistance against the authoritarian and repressive political model, fights for access to land, legitimacy, technology, rights on seeds, affordable credits, fair prices, right to health and education services, culture, preservation of water and public sanitation services.[9]

Brazil, according to the IBGE Census 2010, is divided into 5,565 municipalities, 449 (8.1%) in the North, 1,794 (32.2%) in the Northeast, 1,668 (30.0%) in the Southeast, 1,188 (21.3%) in the South and 466 (8.4%) in the Midwest Region.[10]

The distribution of municipalities by population range draws a significant number of municipalities in the range of up to 5,000 inhabitants (a total of 1,302, equivalent to 23.4% of municipalities)[11]. It can be concluded that Brazil consists of small municipalities with the highest concentration among the municipalities with up to 20,000 inhabitants, equivalent to 70.3% of all Brazilian municipalities. Also, 80.8% of Brazilian municipalities (4,496 municipalities) are concentrated in the range of up to 30 thousand inhabitants.

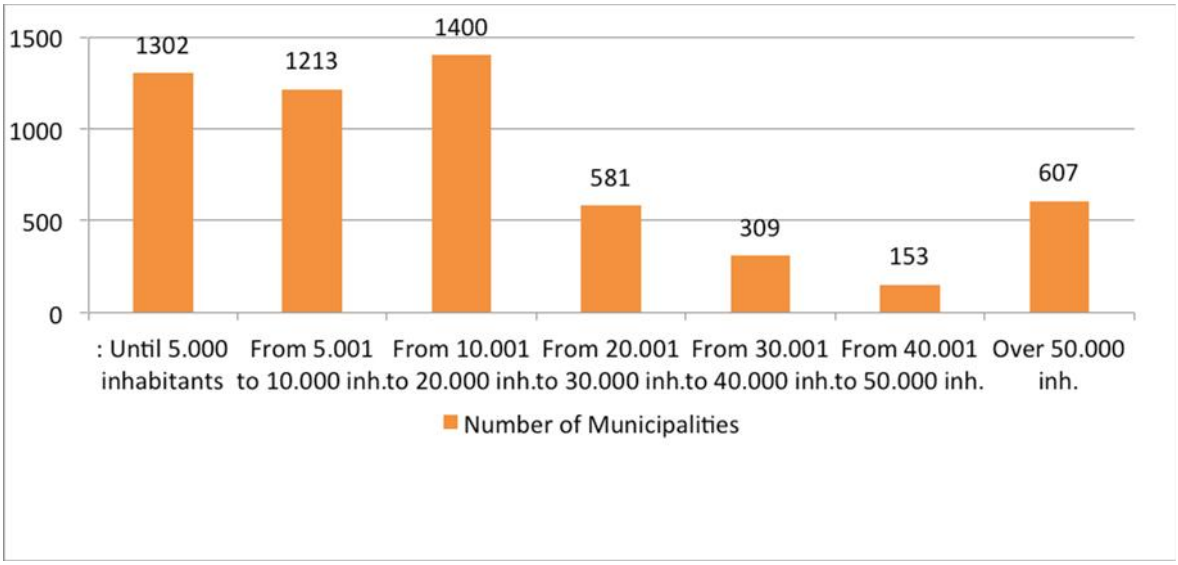


Figure 1: Distribution of municipalities by population range (2010): Source: IBGE Census 2010 (adopted by the author from FUNASA 2012)[12]

[9] Compare: Teixeira (2012), J. B taken from FUNASA, Programa Nacional de Saneamento Rural, Versao preliminar (2013): P.11
[10] Programa Nacional de Saneamento Rural, Versao preliminar (2013): P.11
[11] Ibidem.
[12] FUNASA, (2013): P.12

According to a FUNASA study from 2012, the smaller the population of a municipality, the greater the percentage of its rural population. North and Northeast regions have a significant percentage of rural population in municipalities with up to 50,000 inhabitants. In the South, however, the percentage of rural population in municipalities with up to 5000 inhabitants is greater than the percentage of the total urban population. [13]

In general, the proportion of rural population represents 23.4% of all Brazilian municipalities (1302 municipalities with up to 5,000 inhabitants).[14]

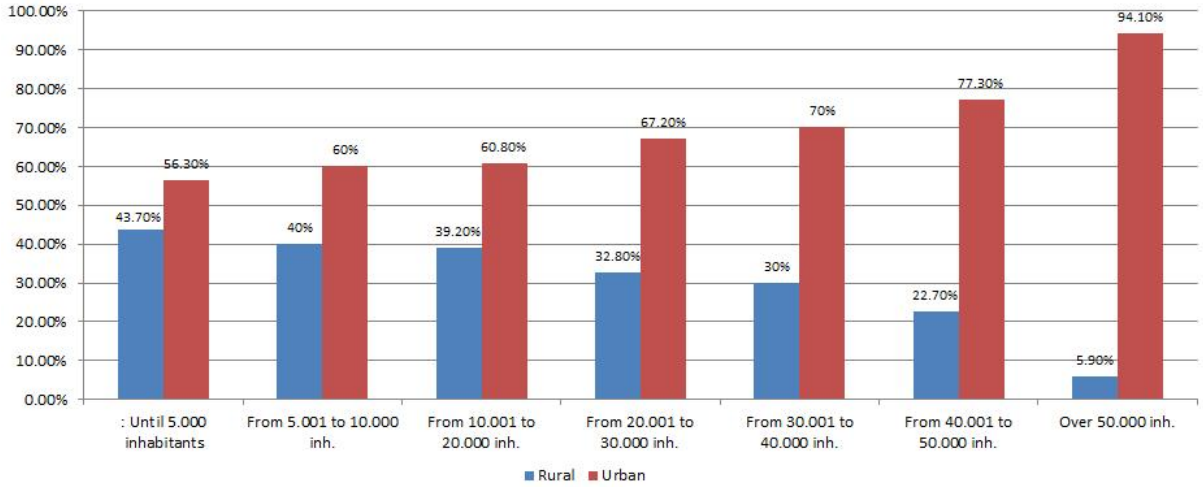


Figure 2: Percentage of urban and rural population depending on the size of the municipality (2010): Source: IBGE Census 2010 (adopted by the author from FUNASA 2012)[15]

2.1.1 Territorial Division:

The political and administrative organization of the Federative Republic of Brazil comprises the Union, the Federal District, the states and municipalities, all autonomous under the Federal Constitution of 1988.

Federal District is an autonomous unit where the federal government has its headquarters with executive, legislative and judicial power. It has the same legislative powers reserved to the states and municipalities, and is governed by an organic law.

The States are the highest-ranking units within the political and administrative organization of the country. They are subdivided into municipalities and organized and governed by their own constitutions and laws, according to the principles of the Constitution.

Municipalities are autonomous units of lower hierarchy within the political and administrative organization of Brazil. Municipalities are governed by organic law, according to the principles of

[13] Compare: FUNASA (2013): P.13
[14] Compare: FUNASA (2013): P.13
[15] FUNASA (2013): P.13

the federal and state constitutions. Municipalities can create, organize and suppress their districts. The Brazilian capital, Brasilia, is considered the Federal District. [16]

2.1.2 Definition of "rural areas" in Brazil and peculiarity in the state of Rio de Janeiro

The definition of a rural area in Brazil, according to the World Bank, "is calculated as the difference between total population and urban population."[17] According to the Brazilian Institute for Geography and Statistics (IBGE), the government agency for geography and statistics, a "rural area is defined as the area of a municipality located outside the urban perimeter".[18] In accordance to the current Brazilian law, there is a legal and administrative separation of urban and rural areas, considering factors such as administration, census and tax regulation. The norms are set by the city council chambers (câmaras de vereadores) of each municipality, according to the municipal economic interests, following the guidelines of the Decree Law 311, 1938 (Decreto Lei 311/1938)[19]. Consequently, also small villages and towns are considered cities by this regulation, introduced in a period when Brazil was still agrarian from an economic and demographic point of view.[20]

This regulation led to the fact, that a significant number of Brazilian municipalities with small population and very low population density, show a high degree of urbanization. "The official methodology for calculating the" degree of urbanization" in Brazil is anachronistic and obsolete".[21]

Similarly, the official definition for rural agglomerates is determined as locations situated in areas not legally defined as urban and are not characterized by a set of permanent and adjacent buildings, forming continuously building areas, arranged with suitable roads along a communication route.[22]

In this sense, depending on the regions topographic, legal and administrative peculiarities, the understanding of the concept of "rural area" differs from state to state.

[16] IBGE 2010: P. 15-16
[17] World Bank Staff estim, mediante contrato de prestação de serviços técnicos por produto, 2012.ates based on United Nations, World Urbanization Prospects: http://www.indexmundi.com/facts/brazil/rural-population
[18] SEY, A et al.: http://connectingpeoplefordevelopment.pressbooks.com/back-matter/appendix-2-country-definitions/
[19] Compare: Locatel, Celso D (2013): P. 6-8.
[20] Compare: Locatel, Celso D (2010): O rural e o urbano no Noroeste de São Paulo, taken from Locatel, Celso D (2013): P. 6-8.
[21] VEIGA, José Eli. Cidades imaginárias. O Brasil é menos urbano do que se calcula. Campinas: Autores Associados, 2002
[22] http://www.ibge.gov.br/home/geociencias/cartografia/manual_nocoes/elementos_representacao.html

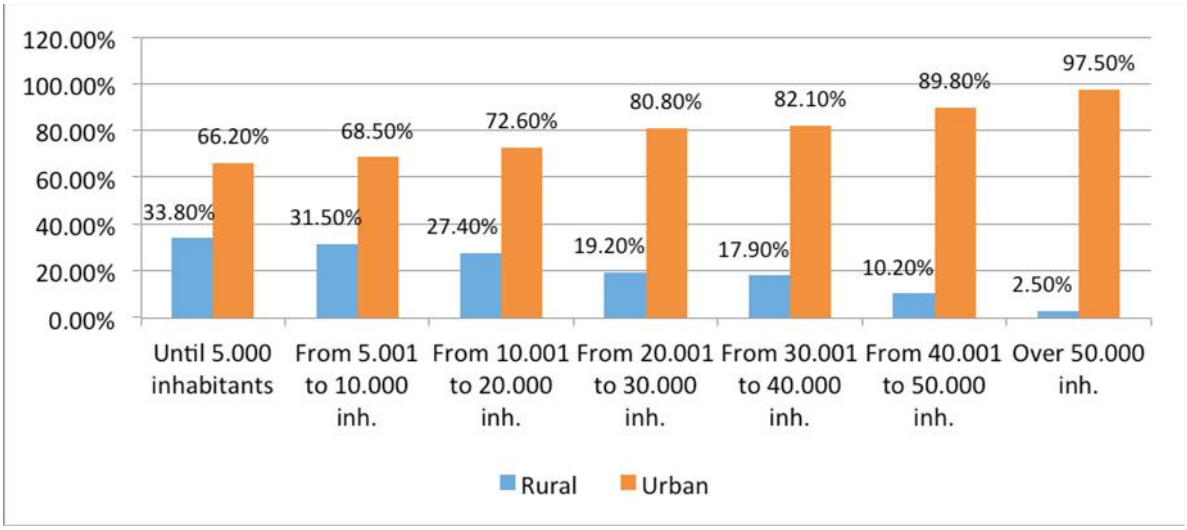


Figure 3: Percentage of urban and rural population by in the Brazilian South-East region depending on the size of the municipality (2010): Source: IBGE Census 2010 (adopted by the author from FUNASA 2012)[23]

Considering the differences in population density, climate, geography, hydrogeology and other environmental, technical, institutional and financial factors, rural sanitation programs should be designed considering the differences and characteristics of rural areas and correspond to the population and environmental needs of each region. It is fundamentally important to analyse and understand the dynamics of contemporary rural areas with all new peculiarities, in order to formulate particular sustainable public policies for rural regions. In the past, the measures of rural policies were adopted from the urban vision and led to failures because they did not meet the needs and objectives of the rural reality.[24]

This work focuses on the analysis of governance for wastewater treatment for areas, not officially considered as urban, such as housing conglomerates in rural areas and rural communities with population from 500 to 1500 inhabitants. The main goal of the second part of this work is to explain the institutional setting, defining the possibilities and responsibilities on different governmental levels, for individual and collective[25] rural wastewater treatment solutions, independent from the choice of technology. In the third part of this work, within the framework of the case study in Barracão dos Mendes, the focus is set on collective semi-decentralized wastewater treatment solutions.

2.2 "Sanitation" vs. "Saneamento"

The definition of the English term "sanitation" differs from the Brazilian concept of "saneamento". While "sanitation", according to WHO is defined as "provision of facilities and services for the safe disposal of human urine and faeces"[26] and "basic sanitation" as the "lowest-cost technology ensuring hygienic excreta and sullage disposal and a clean and healthful living environment both at home and in the neighbourhood of users."[27] In Brazil, the federal sanitation law[28] defines

[23] FUNASA (2013): P.13
[24] Compare: FUNASA (2013): P. 36
[25] In this work, the focus will be set on the concept of collective rural sanitation solutions.
[26] WHO: Sanitation. http://www.who.int/topics/sanitation/en/
[27] http://www.who.int/water_sanitation_health/mdg1/en/.

"saneamento basico" as a set of services, such as drinking water supply, rainwater drainage, sewage collection and treatment, urban cleaning and solid waste management[29]. Consequently, drinking water supply is included into the definition of the term "saneamento" in Brazil.[30]

This work mainly focuses on wastewater treatment in rural areas in the state of Rio de Janeiro taking into account the peculiarity of rural housing conglomerates. As the Brazilian sanitation legislation defines "basic sanitation" as a set of services including fresh water supply and solid waste management, and there is a lack of an explicit national rural sanitation policy, the entire concept of Brazilian "saneamento" will be discussed, in order to better understand the potentials and constraints of rural sanitation.

2.3 Rural wastewater treatment in Brazil

According to the IBGE Census 2010 and as shown in the table below, only 3.1% of rural households have a sewage connection to a wastewater collection network and only 13.9% have a septic tank. Other wastewater treatment solutions, adopted by 83.0% of rural population are often inadequate as sewage facilities, such as rudimentary cesspools, pits, ditches. Having mentioned this, it is important to underline that in comparison, only 55.5% of urban households have access to the sewage network.[31]

The domestic wastewater treatment situation in both, urban and rural areas, endangers the health of the population, especially of children, pollutes water sources and has a negative impact on the environment.

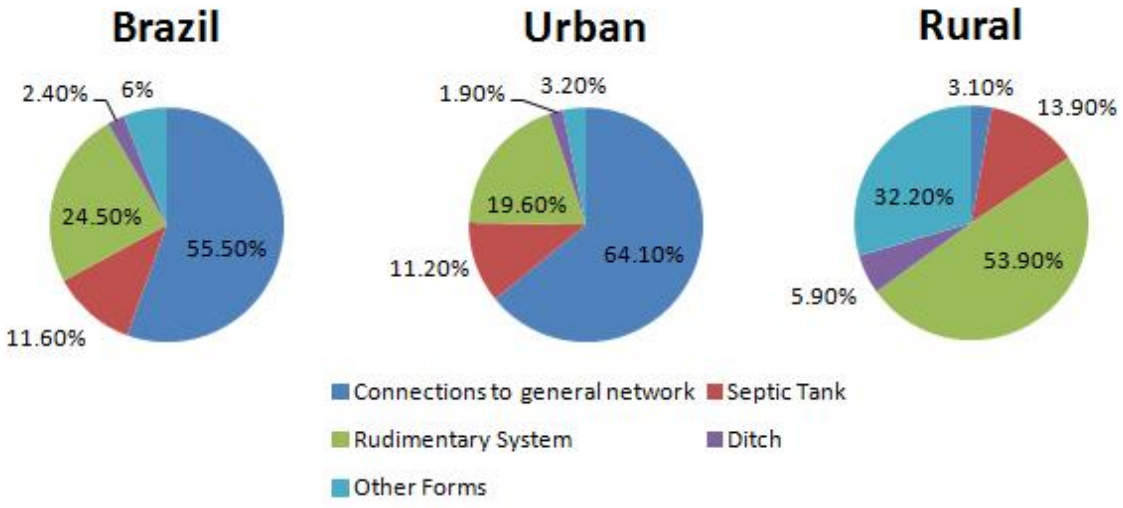


Figure 4: Domestic wastewater treatment in Brazil. Source: IBGE Census 2010[32]

[28] Lei Federal 11.445, de 5/1/2007 - establishes national guidelines for basic sanitation and for the federal basic sanitation policy - it is considered the regulatory framework for the sanitation sector in Brazil.
[29] Governo do Rio de Janeiro, Official Site: http://www.rj.gov.br/web/sea/exibeconteudo?article-id=330838
[30] Compare: WHO: http://www.who.int/water_sanitation_health/mdg1/en/
[31] Compare: FUNASA, Programa Nacional de Saneamento Rural, Versao preliminar (2013): P.27
[32] FUNASA, Programa Nacional de Saneamento Rural, Versao preliminar (2013): P.13

The Federal Government acts through various ministries in rural sanitation sectors in several Brazilian regions through selective and dispersed actions.

The Ministry of Social Development and Hunger Alleviation **(Ministério do Desenvolvimento Social e Combate à Fome)**	Builds cisterns for rainwater reservation in the Brazilian semiarid region for more than a decade. Currently activities in this area have been expanded through partnerships with municipalities and other institutions.
The Ministry of National Integration **(Ministério da Integração Nacional)**	Various sanitation actions and projects through the São Francisco Valley and Vale do Parnaíba Development Company (Codevasf). Currently, the Ministry of National Integration coordinates the "Água Para Todos" (Water for All) program, with the central focus in the Brazilian semiarid region.
The Ministry of Environment **(Ministério do Meio Ambiente)**	Developed through the Department of Water Resources and Urban Environment (Secretaria de Recursos Hídricos e Ambiente Urbano) the programme "Água Doce" and other actions for sanitation in rural areas. Currently, the work of the Ministry of Environment is focused on the coordination of the national solid waste management policy.
The Ministry of Agrarian Development **(Ministério do Desenvolvimento Agrário),**	Supplemental actions for basic sanitation within the Agrarian Reform through INCRA[33]. INCRA is not responsible for infrastructure improvement, which justifies only supplementary actions in rural sanitation.

Table 1: Ministries acting in rural sanitation programs. Source: FUNASA (2013)

Summarizing, it can be said, that the above mentioned rural sanitation programs are scattered and selective. The federal sanitation actions are mostly focused on water supply in semi-arid regions, such as the north-east of the country, and solid waste management. An adequate wastewater treatment program for rural areas does not exist yet.

2.4 Adequate technologies for rural sanitation

The choice of wastewater treatment technologies for rural areas depends particularly on the population density, climate, geography, hydrogeology and other environmental, technical,

[33] INCRA is a federal agency of the Brazilian public administration with the primary mission to carry out land reform, keeping the national register of rural properties and manage the public lands of the Union.

institutional and financial factors. An important decision support approach is the cost-benefit analysis in order to estimate the strengths and weaknesses of available technological alternatives: In rural areas, for instance, where the infrastructure services are scarce, the installation of expensive and complex sanitation solutions won't be feasible due to low population income. To assure the longevity for functioning of rural wastewater treatment solution, simple decentralized technologies with low dependence on human intervention for maintenance (pumping system, electricity) and low complexity are most suitable.[34] In contrast, rural nuclei with high population density will require a more complex technological solution, while individual wastewater treatment solutions are generally more reasonable for rural areas with disperse housing. Overall, decentralized wastewater treatment solutions would be more suitable for remote, low populated and mountainous regions.[35] Nonetheless, the most important point for the implementation of any rural wastewater treatment solution is, that the long-term operation and maintenance of the system is assured before the installation, as part of the project schedule should include a model of the technical-financial sustainability of the wastewater treatment technology (area to be attended, costs, technical capacity required etc.): Complex technological wastewater treatment solutions need to be provided by public authorities while individual solutions can be operated and maintained by the property owner.

According to EMBRAPA, the Brazilian Corporation of Agricultural Research, rural sewage treatment technologies need to provide a high contaminant and pathogens removal efficiency, in line with environmental and health standards, and an affordable, installation and maintenance simplicity.[36]

Main issues of wastewater management systems, divided into technical, institutional and financial subjects, provided by the World Bank are following:

Technical Issues:	
• Decentralized vs. Centralized Approaches:	In low-density setting, decentralized systems may be more suitable than centralized systems.
• Changes in Level of Water Supply:	Water supply increase creates a corresponding need for managing greater volumes of wastewater.
• Physical factors:	The climate, geography, hydrogeology, soil type, and other environmental factors can affect the sanitation solutions that might be the most feasible and cost effective in a given location.
• Technological Factors:	Complex technologies can be difficult as well as costly for rural communities to operate and to maintain, or to obtain spare parts and consumable materials, such as filters or

[34] Compare: Interview with Iene Christie Figueiredo/ COOPETEC/ UFRJ
[35] Compare: Massoud, et al.(2009): P. 652
[36] Compare: EMBRAPA: http://saneamento.cnpdia.embrapa.br/tecnologias.html

	chemicals.
Financial Issues:	
• Organization and Finance:	Investment, operation and maintenance must be kept low. It is important, that generated income matches expenses throughout the lifetime of the system. Thus, low-cost technologies may often represent more sustainable options.
• Balancing Private Investment and Subsidies:	In Brazil, urban sanitation programs receive increased political attention and demonstrate better working dynamics between private investments and public subsidies as in rural areas, where the low private sector participation is responsible for low investments and low efficiency of the sanitation sector.
Institutional Issues:	
• Policies, Standards, Regulations and Guidelines:	Policies, regulations and guidelines need to be clear. Particular importance needs to be given to clearly outline the responsibilities of different parties to minimize the potential for conflict.
• Participatory Approach in Community Development:	The political and administrative decentralization process of water resources management seeks to involve participation of the Government, the users and the community[37]. Local communities get an important voice in their own development. This requires a high level of participation and empowerment of the local communities.
• Long-term Planning for Future Needs:	The planning period established for many infrastructure projects is commonly based on a 20 to 30 year life cycle. A longer lifetime trajectory (30 to 50 years) is suggested to anticipate future changes.
• Training and Capacity Building:	For the long-term success of wastewater management programs, it is essential that the required skills are locally available, to ensure effective maintenance, operation and supervision. Sufficient funds need to be

[37] National Water Law No. 9.4333/97

	allocated to training to ensure establishment of the necessary skills. Institutional training and capacity building are also key to support villages and supply a skilled work force.
• Project Monitoring, Tracking and Evaluation:	A major cause of previous failures has been a lack of oversight and inadequate operation and maintenance of facilities. A project tracking system implemented by the municipal and county wastewater management offices should be an essential part of the WMP.
• Lessons Learned:	Future projects need to take into account what lessons can be learned from past experience.

Table 2: Guide for wastewater management in rural areas. (Adopted by author from World Bank, Water Partnership Program 2012.[38]

In accordance with the above mentioned technological, organizational and financial factors, the Brazilian Corporation of Agricultural Research, EMBRAPA, suggests rather simple and low cost technologies for rural sanitation such as septic tanks (Fossa Séptica Biodigestora), to serve smaller rural communities up to 10 families; water chlorinators (low cost technology designed by EMBRAPA to chlorinate water tanks on farms); and constructed wetlands (Jardim Filtrante)[39], in order to assure the affordability for installation and maintenance in low income areas. Nevertheless, the purchase and installation of a septic tank costs around 6.000 RS and is often not affordable for a single household in a rural community. Furthermore, while water has been always free of charge and wastewater naturally discharged directly into rivers, the consciousness for the need of wastewater treatment facilities still drags behind in many urban and rural communities in Brazil.

[38] World Bank, 2012: P. x, xi, xii.
[39] EMBRAPA: http://saneamento.cnpdia.embrapa.br/tecnologias.html

PART II: MULTI-LEVEL INSTITUTIONS AND PROCESSES

3 Legal basis for urban and rural sanitation in Brazil

In the second half of the 21st century, the investments in sanitation in Brazil occurred only occasionally, with a stronger emphasis in the 1970s and 1980s, when water supply and sanitation in developing countries were internationally recognized as a measure for death rate[40]. In this period Brazil consolidated the National Sanitation Plan (Planasa), which aimed to increase water supply, but, in contrast, did not contribute to the increase of sewage collection and treatment. In this sense, in 2006 only 15% of the sewage generated in urban areas of Brazil's municipalities was treated[41]. Recently, the sanitation sector has experienced an increase of attention and investments from the government. The main governance rules of the sanitation sector are represented by the Law No. 11,445 / 2007, which establishes national guidelines for basic sanitation, and the Law No. 9.433 / 1997, which determine the National Water Resources Policy. Although these laws establish requirements to ensure the sustainability of sanitation investments, there is a predominance of preventative concepts, discursive omissions and ambiguous visions within the same legislation.[42] The not clearly defined duties and the coherent uncertainty tends to create overlapping of actions on federal, state, and municipal levels or/and transfer of responsibilities from one of the other involved stakeholder.[43]

3.1 Introduction into the Water Policy in Brazil

Historically, water resources management in Brazil has been centralized and focused on the hydro-electrical sector. In 1997, Brazil launched a national water resource management reform, which aimed the formation of new institutional and governance mechanisms in order to achieve integration, decentralization of water resources management, assumption of decision making competence on the river basin level and increasing stakeholder participation.[44]

The new Brazilian water resources management is based on the Federal Law No. 9.4333/97, which introduces the concepts of decentralization and public participation. The law is based on the Dublin principals, which recognize fresh water as finite, vulnerable and an economic resource; and underline the necessity of a participatory approach on all governmental levels in the field of water resources management. The State Water Resources Management System is designed to insure good water governance: it integrates multiple stakeholders within it and introduces tools such as water resource plans, classification of water bodies, creation of water use permits and pricing systems as well as a resources information system.[45]

The federal water law settles water governance at three geographical scales: national, state and watershed levels. On the national level, a national council oversees a national water agency (ANA) and state water councils. The state level supervises catchment-level committees and agencies and creates watershed committees, as the smallest territorial decision making units, which must include representatives of civil society organizations. The federal law determines, that watershed

[40] Compare: Soares, S; Bernardes, R; and Cordeiro Netto, O (2002): P.1715
[41] SNIS, 2007: http://www.snis.gov.br/PaginaCarrega.php?EWRErterterTERTer=78
[42] Compare: Souza et al. (2007): P. 371-379
[43] Compare: Bevilacqua Leonetti et al. (2011): P. 4
[44] Compare: Engle, L (2010): P. 5-7.
[45] Compare: ebd.

committees, covering more than one state, should include representatives of "civil water resources entities with proven activity in the watershed"[46], such as associations of municipal governments, water users, research or teaching institutions, and NGOs oriented to "diffuse and collective interests"[47] of the society. In order to implement the decentralization politics for water resource management, in a course of several state reforms, watershed territories with committees and agencies provided with powers of deliberation, supervision and planning of water investments were created. The main goal of the reforms was the introduction of water tariffs for covering investments in new founded watershed territories and the introduction of the civil society participation.[48]

Despite the decentralization, the federal level holds significant power over the lower political levels in policy design and implementation as well as in distribution of financial resources. State levels play an important role in administration of water management and policy determination of the river basins. On the lowest level, the river basin committees and consortia (councils), created out of state and federal government, users and civil society organizations, decide about water allocation, project development and conflict resolution. The river basin committees are composed by the smaller watershed committees, which form the smallest hydrographical administrative units. Basically, the basin committees and consortia should be the strongest and most influential representatives within the decentralized water governance system. However, due to low civil society participation, the role of the watershed committees is still below the intended.[49]

[46] Brazil (1997): Lei No. 9.433., from Brannstrom et al. (2004): p. 307
[47] Ibidem.
[48] Compare: Brannstrom et al. (2004): p. 307
[49] Compare: Compare: Engle, L (2010): P. 5-7

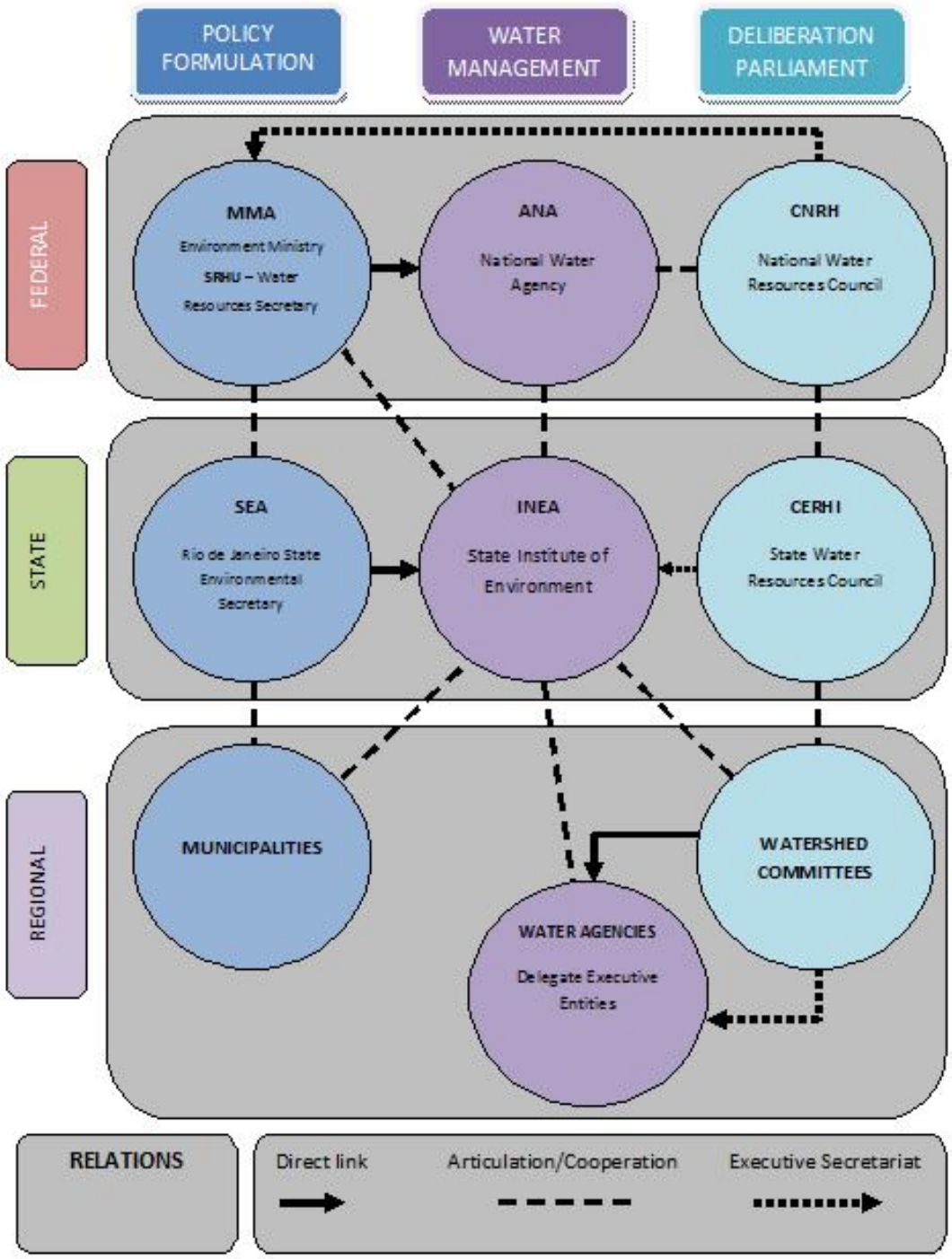


Figure 5: Water management system in Rio de Janeiro. (Adopted by the author). Source: INEA 2014.

3.2 Laws related to sanitation

Under the current Brazilian legislation, there is no particular national policy for rural sanitation. Rural sanitation forms a part of the federal basic sanitation policy. Thus sanitation of rural areas should be part of the basic sanitation plan developed by each municipality nationwide. According to the Sanitation Law (Law 11.445/2007), each municipality is responsible for the elaboration and implementation of its basic sanitation plan, covering both, urban and rural areas and 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 a municipal basic sanitation plan, decide about the adoption of parameters for drinking water quantity, regularity and quality in order to guarantee public health, to define entities responsible for the regulation and supervision of sanitation services; the rights and duties of service users; to establish mechanisms for social participation and control and to develop service information system among others.

Unfortunately, most Brazilian municipalities struggle with the elaboration of their basic sanitation plans due to low technical and financial capacity and have difficulties to contract well skilled technicians, capture federal and state resources designated for sanitation actions and elaborate sound sanitation projects.

3.2.1 Law No. 11.445 / 2007 – Sanitation Law

The federal basic sanitation policy, formulated in the sanitation law No. 11.445 / 2007, builds the regulatory framework for the sanitation sector in Brazil, covering a set of infrastructure services, such as drinking water supply, sewage treatment, street cleaning and solid waste management and drainage of rainwater. The approval of the sanitation law led to the Pact for Basic Sanitation (Pacto Pelo Saneamento Basico), approved by the states and aiming the elaboration of municipal sanitation plans for all Brazilian municipalities untill December 2015 (after the second extension). The municipal sanitation plans are meant to cover urban and rural water supply and sanitation.

The sanitation law establishes national guidelines for basic sanitation in order to regulate actions and investments of the federal government and determinates the development of the National Basic Sanitation Plan - PLANSAB by the Union. The PLANSAB contains national and regional goals, programs and actions to be achieved and needs to be reviewed every four years.

The sanitation law applies to municipalities, states, the Union, and service providers. It sets principles for provision of basic sanitation, defines obligations for the stakeholders, service conditions and rules between clients and service providers. It also establishes the obligation to plan and regulate sanitation services. The sanitation law No. 11.445 / 2007 covers the economic, social and technical aspects of service provision and establishes public participation and social control.

Nevertheless, rural sanitation is only an insignificant part of the current Brazilian sanitation legislation, where the responsibility for the elaboration and implementation of particular basic sanitation plans for the entire municipal areas is attributed to the municipal governments. The Sanitation Law mentions the necessity to attend rural areas in In Art.3 § VIII; and also in Art. 48, § VII demanding to “ensure adequate ways to attend disperse rural population, using solutions compatible with rural peculiar economic and social characteristics”[50] and Art. 49, § IV claiming to

[50] Law Nº 11.445/2007. Art. 48, § VII “garantia de meios adequados para o atendimento da população rural dispersa, inclusive mediante a utilização de soluções compatíveis com suas características econômicas e sociais peculiares”: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/lei/l11445.htm

"provide appropriate environmental health conditions for rural populations and small isolated urban centres" [51], without any further specifications.

According to the first draft of the sanitation law, all Brazilian cities should have developed a municipal sanitation plan till December 2010[52]. The instalment has been prolonged already twice (till 2013 first time and till 2015 the second time), but due to the low capacity of municipalities to develop sanitation projects and to apply for federal resources, the progress of Brazilian sanitation precedes slowly. According to the recent study of the "Instituto Trata Brasil", 34% of the largest Brazilian municipalities did not deliver their municipal basic sanitation plans, six years after the sanitation law was approved. Also economically and organizationally strong municipalities, despite having financial resources, technicians, political structure and knowledge about the law fail in the elaboration of the basic sanitation plans. A total of only 12% of municipalities delivered well designed municipal basic sanitation plans according to the law and requirements for plan formulation and regulation of services. The other 54% delivered the sanitation plan with at least one missing requirement.[53]

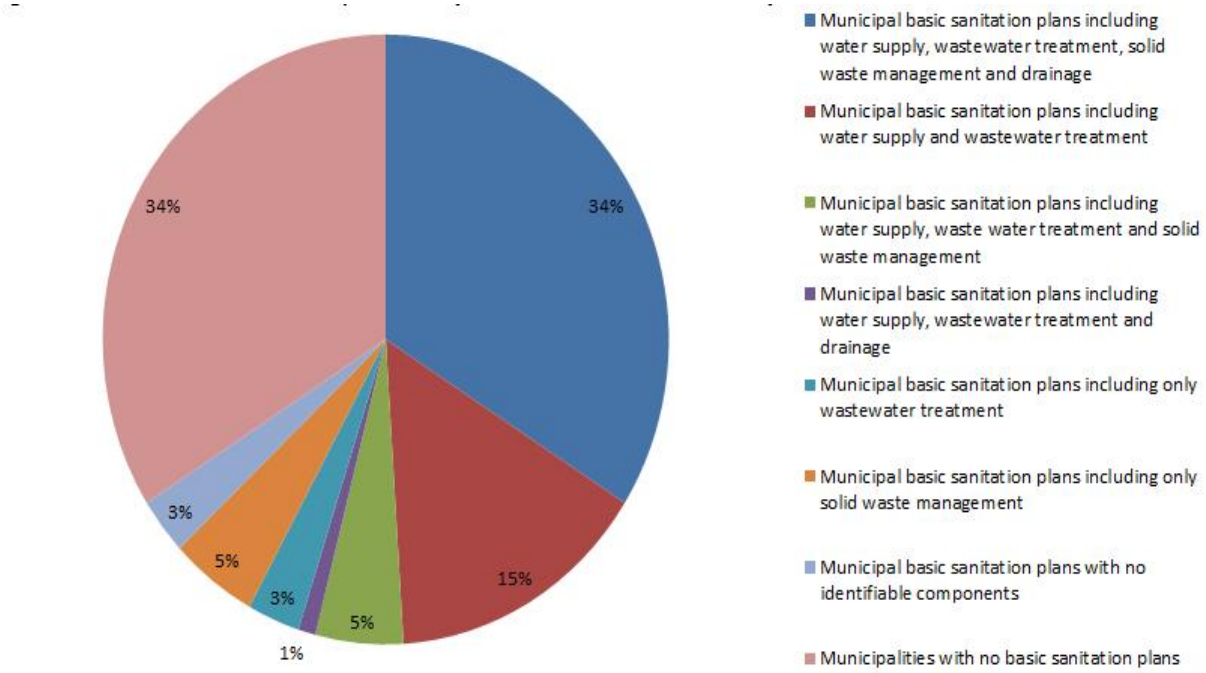


Figure 6: Sanitation characteristics of 100 municipalities analysed within the "Trata Brasil" study. Figure elaborated by the author. Source: Instituto Trata Brasil (2014)[54]

[51] Law Nº 11.445/2007. Art. 49, § IV "proporcionar condições adequadas de salubridade ambiental às populações rurais e de pequenos núcleos urbanos isolados": http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/lei/l11445.htm
[52] Lei Federal 11.445/2007: Art. 58, § 3º
[53] Compare: Instituto Trata Brasil (2014): Diagnosis of the situation of the municipal basic sanitation plans and regulation of servicios. http://www.tratabrasil.org.br/datafiles/estudos/diagnostico/book.pdf
[54] Instituto Trata Brasil (2014): Diagnosis of the situation of the municipal basic sanitation plans and regulation of servicios. http://www.tratabrasil.org.br/datafiles/estudos/diagnostico/book.pdf

3.2.2 CONAMA No. 357/2005

The CONAMA[55] resolution No.357/2005 provides the classification of water bodies, sets environmental guidelines and establishes effluent discharge standards among other measures.

Art. 4 frames the surface fresh water into 5 classes, according to required quality parameters for its main use, classifying from the most restrictive special class, to the less restrictive Class 4. The resolution regulates the use of surface water and sets parameters for water quality. [56]

Guidelines	Parameter	Value
Class 1	PH	From 6 to 9
	Maximum of thermo-tolerant coliforms	200 coliforms/100 ml
	Maximum DBO 5,20	3 mg/L
	Minimum OD	6 mg/L
	Nitrate	10 mg/L
	Nitrite	1 mg/L
Class 2	PH	From 6 to 9
	Thermo-tolerant coliforms	1000 coliforms/100 ml
	Maximum DBO 5,20	5 mg/L
	OD	5 mg/L
	Total Phosphor	0, 05 mg/L

Table 3: Some fresh water parameters and guidelines for class 1 and class 2. Source: CONAMA 357/05. (Elaborated by the author).

3.2.3 CONAMA 430/2011

The resolution 430/2011 sets the effluent discharge standards and modifies the -CONAMA Resolution No. 357/2005.[57]

[55]Conselho Nacional do Meio Ambiente: Brazilian agency responsible for deliberation and consultation of the whole national environmental policy.
[56] Compare: CONAMA No. 357/2005: http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=459
[57] Compare: CONAMA 430/2011: http://www.mma.gov.br/port/conama/legiabre.cfm?codlegi=646

Parameter	Value	Observations
PH	between 5 and 9	...
Maximus $DBO_{5,20}$	120 mg/L	This limit could be exceeded for effluents of the treatment system, if minimum efficiency is given.
Minimum efficiency for DBO 5,20 removal	60%	In relation to raw wastewater.
Sedimentable materials	1 ml/L	...
Oils and greases	100 mg/L	If the environmental agency requires constant standards in Section II of this resolution, using the limits for mineral oils vegetable oils and animal fat.
Mineral oils	20 mg/L	Section II of this resolution.
Vegetal oils and animal fats	50 mg/L	Section II of this resolution.

Table 4: Some parameters for effluent discharge into receiving water bodies. Source: CONAMA 430/11. (Elaborated by the author).

3.2.4 DNAEE Ordinance No. 707/1994 (DNAEE Portaria nº 707/1994)

The DNAEE Ordinance No. 707/1994 establishes the criteria adopted by the National Department for Water and Electric Energy (DNAEE) for the classification of water streams by domain. [58]

According to that ordinance, the study area watershed, Rio Dois Rios, is defined as a state domain. It is not delimiting interstate and international borders and also does not cross them. All the rivers in this watershed belong to the territory of the state of Rio de Janeiro, with the exception of the Union built reservoirs.[59]

3.2.5 State Law No. 5.243/2008: Water use fee in the State of Rio de Janeiro

The state law regulates the use of water resources in the state of Rio de Janeiro. Art. 6 determines that at least 70% of the funds raised by charging for the water use, need to be mandatorily applied for collection and treatment of urban wastewater, until 80% of sewage is collected and treated in the respective river basins.[60]

3.2.6 CERHI Resolution No. 86/2012: Application of FUNDRHI resources in rural sanitation actions

The CERHI resolution No. 86/2012 (State Council for Water Resources of the State of Rio de Janeiro (Conselho Estadual de Recursos Hídricos – CERHI) defines the application of the State

[58]Compare: DNAEE Portaria nº 707/1994: http://www.aneel.gov.br/cedoc/prt1994707.pdf
[59]Compare: Cavallo Pfeil, L.E. (2014): P. 39-40
[60] State Law No. 5.234, Art. 6: Government of Rio de Janeiro: http://www.rj.gov.br/web/seobras/exibeconteudo?article-id=200376

Water Resources Fund - FUNDRHI resources for rural sanitation actions. This resolution completes the State Law No. 5.243/2008 (Water use fee in the State of Rio de Janeiro), determining that 70% of funds raised by charging for the water use must be applied for collection and treatment of urban wastewater. The resolution defines that river basins consist of urban and rural areas, both contributing to the degradation of the river basin water quality. Consequently, collection and treatment of wastewater in rural areas is also essential to improve the river basin water quality and to reach 80% of sewage collection and treatment in the respective river basins.[61]

3.2.7 INEA DZ-215.R-4/2007: Load control directive for organic biodegradable wastewater of sanitary origin.[62]

The INEA load control directive determines the minimum removal efficiency (%) and the maximum load of BOD (mg / L) for the release of treated effluents into receiving bodies, as shown in the tables below.

Gross organic load (C) (kg DBO/ day)	Minimum Efficiency for DBO removal (%)
C ≤ 5	30
5 < C ≤ 25	60
25 < C ≤ 80	80
C > 80	85

Table 5: Minimum efficiency of BOD removal. Source: INEA DZ-215.R-4/2007

Gross organic load (C) (kg DBO/ day)	Maximum DBO charge for residential of medium standard / Indoor (mg/L)
C ≤ 5	210
5 < C ≤ 25	110
25 < C ≤ 80	60
C > 80	40

Table 6: Maximum BOD load for residential of medium standard/ indoor. Source: INEA DZ – 215-4/207. (Elaborated by the author).

3.2.8 ABNT NBR 9649/1986

The norm set by the Brazilian Association for Technical Norms, ABNT[63], fixes the conditions required in the preparation of hydraulic-sanitary projects for sewage collection networks,

[61] CERHI Resolution No. 86/2012: CBH Guandu: http://www.comiteguandu.org.br/legislacoes/ResolucoesCERHI/Resolucao-CERHI-086.pdf

[62] DIRETRIZ DE CONTROLE DE CARGA ORGÂNICA BIODEGRADÁVEL EM EFLUENTES LÍQUIDOS DE ORIGEM SANITÁRIA by INEA/RJ

considering the specific regulations of the responsible authorities for the development and planning of sanitary sewer systems. It also defines, that in the absence of a specific study, the amount of 80% of the consumed water should be considered as return of wastewater to be treated.[64]

3.2.9 ABNT NBR 9648/1986 – Design of sanitary sewer systems

This norm sets the conditions for the design of a sanitary sewer system, in order to enable sanitation project development according to the specific regulations for the entities responsible for planning and development of sanitary sewer systems.[65]

3.2.10 ABNT NBR 12209/1992

ABNT NBR 12209/1992 sets the requirements for the development of sewage treatment plants (WWTP), according to the specific regulations of the entities responsible for planning and development of the sanitary sewer systems."

[63] -Associação Brasileira de Normas Técnicas
[64] Compare ABNT NBR 9696/1986: http://licenciadorambiental.com.br/wp-content/uploads/2015/01/NBR-9.649-Projeto-de-Redes-de-Esgoto.pdf
[65] Compare: ABNT NBR 9648/1986: http://www.scribd.com/doc/61140917/NBR-9648-Estudo-de-concepcao-de-sistemas-de-esgoto#scribd

4 Stakeholder Analysis

The Federal Constitution establishes the improvement of basic sanitation as a common responsibility of the Union, the states and municipalities. The responsibilities are shared between the three levels of government. At the national level, Ministerio das Cidades (Ministry of Cities) coordinates the sectoral policies implemented by various ministries. The Ministry of Health has certain duties related to sanitation while the Ministry of Regional Development, the Ministry of Agriculture, and the Ministry of Agrarian Reforms have assignments in rural areas. The management of water resources is the responsibility of the National Water Agency (ANA).

The national water and sanitation policy determines measures to improve service efficiency through better regulation due to institutional separation of service providers and regulating entities. It also underlines the importance of participation of civil society, investment in low cost technologies and development of financially sustainable pricing mechanisms, including subsidies for low-income families.

Under the Sanitation Law, the regulation and provision of water supply and sanitation services becomes the responsibility of the municipalities. Nevertheless, 14 Brazilian states have established public service regulatory agencies for water supply and sanitation. However, considering that the legal mandate for the regulation lies within the municipalities, the role of the regulatory agencies for water and sanitation is rather low.

For now, the governmental sanitation actions are scattered and selective, which creates an overlapping of responsibilities and actions and creates also uncovered sectors. Various ministries such as the Ministry of Integration or the Ministry of Social Development and Hunger Alleviation act in the area of sanitation. Nonetheless, there is a lack of integrated actions for rural sanitation. The overall concept of the new national rural sanitation program is still in development by FUNASA and should be submitted untill the end of 2016/ beginning of 2017.[66] The new program for rural sanitation is supposed to coordinate the nationwide actions for sanitation in rural areas defining criteria and involving peculiarities of each state and region as well as considering their needs.[67]

4.1 Federal Government

On the national and federal level there are various ministries and institutions working on sanitation programs, which also include rural sanitation actions. However, on the federal level it lacks a consistent national rural sanitation program, given that the urgency and priority of federal politics is focused on urban development.

[66] FUNASA contracted a university to develop the project for rural sanitation.
[67] Interview with Juliana Senzi Zancul, FUNASA, Brasilia

4.1.1 Ministry of Cities (Ministerio das Cidades)

Ministerio das Cidades[68] is supporting municipalities with over 50,000 inhabitants, metropolitan regions and integrated development regions. Within the ministry, a National Secretary for Environmental Sanitation (Secretaria Nacional de Saneamento Ambiental - SNSA), was created as a permanent instance to implement monitoring and evaluation of basic sanitation policies at a national level. The Ministry of Cities became the main institution for assistance in sanitation programs and actions in Brazil, considering the number and value of contracts.[69]

Managing authority	2004	2005	2006	2007	2008	2009	2010	2011
Ministry of Cities (Ministerio das Cidades)	9	9	8	7	7	6	5	5
The Ministry of National Integration (Ministério da Integração Nacional)	6	7	7	6	6	6	4	4
Ministry of Health (Ministério da Saúde)	4	5	5	5	5	4	1	1
Ministry of Environment (Ministério do Meio Ambiente)	5	5	4	3	3	2	1	1
Ministry of Defence (Ministério da Defensa)	1	1	1	1	2	2	1	1
The Ministry of Agrarian Development (Ministério do Desenvolvimento Agrário)	1	1	1	1	1	1	1	1
The Ministry of Social Development and Hunger Alleviation (Ministério do Desenvolvimento Social e Combate à Fome)	1	1	1	1	1	1	1	1
Total	27	29	27	24	25	22	14	14

Table 7: Number of programs and sanitation actions for basic sanitation per ministry. (Adopted by the author). Source: PLANSAB (2013)

Ministerio das Cidades manages urban sanitation programs such as “Programa Serviços Urbanos de Água e Esgoto” (Program for urban water supply and sanitation services) and “Saneamento para Todos” (Sanitation for All).

The Ministry of Cities is insofar involved in rural sanitation, as it coordinates and finances the municipal sanitation plans, which need to include rural and urban sanitation measures, for municipalities with more than 50.000 inhabitants.

4.1.2 The National Health Foundation (Fundação Nacional da Saúde) FUNASA and Ministry of Health (Ministério da Saúde)

FUNASA is the executive agency of the Ministry of Health and therefore responsible for promoting social inclusion through sanitation actions for prevention and control of diseases. The sanitation actions are focussed on specific settlements such as quilombola and caiçara. Formerly, FUNASA also served indigenous population communities in Brazil, but withdrew their activity lately. FUNASA funding aims to support municipalities with up to 50,000 inhabitants as well as vulnerable populations, such as indigenous populations, quilombolas and caiçaras[70].

In the area of public health engineering for sanitation actions, FUNASA has the most continuous experience in the country. There are two areas FUNASA is serving in the moment: Social health

[68] Ministry of Cities was created 2003 in order to combat social inequalities, make cities more human and increase the population's access to housing, sanitation and transportation.
[69] Compare: PLANSAB (2013): P. 70
[70] Quilombolas are residents of settlements founded by fugitive slaves, whereas caiçaras are residents of settlements with different ethnic groups. Compare: Socioambiental: http://www.socioambiental.org/inst/camp/Ribeira/comunidades

engineering, attending programs such as improvement of domestic sanitation and solid waste management, and rural sanitation. Within the framework of the national sanitation policy, FUNASA is responsible for "the implementation of sanitation actions in rural areas of all Brazilian municipalities"[71]. The Ministry of Health is responsible for coordination of the Rural Sanitation Program in line with the particularities of rural territories as defined in the National Basic Sanitation Plan (PLANSAB). According to the population census conducted by the Brazilian Institute of Geography and Statistics IBGE in 2010, about 29.9 million people in Brazil reside in rural areas, forming approximately 8.1 million households.[72]

Formerly, FUNASA used to select municipalities for sanitation actions, send engineers to the field and evaluate sanitation condition in order to elaborate diagnostics and implement adequate solutions for water supply and sanitation. Today FUNASA is merely a financing institution for basic sanitation plans for municipalities with less than 50.000 inhabitants within the entire municipal territory. The selection process is completed online through the municipal mayor. Municipalities with poor project applications or without any project are directly sorted out of the selection process, which makes the access to FUNASA funding for small, financially and technically weak municipalities difficult. [73]

The foundation exists in 26 states with its headquarter in Brasilia. The resources are federally allocated and distributed to the state levels. Within the annual federal planning, the most urgent and important areas and states such as arid and semiarid regions are prioritized for sanitation projects. After serving the urgent projects, states with better sanitation conditions (south and southeast regions) are considered for funding. For example, in 2013, only RS 6 Mio as annual budget for sanitation projects were designated for FUNASA superintendence in RJ. The budget allowed to finance sanitation projects in nine Fluminense municipalities, of which five were for water supply and four for wastewater treatment. The RJ FUNASA sanitation projects were implemented in urban areas with a population less than 50.000 inhabitants and no project was implemented in a rural area. Considering that FUNASA is the responsible institution for the entire rural sanitation of the country according to the Sanitation Law, the number of currently realized rural sanitation projects is insignificant.

It is also important to emphasize that FUNASA only installs sanitation solutions in the selected areas but doesn't assure long turn operation and maintenance of the constructed water and wastewater treatment plants. The project is considered as delivered with the completion of the construction. The accountable municipality is then responsible for the management (operation and maintenance) of the system, which does not always work out due to low organizational and technical capacity of municipal governments.

However, FUNASA is well interconnected within the sanitation sector and cooperates with several federal and state programs, universities and other governmental and non-governmental institutions.

[71] Compare: Funasa: http://www.funasa.gov.br/site/engenharia-de-saude-publica-2/saneamento-rural/
[72] Compare: Funasa: http://www.funasa.gov.br/site/engenharia-de-saude-publica-2/saneamento-rural/
[73] Interview with Claudio Moreira/FUNASA RJ

4.1.3 The Ministry of Environment (Ministério do Meio Ambiente) and National Water Agency (Agência Nacional de Águas) ANA

The Ministry of Environment coordinates the National Programme for Municipal Solid Waste Management and supports the National Water Agency (Agência Nacional de Águas - ANA) in water resources management.

ANA is a national water agency which licences water capitation for water users on federal rivers and acts as an "executive agency responsible for the implementation of the national water resources management system and regulation of water use in federal rivers"[74]. ANA enters in contact with "saneamento" by capturing of raw water from rivers and receiving the treated waste water back to the rivers. ANA launched various programs to improve the water quality conditions and reduce the quantity of waste water in Brazilian rivers such as PRODES, where the water agency purchases treated wastewater from municipalities. The agency doesn't finance any new installations for waste water treatment. It merely acquires treated wastewater from municipalities, monitoring the efficiency and treatment capacity of the existing wastewater treatment plants. As the number of the benefited population and the treated wastewater quantity are crucial factors for the PRODES selection process, rural areas have low chances to enter the program.[75]

4.1.4 Brazilian Corporation of Agricultural Research (Empresa Brasileira de Pesquisa Agropecuária) EMBRAPA and Ministry of Agriculture (Ministério da Agricultura)

EMBRAPA is a state-owned company affiliated with the Brazilian Ministry of Agriculture, which is devoted to applied research on agriculture. EMBRAPA conducts agricultural research on many topics including animal agriculture and crops and also develops rural sanitation technologies.[76]

4.2 State Government

The states have acted predominantly in the service provision for drinking water supply, wastewater collection and treatment through their companies. In recent years, some states started also to act in the regulation of services through regulatory agencies (delegated by municipalities). Other states, have their own legislation for sanitation and established State Cities Councils for Sanitation (Conselhos Estaduais das Cidades e de Saneamento).[77]

The state of Rio de Janeiro founded a State Council for Housing and Sanitation of Rio de Janeiro (Conselho Estadual de habitação e Saneamento do Rio de Janeiro) in 1995 in order to improve the state housing situation in line with the former state policy for sanitation, but the council is not active any more.

[74] Braga, B.P.F., Agência Nacional de Águas (2005): RIVER BASIN MANAGEMENT IN BRAZIL
[75] In the state of Rio de Janeiro only the municipality of Volta Redonda has a PRODES contract with ANA
[76] https://en.wikipedia.org/wiki/Empresa_Brasileira_de_Pesquisa_Agropecu%C3%A1ria
[77] Compare: Plano de Saneamento Básico Participativo: http://www.meioambiente.pr.gov.br/arquivos/File/coea/pncpr/Cartilha_Plano_de_Saneamento_Basico_Participativo.pdf

In April 2011 the state government of RJ accepted the Sanitation Pact (Pacto do Saneamento) by Decree No. 42 930, according to the Federal Law 11,445/2007, establishing national guidelines for basic sanitation. The Sanitation Pact of RJ involves programs such as "Zero Landfill" (Lixão Zero) in partnership with the municipalities and the National Health Foundation FUNASA; and the program "RIO + LIMPO" (River+ Clean), in partnership with the state company for water and sewage treatment, CEDAE, the State Secretary for Agriculture and Livestock (Secretaria de Estado de Agricultura e Pecuária) and municipalities.[78]

The state program "RIO + LIMPO" aims to collect and treat 80% of the sewage throughout the State of Rio de Janeiro until 2018, also including the implementation of sanitation solutions in 45 rural locations in order to protect the majority of the state water springs, situated in the countryside. From 2009 to 2014 more than R$ 1.9 billion were invested in the program, expanding the treated wastewater from 30% to 38%. The program also includes the state project for sustainable development "RIO RURAL" led by the Ministry of Agriculture and Livestock and has strong partners such as the State Secretary of Environment and the Paraíba do Sul River Basin Integration Committee - CEIVAP.[79] However, the efficiency of the project is still very low due to the weakness of the management system for sanitation services on the state level. The responsibilities for various actors involved in planning, managing, monitoring and regulation of sanitation projects remain unclear and uncoordinated.

Also within the program "RIO + LIMPO" a special sanitation program, PSAM,[80] for the river basin of Guanabara was created. PSAM was developed by the State Secretary of Environment and financed by BID (Banco Interamericano de Desenvolvimento) and the state of RJ. The project has a duration of four years, from 2012-2016, and aims to strengthen state institutions like AGENERSA, INEA, CEDAE, State Secretary of Environment (SEA) and to develop sustainable municipal sanitation politics. The resources (a total of US 640 Mio: US 452 Mio from BID and US 188 Mio state counterpart[81]) are designated for construction of wastewater treatment solutions in order to treat 80% of the river basins wastewater till 2018.[82] PSAM supports the development of municipal basic sanitation plans around the Guanabara Bay[83] and the implementation of sanitation solutions in smaller communities such as Taquara, Rio Bonito and Cachoeiras de Macacu. However, within the PSAM project there is no sanitation program for rural areas as the selection criteria for municipalities is determined by population density, favouring urban areas. [84]

In this context, the river basin committees play a key role as a link between the state institutions, policies and programs on one hand, and municipalities on the other hand. River basin committees form an important element of the Brazilian water resources management system by charging water user for water use rights (through capturing of raw water and effluent discharge into water bodies, according to the mechanism provided by the Law No. 4,247/03) and applying the financial

[78] Compare: Government of Rio de Janeiro: http://www.rj.gov.br/web/sea/exibeconteudo?article-id=330838
[79] Compare: Government of Rio de Janeiro: http://www.rj.gov.br/web/sea/exibeconteudo?article-id=1056195
[80]PSAM: Environmental Sanitation Program for the Surrounding Municipalities of the Guanabara Bay (Programa de Saneamento Ambiental dos Municípios do Entorno da Baía de Guanabara)
[81] PSAM: http://fbds.org.br/fbds/IMG/pdf/doc-621.pdf
[82] Interview with Eloisa Torres/ PSAM, State Ministry of Environment RJ.
[83] PSAM support for municipalities by attending the municipalities in preparation of terms of reference for the municipal sanitation plans, in quest of resources by CBHs, publishing tendering fkor project execution, budgeting and securing of social control by promoting public audiences, seminaries, technical meetings and workshops.
[84] Interview with Eloisa Torres/ PSAM, State Ministry of Environment RJ

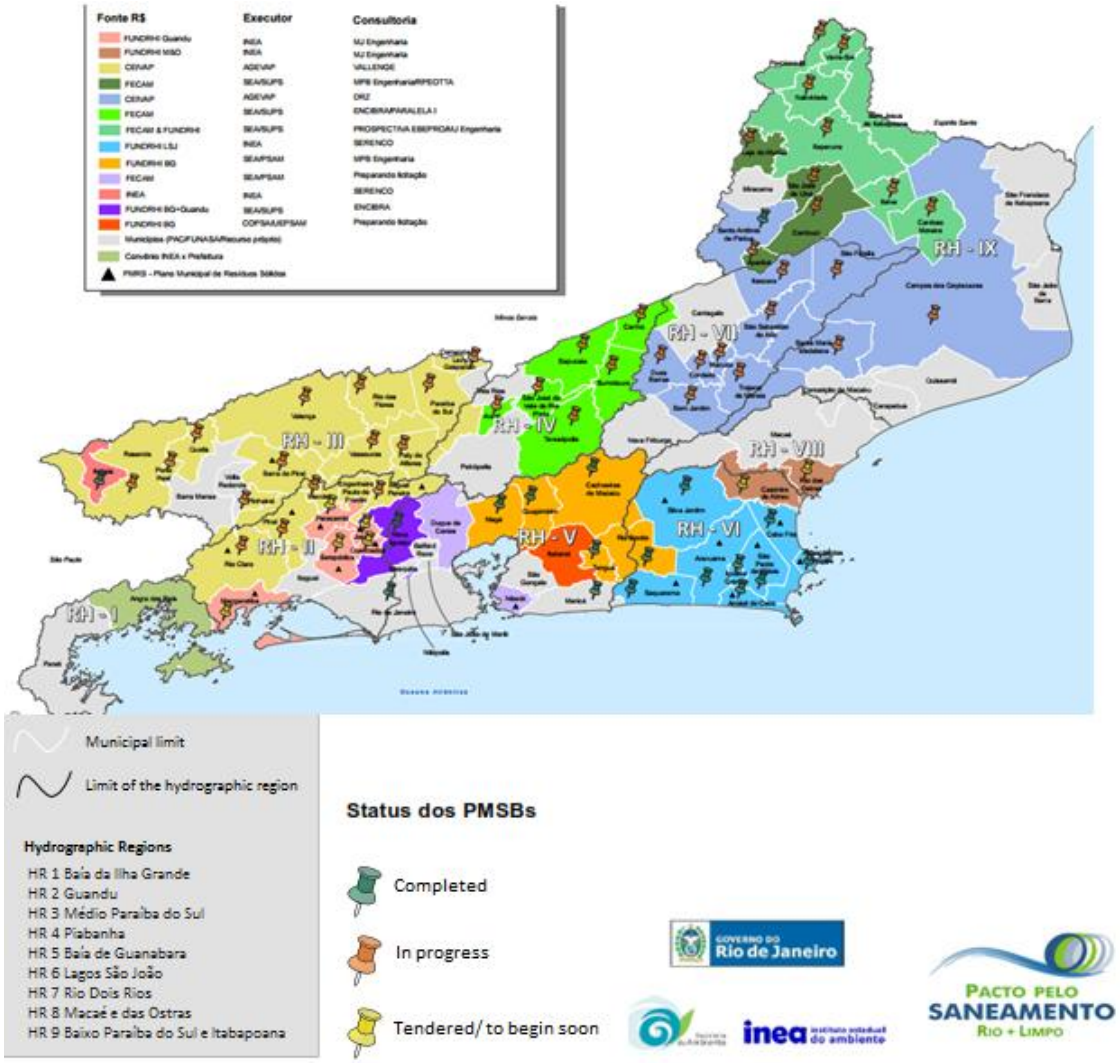
resources on river basin management actions according to the water resources plan, which also include sanitation.[85]

The resources raised from granting of water use rights in state domain, are administered by the State Water Resources Fund (FUNDRHI). FUNDRHI is part of the State System of Water Resources Management (Sistema Estadual de Gerenciamento de Recursos Hídricos – SEGRHI) in the State of Rio de Janeiro, created in order to assure the economic feasibility and decentralization of the water management sector. The fund is managed by the State Institute of Environment (Instituto Estadual de Ambiente – INEA), which act as an environmental executive agency by funding of development programs and projects for the State Water Resources Plan (Plano Estadual de Recursos Hídricos), watershed plans and other water management related government programs.

The State Council for Water Resources of the State of Rio de Janeiro, CERHI[86], is another important stakeholder for water resources management on the state level. CERHI is a collegiate body with regulatory, consultative and deliberative powers, responsible for the implementation of the RJ State Water Resources Policy. It establishes guidelines for formation and organization of the river basin committees (CBHs) and water agencies, arbitrates as the last administrative instance conflicts between river basin committees and establishes general criteria on granting of rights for water use and collection, among other duties.[87] CERHI doesn't have any responsibility for sanitation projects. However, the plan for water resources management for RJ underlines the importance of sanitation actions (wastewater collection and treatment) to improve the water quality in the state rivers. Therefore, sanitation became a priority for investments within the CERHI guidelines. For example, the state water management resolution No. 50 / 2010 between INEA and AGEVAP, approved by CERHI, assigned that 70% of the resources of river basin committees generated by charges for water use in the state of RJ need to be invested in sanitation actions[88]. The resolution does not specify, if sanitation actions should be focused on urban or rural areas. Nonetheless, the urgency for urban wastewater treatment in RJ leads to the conclusion that sanitation actions in rural areas won't be privileged. Though, CERHI doesn't liberate financial resources for sanitation programs and actions, it only designs the state political guidelines for water resources management of the state of Rio de Janeiro.

However, the sanitation sector experiences a strong legal and institutional vacuum in RJ. It also lacks well-designed structured and integrative sanitation projects and programs within the RJ water resources management system.[89]

[85] Compare: Government of Rio de Janeiro: http://www.rj.gov.br/web/sea/exibeconteudo?article-id=1056195
[86] CERHI was established by State Law No. 3,239 / 1999 an is part of the State System of Water Resources Management – SEGRHI.
[87] Compare: INEA:
http://www.inea.rj.gov.br/Portal/Agendas/GESTAODEAGUAS/RECURSOSHIDRICOS/Conselhoestadual/index.htm
[88] CERHI resolution 2010: AGEVAP: http://www.agevap.org.br/agevap/conteudo/RESOLUCAO%20CERHI%2050.pdf
[89] Interview with Moema Versiani Acselrad/ INEA, RJ, April 2015.



Map 1: Situation of municipal sanitation plans 2014. Shown on limits of municipalities and hydrographic regions. (Adopted by the author). Blue pin: completed; Red Pin: in process; Yellow pin: tendered/ to begin. Source: Government of Rio de Janeiro[90]

4.2.1 State Secretary of the Environment (Secretaria de Estado do Ambiente - SEA) / State Environmental Institute (Instituto Estadual do Ambiente) - INEA

The State Environmental Institute (Instituto Estadual do Ambiente – INEA), is an environmental management agency of the state government of Rio de Janeiro, linked to the State Secretary of the Environment (Secretaria de Estado do Ambiente - SEA). The agency, established in 2008, applies the state environmental policy through environmental services, control and monitoring mechanisms. INEA operates in a decentralized manner within the state territory under hydrographic division. Thus, there are regional offices of INEA, operating in the nine river basins of the state of Rio de Janeiro, working together with river basin committees on the development of water resources management plans.[91] INEA coordinates and extends the activities of the Environment Secretary of State of Rio de Janeiro. “The institute is developing municipal sanitation

[90] Government of Rio de Janeiro: http://www.rj.gov.br/web/sea/exibeconteudo?article-id=1056195
[91] Compare: INEA: http://www.inea.rj.gov.br/Portal/Agendas/GESTAODEAGUAS/index.htm&lang=

plans for each watershed. The plan is composed at least by 1) infrastructure construction, 2) institutional strengthening and 3) sustainable policies parts."[92]

The main duty of INEA is however the environmental licencing: Environmental licencing can be granted on different governmental levels: projects of national interest are granted by the Brazilian Institute of Environment and Renewable Natural Resources – IBAMA; state and local projects are licenced by INEA. INEA also grants licencing rights to municipalities. Within the state of Rio de Janeiro, around 40 of 92 municipalities have the right to grant environmental licences, including for the construction of wastewater treatment solutions.

INEA being also the executing secretary of CERHI[93], is responsible for the coordination of FUNDRHI, which manages the funds of each hydrographic region of the state. According to Law No. 5,234 / 2008, 90% of the amount raised by this fund should be applied to the correspondent river basin, and the remaining percentage is applied to the managing state agency, INEA. As already mentioned above, at least 70% of the funds raised for water use in each river basin within the state of Rio de Janeiro, must be applied for collection and treatment of urban wastewater until it reaches 80% of collected and treated wastewater.[94]

The plans for water resources formulated by CBHs and approved by CERHI, define the investment guidelines. INEA applies those decisions through licencing, enables articulation with other institutions, signs agreements or supports the search for alternative funds for water resources management plans. The agency also accompanies the development of municipal sanitation plans (PLANSABs) together with AGEVAP and CEIVAP within the Paraiba do Sul River basin. However, it does not provide trained staff for supporting and advising for sanitation projects. Hence, INEA is an important institutional tie in the implementation process of sanitation actions on the state level.[95]

INEA also co-manages as environmental agency state programs related to sanitation such as ICMS-Verde, Payment for Ecosystem Services (PSA), FUNBOAS and sanitation programs for various regions, such as the metropolitan region, Ilha Grande and Paraty, Medio Paraíba region, and programs of the Sanitation Pact (LIXÃO ZERO and RIO+LIMPO).

4.2.2 Secretaria de Agricultura/ Program RIO RURAL

An important stakeholder for rural sanitation on the state level is the Sustainable Rural Development Program for Watersheds in the State of Rio de Janeiro - "RIO RURAL". The program, coordinated by the State Secretariat of Agriculture and Livestock of Rio de Janeiro and "funded by GEF (2006-2011), the World Bank (2010-2018), federal and state programmers and private

[92] Bufoni, A; Silva Carvalho, M; Basto Oliveira, L; Pinguelli Rosa, L (2014): P. 888

[93] CERHI approves decision of the CBHs and applies resources through INEA. CBHs dispose over resources to implement in sanitation projects such as licencing for construction. CERHI approves the decision of CBHs and INEA incentives and supports the decided actions proving if they fit within the previous planning. INEA doesn't have own resources for water resources management.

[94] Compare: INEA: http://www.inea.rj.gov.br/Portal/Agendas/GESTAODEAGUAS/RECURSOSHIDRICOS/FUNDRHIAGENDAAZUL/index.htm

[95] For example, resources from the state of RJ and Paraiba do Sul River Basin Committee - CEIVAP were invested through the State Fund for Environmental Conservation and Urban Development - FECAM (Fundo Estadual de Conservação Ambiental e Desenvolvimento Urbano), and delegated to the executing agency AGEVAP through INEA, in order to elaborate plans for the municipalities of the watersheds of the Paraiba do Sul River Basin.

sector",[96] aims to improve the quality of life in rural areas increasing the income of farmers combined with the conservation of natural resources. The strategy of RIO RURAL is based on river basins as planning units and on direct involvement of rural communities. The river basin/ watershed methodology has been enhanced in Brazil in the last 20 years and seeks management of natural resources through the adoption of sustainable management practices by rural communities. The methodology is based on principles such as decentralization, transparency of decision making process, empowerment and sustainability. "The project will benefit 78,000 farmers, 47.000 with direct financial incentives and technical assistance to improve productivity. In return farmers agree to implement conservation and restoration practices in their lands, contributing to sustainability of the Atlantic Forest biome. The farmers are increasingly adopting practices such as reforestation, spring protection, recovery of riparian vegetation and protection of water recharge areas, sanitation, road rehabilitation, green and organic manure, among other actions with direct impact on natural resources. Besides direct incentives for sustainable production techniques, rural communities will benefit from conservation practices on 44,889 km of rivers and streams, conservation of 6,000 km feeder roads, rural sanitation and training. The programme will cover 2.5 million hectares, about 95 % of total agricultural land in the state."[97]

RIO RURAL focusses its work inter alia on improvement of water and environmental quality through the reduction of river pollution by domestic wastewater in the river basins of RJ. Rural sanitation is not a direct responsibility of the state Secretary of Agriculture or RIO RURAL. However, as rural sanitation contributes to the improvement of water quality in river basins, Rio Rural coordinates rural sanitation actions in rural areas of RJ.

Currently, RIO RURAL runs two types of rural sanitation projects: one project for individual rural sanitation solutions and another project for collective sanitation solutions in order to serve urban nuclei in rural areas counting from 30 to 100 families.[98] Within the project for individual rural sanitation, 7.200 individual solutions and three pilot projects for collective wastewater treatment are planned to be implemented with RS 18 Mio funding from the World Bank.[99] Between 2012 and 2013 already 3.000 bio-digester septic tanks have been installed within the most vulnerable priority watersheds, selected according to the environmental state and rural population income in the north and north-east[100] regions and in the highlands of RJ.[101] In the three selected priority regions, RIO RURAL plans to install individual sanitation solution without a counterpart from rural community members. In other regions of RJ not classified as vulnerable, 20% counterpart will be charged by the beneficiaries.

[96] Planeta Organico: RIO RURAL PROGRAMME – GREEN ECONOMY AND SUSTAINABLE DEVELOPMENT IN MICRO-WATERSHEDS OF RIO DE JANEIRO. http://planetaorganico.com.br/site/index.php/micro-watersheds-of-rio-de-janeiro/
[97] Planeta Organico: RIO RURAL PROGRAMME – GREEN ECONOMY AND SUSTAINABLE DEVELOPMENT IN MICRO-WATERSHEDS OF RIO DE JANEIRO. http://planetaorganico.com.br/site/index.php/micro-watersheds-of-rio-de-janeiro/
[98] A total amount of 25.215.650, 00 RS the World Bank invested into the project RIO RURAL for a term of six years for infrastructure investment/DRS, which includes construction of sites for packaging; gardens for native and exotic seedlings; municipal and inter-municipal patrols, acquisitions for agro-ecological transition. Construction of reservoirs (Community supply / irrigation and watering); etc. And also provision of rural properties with individualized solutions in order to solve sanitation problems (water supply, wastewater treatment and solid waste). From: PROJETO DESENVOLVIMENTO RURAL SUSTENTÁVEL EM MICROBACIAS HIDROGRÁFICAS: PROJETO RIO RURAL – BIRD (2011): P. 53
[99] RIO RURAL: http://www.microbacias.rj.gov.br/projeto_bird.jsp
[100] The Serran region was added to the list of most vulnerable regions of RJ after the landslide catastrophe in 2011
[101] Interview with Adriano Lopes, employee by Project RIO RURAL/Secretary of Agriculture and Livestock of the State of Rio de Janeiro (Secretaria de Agricultura e Pecuária do Estado do Rio de Janeiro - SEAPEC)/ Office of Sustainable Development (Superintendência de Desenvolvimento Sustentável - SDS)

The project for collective rural sanitation solutions, coordinated by the State Secretary of the Environment (Secretaria de Estado do Ambiente), with RS 9, 4 Mio funding from FECAM[102] in the north east of the state was approved in 2009. However, the approved resources were not awarded to date, so the implementation of the project stuck on the waiting line due to the lack of political coordination between the state secretaries of agriculture and environment, which are in fact well interconnected, but yet lack a sound coordination.[103]

RIO RURAL also cooperates with universities in order to collect and evaluate field data and elaborate technical projects. It is also a partner of the German-Brazilian project INTECRAL for the rural sanitation project in Barracão dos Mendes.

4.3 Municipalities

Municipalities are responsible for the organization and provision of sanitation services to the entire municipal population. So it is up to each municipality to develop the municipal sanitation policy and a basic sanitation plan of its entire territory, including the four basic sanitation services (drinking water supply, wastewater treatment, drainage and solid waste management), including urban and rural sanitation. Municipalities can provide the sanitation services directly or delegate them to a service provider. Each municipality needs to define the entity responsible for the regulation and supervision of sanitation services, set quality parameters, users' rights and responsibilities and establish mechanisms for social control and participation. In Brazil, urban cleaning, solid waste management, storm water and urban drainage are generally carried out directly by municipalities through environmental, construction or public services departments. Municipalities can also form public consortia with other municipalities with similar interests in order to share competences and save resources for similar tasks.[104]

A municipal basic sanitation plan is a document, which describes the way a municipality plans to invest into the development and growth of its entire municipal sanitation sector. Once a municipal basic sanitation plan has been accomplished it needs to be approved by the municipal council (câmara dos vereadores) to a municipal law, all the further rural and urban sanitation actions planned and implemented within the municipal territory must conform to the basic sanitation plan. The technical control is assigned to the municipal technical chambers, responsible to control the implementation of the municipal basic sanitation plans, which need to be reviewed every four years and re-approved by the municipal council, through participation of civil society as a control mechanism.

The elaboration of the basic sanitation plan is a profound and costly study and bases on the sanitation situation diagnosis, a social mobilization plan and the development of guidelines and programs. Hence, several particular federal and state financial resources have been made available in order to fund the elaboration of the municipal basic sanitation plans and will be described in the chapter 5.2.

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[102] Governo do Rio de Janeiro: http://www.rj.gov.br/web/seapec/exibeconteudo?article-id=316919

[103] Interview with Jarbas Saraiva– former coordinator for infrastructure at Rio Rural/ BID advisor/ RIO RURAL employee for rural sanitation actions.

[104] Compare: Plano de Saneamento Básico Participativo: http://www.meioambiente.pr.gov.br/arquivos/File/coea/pncpr/Cartilha_Plano_de_Saneamento_Basico_Participativo.pdf

Nonetheless, municipalities also obtain income through diverse taxes. Irrespective of the taxes from resident companies, industries and services, all Brazilian municipalities benefit from the Participation Fund of Municipalities (Fundo de Participação dos Municípios – FPM), which divides a significant part of federal taxes collected to the National Treasury and previously allocated to the states, between municipalities. According to the Art. 91 of the Participation Fund of Municipalities from 1967, state capitals share 10% of the fund and the remaining 90% are divided between all the other municipalities.[105] Another municipal tax is the urban property tax (Imposto Predial Territorial Urbano) – IPTU, which is collected from all urban properties to provide municipal infrastructure services such as public illumination, waste management etc. IPTU is significantly lower than the receipts from the Participation Fund of Municipalities. Rural areas however, are not subject to the municipal tax, IPTU and belong to the federal taxation, charged by the Federal Agency of the Brazilian Public Administration - INCRA. The rural property tax – ITR (Imposto Sobre a Propriedade Territorial Rural) charged by INCRA, is an insignificant tax charged by the federal government in order to support farming activity in rural areas through low taxation. Therefore, the fact, that rural areas do not contribute any taxes to the municipal budget, creates a conflict of competences regarding service provision within the municipal territories.

Nevertheless, "the municipal sector is a collection of [around] 5,500 municipalities (both rural and urban) encompassing a broad range of units with extreme differences in size, economic structure, and fiscal outlook. Most of them are cash strapped, and they depend heavily upon loans for their investments."[106] On the one hand, sanitation services are taken as a governmental, and not as user responsibility of the citizens. On the other hand, many municipalities don't have the capacity to develop sanitation projects due to insufficient financial resources, organizational structure and low skilled technical staff. Additionally, there is a lack of supporting and controlling entities and no obligating instruments for municipalities to elaborate and implement the sanitation plans, aside from the access block to further federal resources for sanitation measures in the future. A further controlling entity, the organization of civil society, is not yet strongly developed in Brazilian municipalities.

Rural communities belong to their administrative municipal territories and need to demand sanitation services at their municipal administrative centres. There is a low possibility for a rural community to receive funds for rural sanitation measures on state or federal level without the involvement of the municipal administration. Brazilian municipalities willing to receive federal funding for the elaboration and implementation of basic sanitation plans need to develop a basic sanitation plan untill the end of 2015. In order to receive further federal funding for the implementation of the plan, the project needs to be approved by the federal institution (Ministerio das Cidades or FUNASA). Municipalities can also apply for state, CBH or private funding, or use municipal funds for the development of basic sanitation plans. The elaboration of the municipal basic sanitation plan can be done by the municipal sanitation chamber or be outsourced to a private company or an academic institution. After the completion of the basic sanitation plan, which defines sanitation actions for the entire municipal territory, the layout needs to be examined by the responsible coordinating and financing institution in order to approve further funds for the implementation of the basic sanitation actions.

[105] http://www.soleis.com.br/ebooks/tributario1-38.htm
[106] Kopp, P; Prud'homme, Rémy (2005): P. 3

4.4 River Basin Level Institutions: Paraíba do Sul River Basin

The water resources management on the Paraíba do Sul River Basin level plays an important role for the sanitation sector.

The National Water Resources System, established by Laws No. 9.433 / 97 and No. 9.984 / 00, introduced new actors into the Brazilian institutional water resources management setting, such as river basin committees and river basin agencies. The river basin committees are democratic forums for discussions and decisions on issues related to the use of basin water resources. The river basin agencies are meant to be the executive arm of the committees, which receive and apply the funds collected by charging for water use within the river basin. The National Water Agency (ANA) assumes the functions of a management body for water resources controlled by the Union, previously exercised by the Water Resources Department of the Ministry of Environment[107].

Paraíba do Sul River Basin is spread over 57 000 sq. km and covers the states Rio de Janeiro, Minas Gerais, and São Paulo including 180 municipalities, which depend on the Paraíba do Sul water resources. The River Basin contributes 13% to Brazil's gross domestic product and is crucial for domestic water, industries, recreation, and agriculture.[108] "Water pollution is identified as the main problem of the basin, primarily due to industrial and domestic effluents. This situation can be mostly attributed to discrepancies between the socio-economic development of the region and the insufficient measures to preserve environmental quality. The rapid demographic growth experienced by the majority of basin urban areas was not accompanied by adequate planning and sanitation measures, resulting in the indiscriminate occupation of river banks and the lack of sanitation infrastructure."[109]

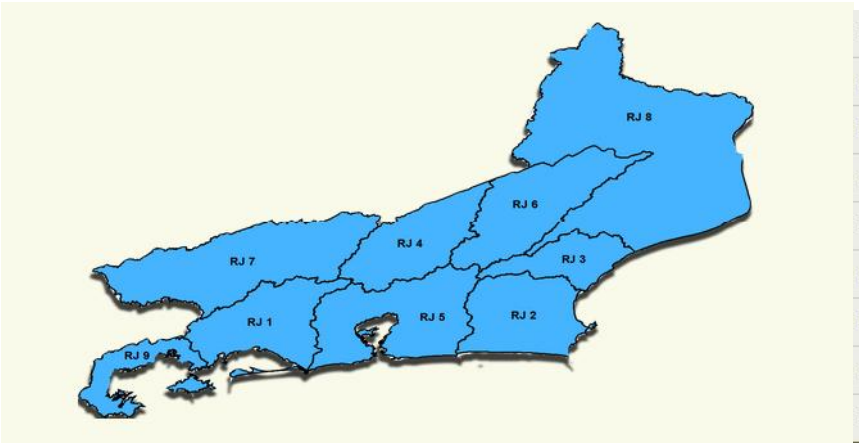
Map 2: Paraíba do Sul River Basin covering the states of Sao Paulo, Rio de Janeiro and Minas Gerais. Dark blue: Union rivers; Light blue: State Rivers. Source: Braga, B.P.F., Agência Nacional de Águas (2005): River Management in Brazil. The Paraíba do Sul Case.

[107] Compare: CEIVAP: http://www.ceivap.org.br/apresentacao.php
[108] Compare: Kumler; Lemos (2008), Dias Soarez et al.
[109] Seroa da Mota, R; Thomas, A; Saade Hazin, L; Feres, J.G; Nauges, C; Saade Hazin, A (2004): P. 110

The Paraíba do Sul River Basin consists of eight integrated river basins committees. The Integration Committee of the Hydrographic Basin of the Paraíba do Sul River, CEIVAP integrates the eight committees (CBHs) into the Paraíba do Sul River Basin as one. The water resources management within the Paraíba do Sul River Basin is complex due to the multiple jurisdictions of the Union, the states of Sao Paulo, Rio de Janeiro and Minas Gerais; multiplicity and variety of the river basin committees, different stages of organizational development in the three states and also different levels of capacity of the executing water agencies.[110]

The state of Rio de Janeiro is divided into nine hydrographic regions. Five of the nine hydrographic regions belong to the superordinate hydrographic region of the Paraíba do Sul River. Each river basin within the RJ territory belonging to the Paraíba do Sul River Basin holds a hydrographic river basin committee (Comitês de Bacia Hidrográfica/ CBH). The committees have "among their responsibilities the design and implementation of bulk-water permits and charging systems, approval of river basin management and water zoning plans, and facilitation of conflict resolution among users".[111]

The diverse and democratic composition of the committees involves all sectors of society in the river basin based water resources management (representatives of government, municipalities, water users, NGOs etc.). However, they don't have a legal status and require an executing agency in order to implement the committee decisions within the watershed. [112]
The river basin committees, belonging to the Paraíba do Sul River Basin, within the state of Rio de Janeiro are: CBH do Rio Guandu, CBH do Rio Piabanha, CBH Rio Dois Rios, CBH Médio Paraíba do Sul and CBH Baixo Paraíba do Sul. The river basin committees in RJ not part of the Pariíba do Su River Basin are: CBH Lagos São João, CBH do Rio Macaé, CBH do Leste da Baia de Guanabara and CBH da Baía da Ilha Grande.



RJ1	CBH do Rio Guandu
RJ2	CBH Lagos São João
RJ3	CBH do Rio Macaé
RJ4	CBH do Rio Piabanha
RJ5	CBH do Leste da Baia de Guanabara
RJ6	CBH Rio Dois Rios
RJ7	CBH Médio Paraíba do Sul
RJ8	CBH Baixo Paraíba do Sul
RJ9	CBH da Baía da Ilha Grande

Map 3: Hydrographic regions in the state of Rio de Janeiro: Source: Comitês de Bacias Hidrográficas[113]

[110] Compare: Braga, B.P.F., Agência Nacional de Águas (2005)
[111] Compare: Kumler, L; Lemos, M.C (2008): P. 2
[112] Compare: Comitês de Bacia Hidrográficas: http://www.cbh.gov.br/GestaoComites.aspx
[113] Comitês de Bacia Hidrográficas: http://www.cbh.gov.br/DataGrid/GridRio.aspx

4.4.1 The Integration Committee of the Hydrographic Basin of the Paraíba do Sul River - CEIVAP

The Integration Committee of the Hydrographic Basin of the Paraíba do Sul River (Comitê de Integração da Bacia Hidrográfica do Rio Paraíba do Sul) - CEIVAP, created by Federal Decree No. 1,842 / 96, is a parliament for debates and decentralized decisions on issues related to the multiple use of water resources in the Paraíba do Sul River Basin. The Committee is composed of representatives of public authorities, users and social organizations with focus on conservation, preservation and restoration of the quality of the Basin waters. CEIVAP is composed of 30% of civil society (NGOs, universities and professional associations), 30% of water users (industries, water utilities such as water supply and WWT providers, farmers) and 40% of representatives of municipal, states and federal government. The Committee consists of 60 members, three of the Union and 19 of each state (SP, RJ and MG). [114]

"The river's water committee, CEIVAP, is an important case from a number of perspectives. The basin is one of the most physically complex, with dams and reservoirs built over a time span of nearly a century. Because the river crosses three states and the industrial corridor between Brazil's two largest cities (São Paulo and Rio de Janeiro), it also has political, jurisdictional, and socioeconomic importance. The committee stands out in terms of its implementation because it is the first federal committee to institutionalize the collection of bulk-water fees from users and the first to create a dedicated administrative agency AGEVAP ("Agência do Vale do Paraíba," Paraíba Valley Agency)."[115]

CEIVAP started the development of particular sanitation activities within the river basin already in 2006, before the approbation of the Sanitation Law and emerging municipal basic sanitation plans in order to improve water quality of Paraiba do Sul River. CEIVAP receives around RS 12 Mio per year from water use charges from the Paraiba do Sul River and is considered a financially strong river basin committee. In order to advance the progress of the completion of PLANSAB, the river basin committee finances the elaboration of the development of municipal basic sanitation plans for all river basin municipalities, which did not obtain any federal, state or private funding. Nonetheless, the implementation of the basic sanitation plans, including construction of water and wastewater treatment plants and infrastructure development, are much more expensive and require additional resources. Accordingly, regarding sanitation issues, CEIVAP mainly focuses its resources on elaboration of basic sanitation plans for the affiliated municipalities.[116]

4.4.2 AGEVAP – Water Agency of Paraíba do Sul (Agência da Bacia do Rio Paraíba do Sul)

AGEVAP is an important governance instrument for water resources management in the Paraíba do Sul River Basin. It is a civil, private, non-profit entity with the mission to plan, execute actions deliberated by CEIVAP in order to ensure sufficient water quality and quantity for multiple use within the Paraíba do Sul River Basin. AGEVAP is operating as: a) Executive secretary of the committee; b) Support of the plan for water resources of the river basin; and also supports: c) Implementation of investment studies and projects; d) Application of financial resources; e) Social

[114] Compare: Braga, B.P.F., Agência Nacional de Águas (2005)
[115] Kumler, L; Lemos, M.C (2008): http://www.ecologyandsociety.org/vol13/iss2/art22/
[116] According to the interview with Juliana Fernandes/ AGEVAP

communication; f) Support by implementation of water resources management tools. The administration of AGEVAP is under control of a council of CEIVAP, of ANA and of the Brazilian federal accountability office (Tribunal de Contas da União).[117]

AGEVAP receives and implements fees charged for water use and discharge of wastewater, which are collected by ANA on federal waters and by INEA on RJ state waters.[118]. According to the state law No. 5.243/2008, 70% of all revenues charged for water use on the RJ state level, need to be invested in sanitation.

In the last years AGEVAP worked its way up to a strong skilled delegated entity with a focus on sanitation. Today, the agency attempts to compensate the technical incapacity of municipalities and of other sanitation sector stakeholders to boost the implementation of sanitation programs and solutions within its river basin area. Therefore, AGEVAP is financing with resources of CEIVAP the development of municipal basic sanitation plans for all municipalities of the Paraíba do Sul River Basin, which did not receive any other federal, state or private funding. Taking in account the technical difficulties of municipalities to apply for resources for elaboration of municipal sanitation plans, AGEVAP developed a standard term of references for all the municipalities of the Paraiba do Sul River Basin. Accordingly, municipalities only need to fill in the form in order to receive CEIVAP funding.[119]

AGEVAP is also turning into an important stakeholder in the rural sanitation sector: In 2015 AGEVAP elaborate a rural sanitation diagnostic for RJ municipalities of Nova Iguaçu, Queimados, Vassouras, Rio Claro, Miguel Pereira, Engenheiro Paulo de Frontin and Barra do Piraí. The diagnostic of rural areas in the above-named municipalities represents a pre-evaluation for the subsequent relevance ranking according to AGEVAP criteria for further sanitation actions.[120]

The weak coordination between river basin based and municipal zoning is however challenging: sanitation plans for the Paraíba do Sul and integrated river basins determine environmental priority areas such as forests, water springs, etc. in order to protect water resources. However, the respective municipality is the definitive owner of the municipal territory. Thus, against the priority plan developed by the agency, the municipality may apply its own zoning and place an industry close to the prioritized water source protection area. The communication and cooperation between AGEVAP and many municipalities, is not yet as good as desired, which also results from the lack of political guidelines in order to strengthen the existing sanitation programs and actions, and lack of a holistic planning structure on governmental levels.

However, AGEVAP is an important reference for urban and rural sanitation in Brazil, which aims to move forward the sanitation sector development and find solutions for challenges, which could not be approached within the existing institutional setting.

The graph below explains the responsibility of the Paraíba do Sul River Basin committee to the state and national levels.

[117] Pires Cardoso, M. (2008): P. 14
[118] The value of the water use fee is defined by CEIVAP
[119] According to the interview with Juliana Fernandes/ AGEVAP

[120] TECNOGEO INFORMÁTICA S/S LTDA (2015): P. 290

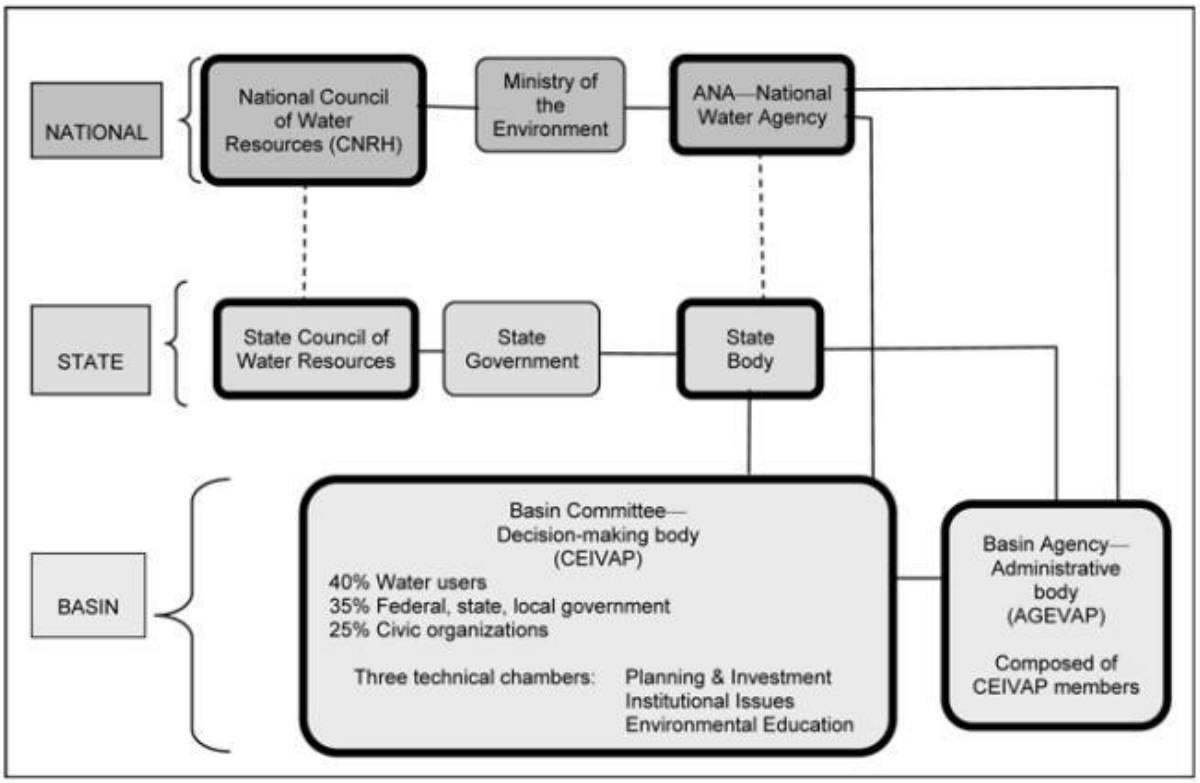


Figure 7: Diagram of National Water Resources System. Source: Kumler, Lemos 2008

According to the RJ State Law No. 3239, water agencies can be also formed by inter-municipal or inter- river basin consortia, regional, local or sectoral associations of water users; technical, teaching and research organizations working with water and environmental resources; non-governmental organizations aiming to defend interests of the society; and other organizations recognized by CERHI.[121] In RJ, only two CBHs, CBH Macaé das Ostras and CBH Lagos São João, are managed by one inter-municipal consortium Lagos São João (Consórcio Intermunicipal Lagos São João - CILSJ).[122]

4.5 Service providers

Municipalities can delegate water supply and sewage services to state companies, or provide services directly through municipal authorities, companies or departments. Otherwise, municipalities can outsource services by contracting private or public companies. Associated sanitation services provision can also be managed by formation of public consortia by various municipalities. The formation of public consortia is regulated by Law No. 11,107 / 2005, which regulates the provision of services shared by several municipalities.[123]

[121] Compare: State Law No. 3239: http://alerjln1.alerj.rj.gov.br/contlei.nsf/01017f90ba503d61032564fe0066ea5b/43fd110fc03f0e6c032567c30072625b?OpenDocument

[122] http://www.lagossaojoao.org.br/nc-contratogestao.htm and http://cbhmacae.eco.br/site/index.php/gestao-da-bacia/contrato-de-gestao/

[123] Compare: Plano de Saneamento Básico Participativo: http://www.meioambiente.pr.gov.br/arquivos/File/coea/pncpr/Cartilha_Plano_de_Saneamento_Basico_Participativo.pdf

However, as not many municipalities in RJ have the capacity for autonomous planning and implementation of sanitation services, thus private or public companies come into play under concession contracts. “Potable water and sewage collection and treatment in Brazil are largely the responsibility of the state (77%), with the balance of the services provided by municipalities (15%) and private companies (18% and growing).”[124] In the state of RJ, 70%[125] of municipalities are under the concession of the state sanitation company Companhia Estadual de Águas e Esgotos do Rio de Janeiro – CEDAE; remaining municipalities disposing over sanitation services are served by private companies such as “Aguas de Brasil Group”[126] or by municipal and inter-municipal public companies. “CEDAE is the primary water supplier and wastewater collection and treatment company in Rio de Janeiro. CEDAE's water division operates and maintains over 75 water treatment plants (WTPs) including the Guandu WTP, which is the largest in the world.”[127] “CEDAE currently supplies water to 64 municipalities in Rio and has sewage contracts with 33 of them[128]“. Nonetheless, the existing concession contracts are obsolete, designed in favour of service provider and have not been reviewed and renewed for years. Only 52% of municipalities under the concession of CEDAE in RJ have contracts for wastewater treatment. Being the biggest sanitation company in RJ, CEDAE has a significant political weight on design of the concession contracts. According to the interview with Victor Zveibil from the State Secretary of Environment, if the company is not benefited by wastewater treatment, it may decline the service to the municipality. Therefore, many wastewater treatment plants in RJ, financed and installed by FUNASA, and other projects stand still without any operation.[129]

The company has been lately coming under increasing scrutiny due to the lack of the corporate transparency and “recent reports revealing that only 39.2% of the population of municipalities that have contracts with CEDAE for sewage collection are in fact connected to a formal network”.[130]

Additionally, all concession contracts for sanitation services in RJ only apply for urban areas. In order to involve concessionaires to provide service in not economically feasible rural areas, obligation mechanisms applied through the regulating agencies, such as the RJ state agency AGENERSA or municipal and inter-municipal regulating agencies are required in order to assure the coverage of those otherwise unattended areas. Although the necessity of regulating agencies is required by the Sanitation Law, on municipal level it still lacks understanding for the necessity of an intermediating institution for dialoguing with service providers to design fair and accurate concession contracts.

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[124] Douglas-Watson, J: Back to Basics in Brazil. Water World: http://www.waterworld.com/articles/wwi/print/volume-26/issue-3/regional-spotlight-latin-american/back-to-basics-in-brazil.html

[125] CEDAE (2010): http://www.cedae.com.br/ri/Balan%C3%A7o_CEDAE_2010.pdf

[126] Grupo Aguas de Brasil: http://www.grupoaguasdobrasil.com.br/

[127] Federal Business Opportunities (2015): https://www.fbo.gov/index?s=opportunity&mode=form&id=aa04694d9207eeb6c737690f63500fc5&tab=core&_cview=1

[128] Valor Beta: http://www.valor.com.br/international/news/2882564/cedae-be-4th-brazilian-sanitation-company-go-public from 28.10.2012.

[129] Interview with Victor Zveibil/ Secretary of Environment RJ

[130] Hosek, E. (2013): The Troubling State of Sanitation in Rio. Published on August 21, 2013. in Solutions, 2016, by International Observers, Policies, Research & Analysis, Sustainability http://www.rioonwatch.org/?p=10892

4.6 Regulating Agencies

Regulating agencies represent an equilibrating mechanism between municipality, concessionaire and society in order to regulate interests, costs and demands of the sanitation sector. The autonomous and economically independent agencies are financed through the regulating rate ("taxa de regulação"), a percentage (around 0, 5%) of the revenues charged by the service providers, such as granted companies, concessionaires, licensees and independent municipal services[131].

The regulation of sanitation services through regulation and equilibration of concession contracts between the municipality and the service provider targets to ensure a higher juridical security for both sites. An important point is also the negotiation of tariff affordability, related to different social levels and ability to pay for a cubic meter of treated water and wastewater by different consumption sectors (industry, commerce, human consumption). On one hand, the concessionaires may be protected from short term political interests of the municipality. On the other hand, municipalities having mostly low capacity and knowledge about laws, taxes and design of concession contracts, have the possibility to formulate proper concessionaire contracts or to equilibrate the existing ones.

Furthermore, it is obligatory by the Sanitation Law, that each municipality regulates its sanitation services (water supply, wastewater treatment, solid waste management and drainage). The municipality can regulate those services by forming a municipal regulating agency, which is a costly and administratively complex solution; or municipalities can syndicate in an inter-municipal consortia in order to share costs and administrative work; or contract a state regulating agency. The regulation contract with the regulating agency is bound to the sanitation service contract between the concessionaire and the municipality. Due to the fact that water supply and sanitation concessionaires do not serve rural areas, the importance of regulating agencies for rural sanitation is very low.

According to the study conducted by the "Instituto Trata Brasil", only 56 of 100 within the survey analysed municipalities possess a regulating agency, independently of having a basic sanitation plan. 44 large Brazilian cities still do not have regulated sanitation services, which conveys insecurity regarding their sanitation management.[132]

4.6.1 State Regulating Agency of Rio de Janeiro– AGENERSA

AGENERSA is the regulatory agency for energy and sanitation of the State of Rio de Janeiro, created in 2005 and linked to the state government of RJ (Secretaria de Estado da Casa Civil). The agency is intended to regulate, monitor, control and supervise concessions and permissions for public service providers for energy (piped gas distribution)and sanitation (domestic and industrial wastewater collection, water supply and solid waste management) provided by granted companies, concessionaires, licensees and independent municipal services. The contracts between the municipality, service provider and regulating agency are usually set up to be

[131] Usually regulated companies pass the amount charged by the regulating agency to the end user.
[132] Compare: Instituto Trata Brasil (2014): Diagnosis of the situation of the municipal basic sanitation plans and regulation of servicios. http://www.tratabrasil.org.br/datafiles/estudos/diagnostico/book.pdf

reviewed every 5 years, measuring the service and financial quality of the contracts (review of investments and costs in the last 5 years and forecast for the next 5 years in order to prove the adequacy of the fee charged from the end user).

AGENERSA has the permit to regulate all of the 92 municipalities of RJ, as the Sanitation Law obligates all the municipalities to regulate their sanitation services. However, the municipalities have the choice to determine the agency to regulate their sanitation services: i) municipalities can contract a state regulating agency, ii) or a municipality can form its own municipal regulating agency, or iii) various municipalities can form an inter-municipal (municipal consortia) regulation agency.

AGENERSA is regulating eight (of 92) municipalities in the State of Rio de Janeiro. From August 2015 AGENERSA started to regulate the state company for water supply and wastewater treatment, CEDAE. Including CEDAE, AGENERSA assumes the regulation of 64 more municipalities as it regulated before. The agency, counting 70 employees in 2015, barely will be able to manage the regulation of a company such as CEDAE. Therefore, a learning process from different regulating agencies such as ARSESP and SABESP in Sao Paulo and other inter-municipal regulating agencies will be important in order to improve its regulating skills.[133].

By now, none of the contracts between municipalities and concessionaires for water supply and sanitation regulated by AGENERSA include the coverage of rural areas. Nonetheless, the role of regulating agencies for regulating rural sanitation might emerge with the development of the national rural sanitation plan by FUNASA and the municipal sanitation plans with the obligation to provide sanitation services in rural areas.

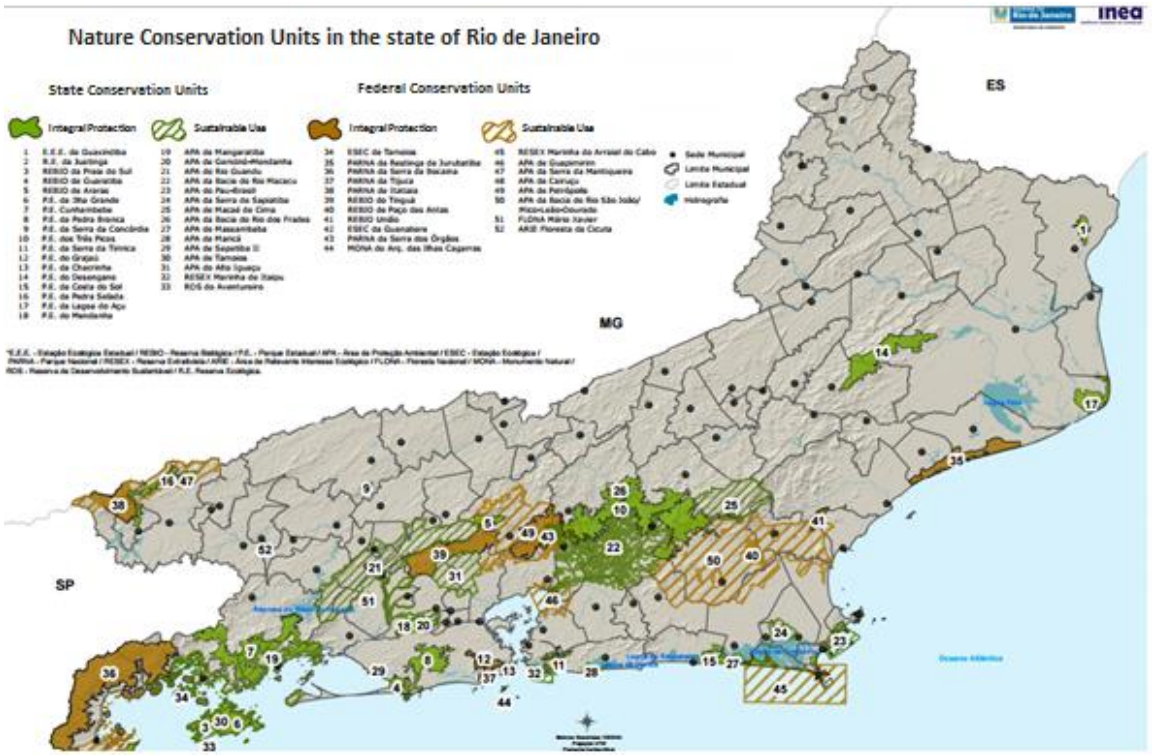
4.7 Cross-level and indirect Stakeholders

4.7.1 Conservation areas: Areas of Environmental Protection (Área de proteção ambiental – APA) and Natural Parks

The Brazilian national, state and municipal nature parks as well as the areas of environmental protection – APAs, were created through the nature conservation law No. 9985/2000 (Sistema Nacional de Unidades de Conservação da Natureza – SNUC). Within this law, two different protection unit categories have been created: units for integrated protection and units for sustainable use. The Integrated protection units are areas, where human intervention or occupation is not permitted. Those areas can be only used indirectly for visits, public use or scientific investigation. Integrated protection units also have buffer zones. Those can be, depending on their categorization, conservation units of sustainable use, where a direct use of natural resources is permitted. The direct use of natural resources is permitted and regulated within a management plan of the nature conservation area (Plano de Manejo). The management plan is designed according to a set of federal, state and municipal laws and attempts to improve the management of protected areas.

[133] The difference between the situation in the states of Sao Paulo and Rio de Janeiro is that in RJ the state government is very strong in relation to the municipalities. In Sao Paulo in contrast, financially strong municipalities form consortia and oppose to the state interest.

In RJ there are 15 state and 9 federal units of sustainable use (including nature parks and APAs among other unit categorizations). The federal and state conservation units overlap often. In those cases, the norms of the most restricted areas apply for an overlapping zone. State units of sustainable use, such as APAs and state nature parks in the RJ state are part of the state structure and belong to the INEA. Municipal parks are managed by municipalities.



Map 4: Nature Conservation Units in RJ. Source: INEA[134] (Adopted by author).

Neither APAs nor nature parks have a direct link to rural sanitation. However, the environmental quality directly interferes with the water quality, which is important in rural areas as natural resource and as an economic income in the conservation areas of sustainable use. Thus, the implementation of rural sanitation within the units of sustainable use and buffer zones is an important environmental protection issue, even not explicitly formulated in the conservation area management plans.

In RJ, the indirect implementation control of sanitation solutions within state conservation areas is applied by the INEA: the state environment institute has a right and obligation to inspect the processes of house constructions within the conservation areas of sustainable use. Units of direct use permit house construction and need to follow environmental guidelines, such as the requirement of a sanitary system. In contrast, constructions cannot take place in areas of permanent protection. The control of the environmental guidelines for house construction is linked to the environmental licencing for connection to the electricity net granted by INEA. The Brazilian association for technical norms (Associação Brasileira de Normas Técnicas - ABNT) defines the sanitation technologies to be implemented. However, the strict implementation of the environmental norms often fails due to the lack of staff and funding. Furthermore, according to the New Brazilian Forest Code from 2008 (Novo Código Florestal Brasileiro), environmental

[134] INEA: http://www.inea.rj.gov.br/cs/groups/public/documents/document/zwew/mdu5/~edisp/inea0059191.pdf

licencing only applies for house constructions built since 2008. Further, there is also a lack of communication between nature conservation units on state and federal levels and the correspondent municipal authorities.[135]

4.7.2 Private Institutes and Initiatives involved with rural sanitation actions

Due to a lack of an integrative national rural sanitation policy, various private initiatives addressed their work to that task. Below, two private initiatives, Instituto Trata Brazil and Instituto Terra de Preservação Ambiental" – ITPA, successfully acting in the rural sanitation sector will be brought up:

- "Instituto Trata Brasil" is a civil society organization of public interest formed in 2007 by private companies interested in progress of sanitation and protection of Brazilian water resources, being significant water consumers or companies working in the sanitation sector. "Instituto Trata Brazi" works nationwide with social education in sanitation issues and develops sanitation projects in vulnerable communities nationwide. Within the scope of work for three areas of action: " Água e Cidadania pela Vida" (Water and Citizenship for Life); "Trata Brasil na Comunidade" (Trata Brasil in Community); and "Apoio ao Saneamento Rural e em Áreas Isoladas" (Support for Rural Sanitation and in Isolated Areas).[136] The rural sanitation program was developed by Instituto Trata Brasil in cooperation with WWF and EMBRAPA.[137]

- "Instituto Terra de Preservação Ambiental" - ITPA is a private institute for nature conservation founded in 1998, which also lately applies rural sanitation actions in the state of RJ. The ITPA is a non-profit organization that covers a broad set of tasks introducing environmental education and social mobilization to restoration of degraded areas and nature conservation. The organization involves diverse stakeholder into its work such as private companies, public authorities, non-governmental organizations and associations, ITPA has become in the last 17 years an important environmental organizations in the state of Rio de Janeiro.[138]

  The rural sanitation project is a pilot project developed by the ITPA in cooperation with WWF and "The Nature Conservancy". ITPA approaches to undertake rural sanitation actions and link them to restoration of degraded areas and environmental education of the awarded communities: Within the project, 150 families will profit by sanitation solutions and 49 ha of degraded areas will be restored with 35,000 trees planted through voluntary work by benefited community, thus forming part of the communities' environmental education. On a long term, the project aims to restore 190 ha of degraded areas through voluntary work linked to sanitation actions in rural communities. In order to interconnect forest restoration with rural sanitation, the ITPA selects rural properties with degraded areas, important for water production. The ITPA offers sanitation solutions to the property owner in change for restoration of degraded areas within the property.

[135] Interview with Victor Niklitschek Urzua, Head of state APA Macae de Cima/ INEA, RJ.
[136] Compare: Instituto Trata Brasil: http://www.tratabrasil.org.br/quem-somos
[137] Compare: Instituto Trata Brasil: http://www.tratabrasil.org.br/apoio-ao-saneamento-rural-e-em-areas-isoladas
[138] Compare: ITPA: http://www.itpa.org.br/?page_id=2

The land owner assigns areas of permanent protection (APP) and ITPA reforests these areas to assure water production and conservation of the area. The technologies used for individual rural sanitation solutions are engineered to be simple in installation and maintenance. The ITPA applies bio-digester septic tanks, which do not require a pumping system and are easy to maintain. In order to assure long term functioning of the system, the institute assures the maintenance of the systems and trains the beneficiaries for two years. After two years the maintenance of the sanitation system becomes the responsibility of the beneficiaries.[139]

It also runs a project for collective wastewater treatment solutions related to water resources management in the Guandu river basin. The NGO implements collective sanitation solutions in a rural illegal settlement of 150 houses, which pollutes the adjacent Fragoso River due to untreated wastewater and consequently pollutes the Santana River, which supplies the metropolitan region of RJ. As the implementation of individual solutions would be too expensive due to the size of the settlement, the ITPA implements one large collective bio-digester septic tank, which does not require a pumping system and is simple to maintain. The collective sanitation solution is planned for 240 families, taking the growth of the future community population into account. The ITPA integrates as many stakeholders as possible, such as private companies, CBHs, municipalities, NGOs within its projects. However, according to the interview with the ITPA technical manager, Abilio Vilela Neto, the cooperation with the municipalities is difficult because of the bureaucratic processes within the municipal administration.

In conclusion it can be said, that the organization of civil society for rural sanitation actions in the state of RJ still lacks broad application. However, the importance of the work of private initiatives, institutes and NGOs is indispensable for the information disclosure and environmental education of the society, as well as good examples in practice for sustainable environmental management in rural areas.

5 Waste water governance and regulation

5.1 Control mechanisms

The Sanitation Law (No. 11,445/07) establishes sanitation services as public services. Consequently, it is a duty of the public authority to organize and ensure the planning, regulation and provision of sanitation services. The control and regulatory function is thereby a states' economic and social responsibility with the purpose to protect public interests. Therefore,

[139] According to the interview with the ITPA technical manager, Abilio Vilela Neto, the pilot rural sanitation project was part of a bigger project called "Saneamento rural da APA do Rio Santana", which would cover 600 rural properties within the river basin of Guandu and covering the sanitation of 60% of the river basin. The project Saneamento rural da APA do Rio Santana"was developed by ITPA in order to capture FUNDRHI resources through the CBH Guandu. The project was not approved because of some bureaucratic difficulties within the CBH Guandu. So ITPA applied with a particular project for resources of WWF and created a rural sanitation pilot project. The NGO aims to gain experience in rural sanitation actions within the pilot project in order to perform the "Saneamento rural da APA do Rio Santana" project.

regulation goes beyond the economic area, and should also guarantee the rights of citizens for a proper provision of services. [140] Social control has been established as one of the fundamental principles by the sanitation law No. 11.445/2007, insuring information, technical representation, and participation in policy-making, planning and evaluation related to public sanitation services.[141] From 1988, participation and social control are the key elements of the new public policies framework by Constitution. The national basic sanitation plan (PLANSAB) is based on the integration of mechanisms for democratization of the sanitation sector, based on situational analysis, workshops and public consultations.[142] However, the existing Brazilian regulatory model includes the participation of civil society only limited to online public consultations and public hearings with the single function to comply with legal requirements. Therefore, it is necessary that water and regulating agencies incorporate the participation of civil society, expanding and reinforcing the spaces of social control over public policies. [143]

According to the study published by the Institute "Trata Brasil", around 2/3 of the researched 58 municipalities, which at least included wastewater treatment within their municipal basic sanitation plans, integrated any forms of social control. The final analysis of social participation in the design of municipal basic sanitation plans could not be completed within this study, as 55% (32 of 58) of the surveyed municipalities did not respond the institutes' request.[144]

Also transparency is one of the principles of the Sanitation Law 11.445/07: The availability of municipal sanitation plans on internet should be mandatory, so that society can be able to monitor the fulfilment of the service targets. 39 of 58 surveyed municipal sanitation plans, which at least included wastewater treatment, were available online.[145]

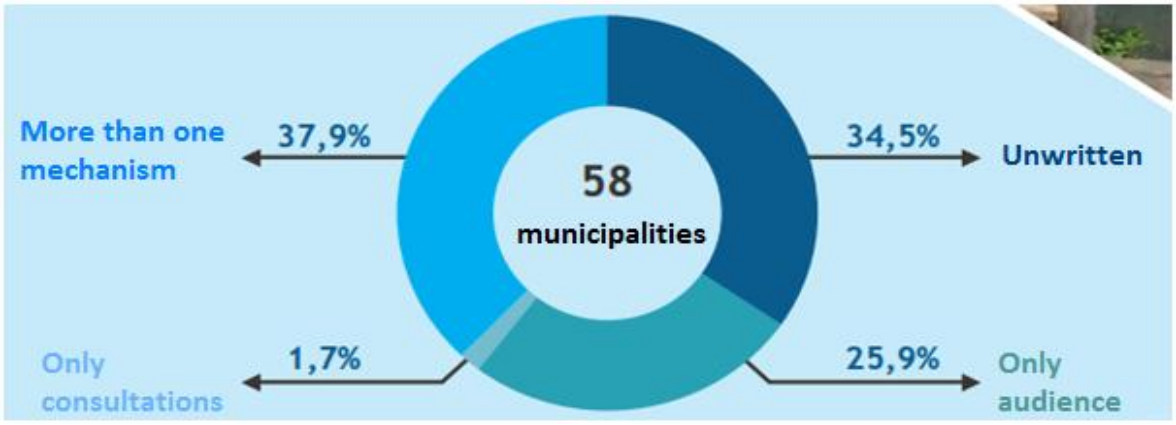


Figure 8: Municipalities disposing over a municipal basic sanitation plan with at least wastewater treatment by Instituto Trata Brasil (2014).[146]

[140] Compare: PLANSAB (2013): P. 87
[141] Compare: Plano de Saneamento Básico Participativo: http://www.meioambiente.pr.gov.br/arquivos/File/coea/pncpr/Cartilha_Plano_de_Saneamento_Basico_Participativo.pdf
[142] Compare: PLANsAB (2013): P. 90
[143] Compare: PLANSAB (2013): P. 87
[144] Compare: Instituto Trata Brasil (2014): Diagnosis of the situation of the municipal basic sanitation plans and regulation of servicios. http://www.tratabrasil.org.br/datafiles/estudos/diagnostico/book.pdf
[145] Compare: Instituto Trata Brasil (2014): Diagnosis of the situation of the municipal basic sanitation plans and regulation of servicios. http://www.tratabrasil.org.br/datafiles/estudos/diagnostico/book.pdf
[146] Instituto Trata Brasil (2014): Diagnosis of the situation of the municipal basic sanitation plans and regulation of servicios. http://www.tratabrasil.org.br/datafiles/estudos/diagnostico/book.pdf

Aside from social control and regulating agencies acting as taxation entities for sanitation services, as mentioned above, there are several indirect governmental controlling mechanisms covering the implementation of sanitation services. INEA, for example, being a state environmental organ with the mission to protect, conserve and restore the environment of the State of Rio de Janeiro, applies its controlling mechanisms in case of environmental crime, also applicable on the sanitation sector.

Another controlling mechanism is the Public Prosecutor's Office (Ministério Público), "a body of independent public prosecutors at both, the federal (Ministério Público da União) and the state level. […] In addition to prosecuting crimes, Brazilian prosecutors are also authorized, among others, by the Brazilian constitution to bring action against private individuals, commercial enterprises and the federal, state and municipal governments, in the defence of minorities, the environment, consumers and the civil society in general."[147] The Public Persecutor's Office acts through denouncements and on its own initiative and covers all legal sectors. In case of non-fulfilment of sanitation responsibilities, municipal, sate or also federal executives in charge, can be indicted and charged by the Ministério Público.

5.2 Financing Mechanisms for sanitation programs, plans and actions

Various mechanisms and institutions for sanitation programs exist already since the National Sanitation Plan (PLANASA) from 1971. The main financial sources for basic sanitation sector in Brazil are: i) financing funds (Guarantee Fund for Employees (Fundo de Garantia por Tempo de Serviço), FGTS and Workers Support Fund (Fundo de Amparo ao Trabalhador), FAT (onerous resources). The managing institutions of the financing funds are the Brazilian Development Bank (Banco Nacional de Desenvolvimento Econômico e Social – BNDES) and Caixa Econômica Federal. Both institutions are the main financial players, responsible for the deliberation of resources for implementation of the federal sanitation programs and transferring of resources and accompanying sanitation actions.[148]; ii) non-onerous resources from the Annual Budget Law (Lei Orçamentária Annual – LOA), also known as the Federal Budget (Orçamento Geral da União , OGU, and budgets of states and municipalities; iii) funds from international loans contracted with the multilateral credit agencies such as the Inter-American Development Bank and the World Bank; (Iv) own resources from service providers resulting from revenues; and (v) charges for the use of water resources (State Funds for Water Resources, such as FUNDRHI in RJ).[149] However, the monitoring of sanitation actions continues till the delivery of the project. A long-term sustainability control of implemented solution does not exist yet.

As mentioned before, the responsibility for the design and implementation of sanitation actions for the entire municipality should be determined within the municipal basic sanitation plan, which defines all the future sanitation actions in urban and rural areas of the respective municipality. The development of those plans and the quest for funding is also the matter of municipalities.

[147] Wikipedia: https://en.wikipedia.org/wiki/Public_Prosecutor%27s_Office_(Brazil)
[148] Compare: Plano de Saneamento Básico Participativo: http://www.meioambiente.pr.gov.br/arquivos/File/coea/pncpr/Cartilha_Plano_de_Saneamento_Basico_Participativo.pdf
[149] Compare: PLANSAB (2013): P. 43

There are various sources of finance for municipal basic sanitation plans on federal, state and river basin levels. Also private companies, mostly large water users, invest in sanitation.

On the federal level, municipalities with more than 50.000 inhabitants, can apply for the funding at the Ministry of Cities (Ministerio das Cidades) and municipalities with less than 50.000 inhabitants, at FUNASA (both receive their sanitation funding from the federal financing funds such as OGU, and institutions such as BNDES and CEF, as mentioned above). After the completion of the municipal basic sanitation plan, in order to receive further funding for the implementation, the plan project needs to be approved by the corresponding financing institution on federal level.

In order to attend the requirements of the national basic sanitation program, the federal government launched in 2007 the Growth Acceleration Program (better known as PAC), in order to finance the development of municipal sanitation plans. PAC is a Brazilian federal government program that encompasses a set of economic policies, planned for respectively four years to accelerate Brazil's economic growth with priority investment in infrastructure areas such as sanitation, housing, transportation, energy and water resources, among others. “PAC is a strategic investment program that combines management initiatives and public works. In its first phase, launched in 2007, the program called for investments of US$ 349 billion (R$ 638 billion), of which 63.3% has been applied. Similar to the first phase of the program, PAC 2 focuses on investments in the areas of logistics, energy and social development, organized under six major initiatives: Better Cities (urban infrastructure); Bringing Citizenship to the Community (safety and social inclusion); My House, My Life (housing); Water and Light for All (sanitation and access to electricity); Energy (renewable energy, oil and gas); and Transportation (highways, railways, airports).”[150] “The PAC counts on investment from federal, state and municipal government as well as from private and state companies to fund the projects for infrastructure, social issues and energy. Of the planned investment R$504 billion for the first PAC program, R$67.8 billion came from the federal government and R$436.1 billion came from state and privately owned companies, according to the NGO Contas Abertas.”[151] Within PAC 2, in the first stage (2007-2009) R$ 40,0 billion and in the second stage (2010-2014) R$ 45,0 billon, were invested in basic sanitation, including rural sanitation programs run by FUNASA.[152] Nevertheless, the efficiency of PAC investments was lower than expected previously. “Numbers released by the government paint an optimistic picture, and highlight the amount spent on completed works or works in progress reached nearly 63 percent of the total amount promised.”[153] The Brazilian government expected promising results from the PAC investments “the great majority of these promises have gone unfulfilled. Trata Brasil’s study “Eyes on the PAC,” reveals that of the 114 major sanitation projects realized within the PAC, only 7% were completed by December of 2011. 60% of the projects have been stalled, delayed, or not yet started.[154]

[150] The World Bank (2010): http://blogs.worldbank.org/growth/brazil-announces-phase-two-growth-acceleration-program
[151] The Rio Times Online (2011): http://riotimesonline.com/brazil-news/rio-business/brazil-pac-2-spending-plans/
[152] Compare: FUNASA (2013): P. 21-22
[153] The Rio Times Online (2011): http://riotimesonline.com/brazil-news/rio-business/brazil-pac-2-spending-plans/
[154] Compare: Hosek, E. (2013): The Troubling State of Sanitation in Rio. Published on August 21, 2013. in Solutions, 2016, by International Observers, Policies, Research & Analysis, Sustainability http://www.rioonwatch.org/?p=10892

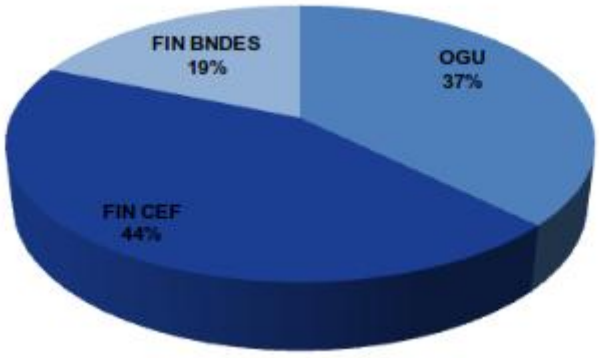


Figure 9: Distribution of the 91 wastewater treatment constructions realized between 2009 and 2013, according to the sources of funds. Source: Source: Instituto Trata Brasil (2014).

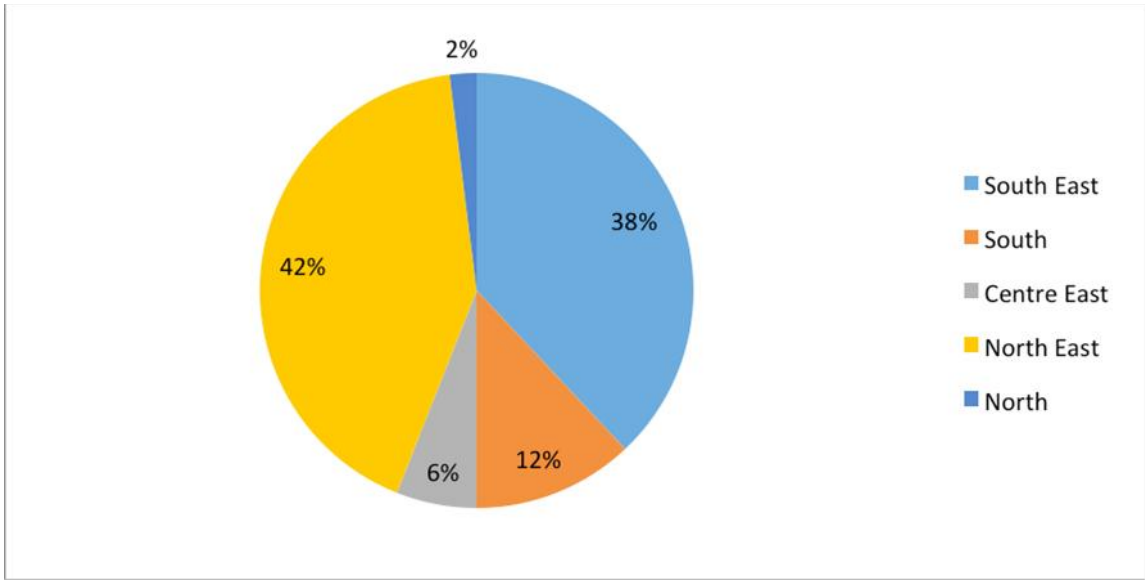


Figure 10: Distribution of the 91 wastewater treatment constructions realized between 2009 and 2013 by region. Source: Source: Instituto Trata Brasil (2014).

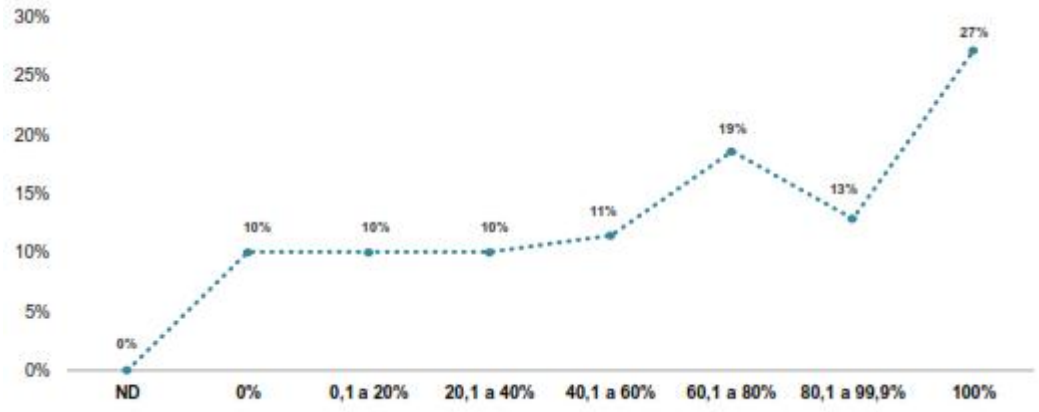


Figure 11: Progress of the 70 water supply constructions by implementation in 2013. Source: Source: Instituto Trata Brasil (2014).

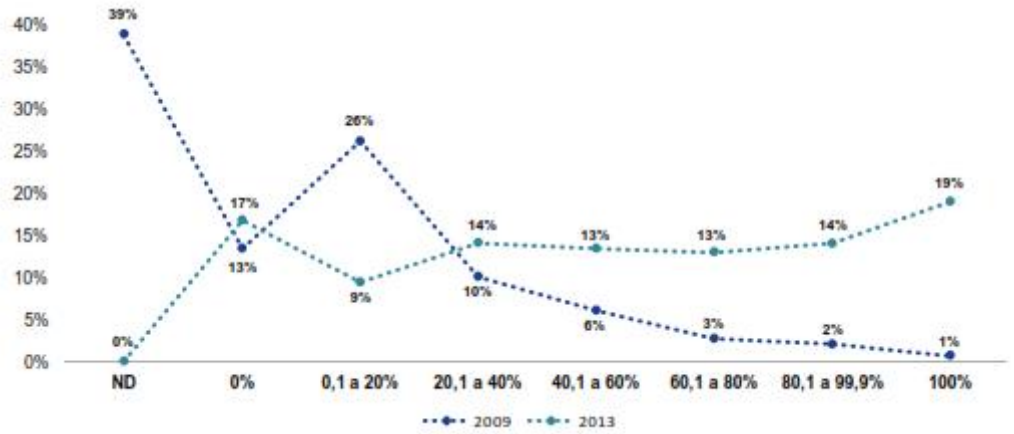


Figure 12: Progress of the 149 wastewater treatment constructions from 2009 to 2013. Source: Source: Instituto Trata Brasil (2014).

On the state level, the State Fund for Environmental Conservation and Urban Development (Fundo Estadual de Conservação Ambiental e Desenvolvimento Urbano – Fecam) was created in order to meet the financial needs of environmental and urban development programs, also including sanitation, in the state of RJ. The fund counts with around R$ 400 million per year, captured from returns of oil companies allocated to the State of Rio de Janeiro and from administrative fines and court convictions of companies for environmental misdoings. The fund is managed by a board, chaired by the head of the State Secretary of the Environment and represented by the INEA among other state entities. Administrative activities of the FECAM are reported directly to the State Secretary of the Environment of RJ. The FECAM finances environmental and urban development projects such as reforestation, restoration of degraded areas, environmental education and sanitation among others.[155]

Rural sanitation actions of the state of Rio de Janeiro can be also financed by the program RIO RURAL, as explained in the chapter 4.2.2. Municipalities or rural communities cannot apply for RIO RURAL resources to implement sanitation solutions, as areas to be attended are selected according to projects criteria such as environmental state of the region and income of rural population. However, the program finances sanitation actions and represents an indirect financing mechanism through the State Ministry for Agriculture for rural sanitation in the state of RJ.

On the Paraiba do Sul River Basin Level, the CEIVAP, whose funding does not depend on national and state sanitation politics, designates financial resources for the development of municipal basic sanitation plans. For example, in 2013, the CEIVAP deliberated R$ 6,582 Mio, complemented with R$ 4,388 Mio from FECAM, in order to contract a company for elaboration of municipal basic sanitation plans in the state of RJ through the AGEVAP. A Total of 27 basic sanitation plans (21 with direct financing from the FECAM requested by SEA) for municipalities in Rio de Janeiro within the Paraíba do Sul River Basin were developed by the company “DRZ Geotecnologia e Consultoria Ldta”. The attended municipalities were Bom Jardim, Cordeiro, Duas Barras, Itaocara, Macuco, Santo Antônio de Pádua, Santa Maria Madalena, São Fidélis, São Sebastião do Alto e Trajano de

[155] Compare: Government of RJ: FECAM: http://www.rj.gov.br/web/sea/exibeConteudo?article-id=163728

Morais in the river basin of the research, Rio dois Rios; and Campos dos Goytacazes in Baixo Paraíba do Sul River Basin.[156]

In order to push the development of municipal basic sanitation plans within the Paraíba do Sul River Basin until the end of 2015, the AGEVAP, using the resources of the CEIVAP, financed the development of municipal basic sanitation plans for all the municipalities within the river basin, which did not obtain any other federal, state or private funding. The agency also simplified the inscription process for sanitation projects as far as possible.[157]

On the one hand, the funding provided by PAC for the elaboration of municipal sanitation plans is higher than funds assigned by the CEIVAP. However, municipalities applying for federal resources need to develop a sophisticated sanitation project to receive funding. On the other hand, the advantage of the application for the CEIVAP sanitation funding, is that the AGEVAP facilitates the application process significantly and supports municipalities in the elaboration of the sanitation pans.

On a lower river basin level, the CBHs within the Paraiba do Sul River Basin also provide resources for sanitation actions. Yet, CBHs are sanitation stakeholders, without sufficient resources for realization of sanitation programs. For example, CBH Meio Paraiba holds around R$ 500,000 per year[158] and the CBH of the study area, Rio dois Rios, around R$.700,000 per year[159]. However, depending on the available funds received from the water use fees, CBHs are able to develop basic sanitation plans for the watersheds, financially support municipalities in the elaboration of municipal basic sanitation plans or invest in particular sanitation actions within the respective river basin.

Private sector may finance sanitation actions and also elaboration and implementation of municipal basic sanitation plans. For example, the municipal basic sanitation plan of the municipality of Canta Galo within the Rio Dois Rios River Basin (belonging to Paraíba do Sul River Basin) was financed by a local cement factory.[160] Municipalities can also use proper municipal funding for the elaboration of basic sanitation plans and implementation of sanitation actions. Though not many municipalities have sufficient resources for financing of basic sanitation plans or actions. However, municipalities can apply for federal, state, private or, in case of Paraiba do Sul River Basin, CEIVAP resources for the elaboration of municipal basic sanitation plans, or, apply for particular sanitation solutions by programs or initiatives working with sanitation actions, or CBHs.

Although the federal government foresees the implementation of PLANSAB in all municipalities, there is no punishment in case municipalities do not apply for funding and miss to develop their

[156] Compare: AGEVAP: http://www.agevap.org.br/agevap/news.php?id=167

[157] AGEVAP does not pass resources assigned for the development of municipal sanitation project directly to the municipality, but to the Caixa Econômica Federal. Consequently, municipalities need to present documentation (terms of reference, detailed budget for sanitation actions, according to the national reference table, CMPJ (Cadastro Nacional da Pessoa Jurídica), documents of the mayor etc) to the Caixa Econômica Federal in order to sign a contract with the financing institution. Then, after the documentation is validated and approved by the Caixa Econômica Federal, Municipalities can launch a call for proposals, where private companies or universities can apply for the municipal PLANSAB project. According to the interview with Julana Fernandes, AGEVAP water resources manager.

[158] Interview with Jarbas Saraiva– ex-coordinator for infrastructure at Rio Rural/ BID advisor/ RIO RURAL employee responsible for rural sanitation actions.

[159] The revenues from water fee charges vary every year. The amount represents an approximate average of CBH R2R from 2010-2014. See tale on page 90.

[160] Interview with Andre Bohrer – AGEVAP nucleus Rio Dois Rios River Basin.

municipal basic sanitation plans aside from the threat that municipalities which did not develop their municipal basic sanitation plan till the end of 2015 won't get any further financial governmental support for the development of their sanitation plans. As the closing date for the delivery of municipal basic sanitation plans has been extended on the federal level already twice, and considering the low number of currently completed plans, a further extension is to be expected.

5.3 Incentive mechanisms including rural sanitation

On federal and state levels, various incentivising programs permitting the inclusion of rural sanitation actions have been created. Within this chapter, four different programs will be presented as examples of integration of rural sanitation actions in federal and state policies, among them the national program for payment for ecosystem services (Pagamento por Serviços Ambientais – PSA); the state program ICMS-Verde or ICMS Ecológico, based on ecologic tax revenue in Rio de Janeiro and the fund "Fundo de Boas Practicas" - FUNBOAS, created by the CBH Lagos São João in order to protect water resources of the river basin. Also the best practice example of the Brazilian rural sanitation program, CICAR of the state of Ceará, will be discussed as one of the most successful management models for rural sanitation in Brazil.

5.3.1 Payment for ecosystem services (Pagamento por Serviços Ambientais) – PES (PSA)

Environmental services are considered as "indirect benefits generated by natural resources or ecosystemic properties of the interrelations between these resources in nature. That is, the entire flow of services that are indirectly generated by an environmental resource and by ecosystems through their natural cycles of existence. […] Some examples of environmental services are: Production and availability of potable water; Regulation of climate; Biodiversity (current or future potential); Landscape; Soil fertility. […] Payment for environmental services would be a form of compensation paid by those who appropriate the benefits generated to those that preserve or conserve resources, ecosystems and environmental services related to the benefits. The principle guiding this relation is known as "protector – recipient".[161] Compensation for environmental services can be undertaken through direct transfer of financial resources, support in obtaining credit, tax and fee exemptions, preference in obtaining public services, access to technology, technical training or subsidies to products.[162]

"Payment for ecosystem services (PES) is a market-based approach to environmental management that compensates land stewards for ecosystem conservation and restoration. Because low income households and communities control much of the ecologically sensitive land in developing countries, they potentially stand to gain from PES, as environmentally responsible stewardship is assigned a value by various actors in society. To date, however, instances of PES benefiting the poor have been limited mainly to specific localities, small-scale projects, and a handful of broader government programs." [163]

[161] Veríssimo, A. et al. (2002): P. 10
[162] Compare: ibidem. P. 11.
[163] Milder, J. C., S. J. Scherr; Bracer, C. (2010):P. 1.

In Brazil, PES is a new area of environmental law that aims to transfer monetary or non-monetary resources, to the "protector" for the adoption of sustainable practices in urban and rural areas.[164] The National Water Agency – ANA adopted the protection of water resources within the national PES policy introducing the program "Produtor de Água", which aims to reduce soil erosion and pollution of water sources in rural areas. The participation in the program is voluntary and allots technical and financial support for implementation of water and soil conservation actions. It also provides incentive payments to farmers contributing to the protection and restoration of water sources.[165] The program includes actions such as construction of terraces and infiltration basins, readjustment of local roads, recovery and protection of water sources, reforestation of environmental permanent protection areas and environmental sanitation, among others.[166] As the benefits generated from the implemented PES practices reach beyond the borders of rural properties and benefit other users of the correspondent river basin, the participating "produtores de agua" receive a compensation, according to the benefits generated on their property. The compensation of farmers is proportional to the environmental service provided, determined through a prior property inspection. In addition, to obtain the brand "Produtsor de Agua", all PES projects must meet a series of conditions and guidelines established by the ANA: It is important that the benefits obtained from the applied actions are measurable. Therefore, a monitoring system of the obtained results is required for the program. Further condition is the assurance of technical assistance for the participating rural producers and the introduction of sustainable production practices by "Produtor de Agua" program. The river basin is taken as the planning unit for PES practices,[167] hence the CBHs are the referential entities for PES within the correspondent river basin.

The first pilot PES project in the state of Rio de Janeiro was "Produtores de Água e Floresta" within the municipality of Rio Claro in the Guandu River Basin. The project was developed and implemented in 2009 by the ITPA in cooperation with CBH Guandu and the municipality of Rio Claro. As CBH Guandu has not created an executing mechanism back then, AGEVAP assumed the management of the PES project in Rio Claro.[168] The "Produtores de Água e Floresta" project uses a methodology directly related to water use, where according to the "provider – recipient" model the water user (the final consumer) pays to landowners responsible for the maintenance of standing forests and the consequent production of the adequate quality and quantity of required water resources. The payments range between RS 10 and RS 60 per hectare per year, according to the potential of each area, and originate from payments for water use and water grants captured and administered by the CBH Guandu. A part of the water use fees is paid to the owners responsible for the water production directly. The criteria for PES is based on the local opportunity cost; the forest conservation stage and the proximity or inclusion of the protected area.[169]

In RJ, aside from the CBH Guandu, also CBH Macae is directing a PES program "Produtor de Agua". Rural sanitation though, will be included as a precondition for rural producers in order to join the

[164] Compare:
CBH Macae: http://www.produtordeaguacbhmacae.eco.br/psa.htm
[165] CBH Macae: http://www.produtordeaguacbhmacae.eco.br/
[166] Compare: ANA/Produtor de Agua: http://produtordeagua.ana.gov.br/
[167] Compare: ANA/ Produtor de Agua: http://produtordeagua.ana.gov.br/
[168] Interview with Abilio Vilela Neto, ITPA.
[169] Compare: ITPA/Produtores de Agua e Floresta: http://www.itpa.org.br/?page_id=497

program. Direct financial benefits from sanitation solutions for “produtores de agua” are otherwise difficult to determine and calculate. Rural sanitation can only be considered as an integral component of the PES program. Nonetheless, according to the within this work conducted interviews, PES is considered one of the most promising future incentives for rural sanitation solutions in Brazil.

However, “The concept of ecosystem services increasingly structures the way conservationists think, the ways they explain the importance of nature to often sceptical policy makers, and the ways they propose to promote its conservation. Is this a good thing? Not entirely. There are risks to the current enthusiasm for the ecosystem services concept. Conservation has a history of placing great faith in new ideas and approaches that appear to offer dramatic solutions to humanity's chronic disregard for nature (e.g., sustainable development, community conservation, sustainable use, wilderness), only to become disillusioned with them a few years later. The payment for ecosystem services framework fits this model disturbingly well. Like the seductive ideas that preceded it, it is being adopted with great speed, and often without much critical discussion, across the spectrum of conservation policy debate and developing a life of its own independent of its promulgators.”[170]

5.3.2 ICMS Verde

Imposto sobre Operações relativas à Circulação de Mercadorias e Prestação de Serviços de Transporte Interestadual e Intermunicipal e de Comunicação – ICMS-Verde or ICMS Ecológico is a Brazilian state tax on goods and services, which can be introduced by the state governments. The source of revenue from the ICMS is the movement of goods such as the VAT levied on provision of communication services, intercity and interstate transportation, and custom clearance of goods, including exports. The concept of the ecologic tax works with the principle, that municipalities, which invest in environmental conservation have a greater revenue from ICMS. The tax was created by State Law No. 5.100/07 and follows two main objectives: Reimbursement of municipalities by restricting the municipal territory use, especially for protected and natural resources supply areas; and rewarding municipalities for environmental investments e.g. wastewater treatment and solid waste management.[171] However, the reimbursement, municipalities receive for environmental conservation from the ICMS-Verde, can be spent on any municipal matters, as there is no obligation to reinvest the revenue in further environmental conservation actions. Nonetheless, the value of the ICMS-Verde for each participating municipality is recalculated annually by INEA, thus municipalities, which do not invest in further environmental conservation actions loose points and receive less ICMS revenues.

The information about how to calculate the amount of ICMS revenues corresponding to each municipality, is available at the municipal or state financial departments (Secretaria de Fazenda). The Conservation Index (Índice de Conservação Ambiental – IFCA), which indicates the percentage ICMS-Verde corresponding to each municipality, is composed by six thematic sub-indexes with different weights:

- Wastewater Treatment (ITE): 20%

[170] Redford, K; Adams, W (2009): P. 785
[171] Compare: Government of RJ/ ICMS-Verde: http://www.rj.gov.br/web/sea/exibeconteudo?article-id=164974

- Waste disposal (IDL): 20%
- Remediation of dumps (IRV): 5%
- Supplying water springs (IRMA): 10%
- Conservation areas - all protected areas - UC (IAP): 36%
- Municipal conservation areas - only municipal conservation areas (IAPM): 9%[172]

The percentage corresponding to each component used for the calculation of the IFCA in order to transfer the ICMS-Verde to municipalities, is totalling: 45% for protected areas; 30% for water quality; and 25% for solid waste management. Each thematic component of the IFCA has a mathematical formula that weights and, or adds up indicators. After obtaining the thematic sub-indices for each participating municipality and insert them into the following formula, the Municipal Index of Conservation, indicating the percentage of the ICMS-Verde for each municipality:

IFCA (%)= (10 x IrMA) + (20 x IrTE) + (20 x IrDL) + (5 x IrRV) + (36 x IrAP) + (9 xIrAPM)[173]

Regarding wastewater treatment, the percentage of the urban population served by a system and factor of the treatment level - primary, secondary or tertiary – are considered for the calculation.

The IFCA is recalculated every year in order to give an opportunity for municipalities that have invested in environmental conservation and want to increase the ICMS. However, to qualify for ICMS-Verde, municipalities need to run a municipal environmental system (Sistema municipal de meio ambiente), composed of an administrative executing agency for municipal environmental policy (órgão administrativo executor da política municipal de meio ambiente), municipal environment council (conselho municipal de meio ambiente), municipal environmental fund (fundo municipal de meio ambiente) and municipal environmental guard (guarda municipal ambiental).[174]

5.3.3 FUNBOAS

The Fund of Good Socioambiental Practices in River Basins (Fundo de Boas Práticas Socioambientais em Microbacias – Funboas) created in 2004 by the inter-municipal consortium Lagos-São João by the State Law 36.733/04, is aligned with the state river basin management program (Programa Estadual de Microbacias). Small farmers in the selected priority areas can apply for the FUNBOAS and after a subsequent evaluation and achievement of the score of 50% of good social and environmental practices, receive the FUNBOAS funding in order to improve landscape management. Those rated above 70% can use a part of the funding to improve their own income and quality of life. The funds transferred by FUNBOAS are non-reimbursable and can be accessed every two years, in case farmers improved their level of assessment in good social and environmental practices. The Permanent River Basin Technical Chamber (Câmara Técnica

[172] Compare: Government of RJ/ ICMS-Verde: http://www.rj.gov.br/web/sea/exibeconteudo?article-id=164974
[173] Compare: CEPERJ/RJ: http://www.ceperj.rj.gov.br/ceep/ent/icms.html
[174]Compare: Government of RJ (2012): http://download.rj.gov.br/documentos/10112/721476/DLFE-53803.pdf/ICMSVerdefolder.pdf

Permanente de Microbacias – CTPEM), is managing the FUNBOAS according to the decisions about the application of funds in the affiliated river basins. [175]

The FUNBOAS also finance rural sanitation projects: R$ 30,000.00 were invested in installation of bio-digester septic tanks in 24 rural properties. All rural sanitation actions were accompanied by FUNASA technicians, as the project was developed in partnership with the national foundation. The FUNBOAS is institutionally well interconnected and works in partnership with FUNASA, RIO RURAL, INEA, CBHs, WWF-Brazil, municipalities and private companies.

5.3.4 SISAR Ceará

The Integrated Rural Sanitation System (Sistema Integrado de Saneamento Rural) - SISAR was developed in 1996 with the support of the KfW and the World Bank with the aim to increase the access of rural population to water services. The model was successfully implemented in the state of Ceará, where SISAR is represented in each of the eight existing river basins and in 128 of 180 municipalities following the IWRM approach. The successful implementation of the model depends on a sound interaction between all governmental levels, local inhabitants and SISAR, which acts as a water utility institution responsible for giving support on technical, administrative and social levels. SISAR is a confederation of local user group associations "created specifically with the purpose of self-managing the local systems, with technical support from the State's Water and Sanitation Company (CAGECE)"[176]. The model requires a "clear state public policy that supports the idea of implementing innovative management models for bridging the gap in access to rural water supply and wastewater services."[177] In the case of Ceará, the state government approved the SISAR model and chose the Water supply and Sewage Company of Ceará – CAGECE as the "implementation organ"[178]. Within the CAGECE, where various sectors support SISAR, GESAR (Gerência de Saneamento Rural) is responsible for technical, administrative and social support, and contributes to regional integration through workshops and constant exchange of experiences. The success of the SISAR model is based on a successful integration of components such as "i) social work with local user groups [participation], ii) defining and strengthening the institutional setup [clear responsibilities and rights, independency], iii) implementation of appropriate technical standards [quality guarantee], and iv) guaranteeing financial sustainability [cost recovery tariff structure]."[179]

The SISAR model has been effectively reducing the dependence of sanitation services on political interests, assuring sanitation services provision in rural areas and pushing the empowerment, administrative and organizational capacities of local user groups. "Although during the initial stages of implementation, SISAR is dependent on subsidies for covering the operational costs, there are already very good examples of some SISARs which are totally financially independent

[175] Compare: CBH Laos Sao Joao: http://www.lagossaojoao.org.br/not-agenda/not-fundoboaspraticas.htm
[176] Global Water Partnership: http://www.gwp.org/en/ToolBox/CASE-STUDIES/Americas--Caribbean/Brazil-An-innovative-management-model-for-rural-water-supply-and-sanitation-in-Ceara-State-411/
[177] Meleg, A. (2007): P. 2.
[178] Ibidem.
[179] Meleg, A. (2007): P. 5

and even offer services regarding rehabilitation of water supply systems and equipment at regional level."[180]

The SISAR model was successfully implemented in the north-east of Brazil, expanding from the state of Ceará to Piaui. The model is likely also applicable in the south-east of the country. However, as participation of users is the most important factor to achieve sustainability of rural sanitation, cultural, environmental and socio-economic characteristics of each state and each community and also the composition of the political and institutional framework of the sanitation sector should be considered.

6 Constraints and Potentials of the Brazilian sanitation sector

6.1 Constrains

The Brazilian sanitation sector experiences multiple structural deficits and challenges to be approached in the next decades. This chapter attempts to summarize the most significant ones in order to complete the overall picture given by the previous chapters and conducted interviews.

In spite of a great number of environmental laws and a sound legal framework for water and the sanitation sector, there are numerous obstacles, which impede the successful implementation of the Brazilian sanitation policies. The sanitation policies, established in 2007, are still in an "embryonic" state[181] due to poor fulfilment of the existing laws and low communication between the existing policies and also between the executing institutions.

- The Brazilian sanitation policy lacks an overall long-term strategic planning and coordination of sanitation programs, especially in rural areas.

The spread of governmental sanitation actions, based on poor interconnection of sanitation programs and coordinating institutions led to overlapping of sanitation related policies and tasks, unclear responsibilities and unattended sectors. Even the PLANSAB addresses this issue in its text, punctuating that "despite the federal basic sanitation policy coordinated by the Ministry of Cities, various ministries apply scattered actions and investments according to their own criteria and prioritization, which interferes with the coherence of political guidelines and makes management, monitoring and achievement of national sanitation policy objectives difficult." [182] The dispersion of competences for basic sanitation on the federal government level consequently leads to scattered efforts and investments. Hence, there is a need for more coordination and strengthening of Ministry of Cities leadership for the basic sanitation policy, as established by Law No. 11,445/07, in order to strengthen the coordination of sanitation programs and actions.[183]

[180] Meleg, A. (2007): P. 8
[181] Interview with Rosa Maria Formiga-Johnson, former Director of the Water and Territory Management of State Environment Institute, Rio de Janeiro, INEA – RJ (Directora de Gestión de Aguas y Territorio del Instituto Estatal del Ambiente, Rio deJaneiro, INEA – RJ)
[182] Compare: BRASIL. Plano Nacional de Saneamento Básico – Plansab. 2014.
[183] Compare: BRASIL. Plano Nacional de Saneamento Básico – Plansab. 2014.

The urgency for sanitation action combined with the lack of strategic planning lead to the appearance of spontaneous initiatives driven by civil society, CBHs, water agencies and municipalities. In order to overcome the existing institutional gap in the Brazilian sanitation sector, the Paraíba do Sul River Basin water management agency, AGEVAP commenced an initiative for facilitation of basic sanitation plans for the river basin municipalities, integrated solid waste management and rural sanitation actions, among other activities.

The absence of clear political guidelines pushing the implementation of sanitation policies on the RJ state level also affects the efficiency of regulating mechanisms established by federal law: The state sanitation services regulating institution AGENERSA started to regulate the biggest state sanitation service provider CEDAE only eight years after the obligation for service regulation by law. Unregulated concessions also create uncovered sectors in service provision: in RJ, CEDAE neglects wastewater treatment to entire municipalities if not profitable and the operation and maintenance of collective sanitation solutions implemented by governmental and non-governmental projects. A large number of existing municipal concession contracts for sanitation services are obsolete, neglectful and not explicit: also private concessionaires, depending on their economic feasibility, take advantage of weak municipal know-how and design contracts with poor detailed planning, low future investments to secure high company benefits.

Rural sanitation stays an unregulated and uncovered sector due to a legal loophole in the Sanitation Law, which doesn't assign clear responsibilities for rural service provision and its regulation. The responsibility for water losses, for instance, is not regulated and leaves space for doubts, as not defined in any law or resolution. According to the interview with Edison Carlos from Instituto Trata Brasil, the control of water losses should be regulated by regulating agencies, while the responsibility for the correction of defects responsible for water losses, should be transferred to sanitation service providers. The latter may integrate the costs for adjustments within the water supply and sanitation end user tariffs.

- Lack of supporting institutions, overall coordination and control mechanisms within the sanitation sector

The study from Instituto Trata Brasil, "De Olho no PAC" reviled the inefficiency of investments in the Brazilian sanitation sector, showing that from 149 of the biggest wastewater treatment plants in construction, launched nationwide within the PAC programs between 2009 and 2013, 58% were in poor condition compared to the original schedule, 23% were standing till, 22% delayed and 13% even not commenced[184]. The unsatisfactory results can be attributed to a lack of a specific governmental focus on coordination, monitoring and control of the existing sanitation actions and programs. The urgency and priority for fast and efficient implementation of the existing sanitation programs is not politically enforced on the federal and state levels, which significantly slows down the progress of the sanitation sector.

Numerous Brazilian municipalities lacking experience, know-how and compliance with the PLANSAB, are simply overstrained with the responsibility to elaborate municipal basic sanitation plans. Accordingly, there is an absence of guiding and supporting institutions responsible for the

[184] Compare: Instituto Trata Brasil (2014): De Olho no PAC: http://www.tratabrasil.org.br/datafiles/de-olho-no-pac/Release-2014-De-Olho-no-PAC.pdf

overall coordination of sanitation sector actions, plans and programs, in order to facilitate the access to federal, state and private funding as well as to monitor and supervise the accuracy of the design and implementation of the municipal sanitation plans.

One of the major problems is also the absence of control mechanisms to assure the longevity of sanitation programs, projects and implemented solutions, given that the transfer of funds for sanitation plans, programs and actions is not conditioned to delivery of final targets[185]**.** For instance, after the accomplishment of a sanitation project, or a construction of a wastewater treatment plant, there is no further control for sustainability, adequate long term implementation and operation of implemented solutions. The control implemented through the Public Prosecutor's Office cannot cover the overall basic sanitation sector, considering the large number of Brazilian municipalities in need. Therefore, according to PLANSAB, participation of civil society and social control are the key mechanisms for monitoring the implementation of sanitation plans and actions. However, the participation of civil society as a controlling mechanism is a recent occurrence in Brazil, which is still weak and scant. The institutional sanitation setting remains a new domain, where the system of controlling mechanisms for the sanitation sector has not been yet entirely developed.

- Deficit of assigned resources for rural sanitation actions and programs

Although various financing mechanisms were created in order to fund federal and state sanitation programs, eventually, only scarce funds were effectively assigned for rural sanitation actions. Even the wealthiest and well organized Brazilian states such as Sao Paulo and Rio de Janeiro lack well-structured political guidelines for rural sanitation and sufficient funds assigned in order to cover the sectoral needs.

- Rural sanitation sector lacks political interest and research

Over the last twenty years, since the creation of the Brazilian water policy in 1997, the entire sanitation sector lacked overall investments. Political actions and programs were and are strongly concentrated on urban development in order to assure the attendance of concentrated populace of voters. Rural areas with their disperse population and weak spending and consuming power, lack interest of politics and private sector participation. However, the development of a national rural sanitation program requires a deep research about rural areas and rural population nationwide, whereas data acquisition in rural areas receives insufficient funding due to the lack of political and economic interest.

IBGE and EMBRAPA provide data on agriculture and forestry research, and recently the federal government launched a nationwide program for the rural environmental registry (Cadastro Ambiental Rural – CAR), which aims to integrate the environmental information about all Brazilian rural properties in one electronic public database in order to facilitate environmental and economic planning of rural areas[186]. However, no research suitable for rural sanitation measures is yet available. CAR is meant to be the first diagnostics to reflect a realistic situation of rural areas

[185] Interview with Edison Carlos/ Instituto Trata Brasil
[186] Compare: CAR/RJ/Guandu: http://www.comiteguandu.org.br/conteudo/apresentaforumINEACAR.pdf

in Brazil and allow prioritization of rural areas for future sanitation actions. Basic sanitation plans elaborated by municipalities however, require a more detailed information about rural areas and properties, than CAR offers. Within the framework of the PLANSAB, it is a municipal responsibility to undertake a detailed and profound study of their rural areas, which lacks political interest on a municipal level.

- The development of the rural sanitation sector drags behind the urban sanitation sector

Rural sanitation programs and actions do not advance, because the political preference on all Brazilian governmental levels is given to development of the urban sector. Rural sanitation forms only an additional component in the PLANSAB, which also does not provide detailed guidelines for rural sanitation actions. Furthermore, comparing the number of the existing Brazilian sanitation programs, such as “Saneamento Ambiental Urbano”, “Infraestrutura Hídrica – Drenagem Urbana Sustentável”, “Projetos de Engenharia – Saneamento Básico”, “Programa Serviços Urbanos de Água e Esgoto” or programs including sanitation actions such as “Morar Melhor” and “Programa de Melhorias das Condições de Habitalidade”, a strong emphasis on urban sanitation can be observed. Among the existing national programs only the program “Saneamento Para Todos” includes rural sanitation actions within its description. Also the national program PRODES (Programa Despoluição de Bacias Hidrográficas), created by the National Water Agency (ANA), also known as "treated wastewater purchase program"[187] is designed to advance the urban sanitation sector. The political weight is strongly concentrated on the urban development. Consequently, the development of the rural sanitation sector drags behind the urban sector lacking attention, importance and governmental financial support.

- Bureaucratic barriers

The bureaucratic procedure to obtain federal funding for sanitation projects or elaboration of municipal basic sanitation plans is a long-lasting and complex process. Many municipalities do not accomplish to meet the necessary requirements, overcome administrative barriers and bureaucratic controls due to the complexity of the application and selection process, technical incapacity and also often lack of interest, despite the support of executing water agencies, such as AGEVAP or state projects and programs such as RIO RURAL and PSAM in case of RJ. Even if the funding has been approved by the government, due to poor coordination between the ministries or state secretaries, it can take up to several years until it is granted to the designated project.[188]

- Positions of Trust (cargos de confiança)

The system of the trust positions "Direção e Assessoramento Superiores", better known as “cargos de confiança” was introduced in 1967 under the military dictatorship and shows another point, hindering the longevity of sanitation programs and policies. In Brazil, about 23.000 positions of trust are freely appointed by the presidency in case of the two highest levels. Most of

[187] Compare: ANA: http://www2.ana.gov.br/Paginas/projetos/Prodes.aspx
[188] Interview with Jarbas Saraiva and Adriano Lopez/ RIO RURAL

those 23,000 positions, especially at the lower levels, are occupied by career employees hired without any qualification, as the selection criteria of the hiring process is not transparent for the society. The result is a highly vulnerable political system showing low transparency and dependence on the length of the period of governance of the particular government official"[189], which strongly influences the consistency and continuity of environmental and sanitation programs. In RJ, the former government in power until 2014, disposed over a clear state sanitation policy and assigned funding for support of municipal basic sanitation programs through FECAM. The current government faces a political crisis due to corruption scandals on the federal level and economic crisis due to the current recession[190], which might lead to a change of the political positions in charge of the current sanitation programs and to budget cuts, which would strongly influence the feasibility of the existing state sanitation policies and programs.

- National program for rural sanitation and FUNASAs institutional disorientation

FUNASA, the oldest Brazilian national institution with continues experience in public health engineering, is today an obsolete, structurally weak institution, continuing its old-established functioning adopted in the 90's. The institution responsible for the entire Brazilian rural sanitation sector requires efficient measures for restructuring and redesign in order to meet requirements assigned to it by the Sanitation Law. Eight years after transferring the responsibility for development and implementation of a national rural sanitation program to FUNASA, no results were delivered yet. Although FUNASA attends municipalities with less than 50.000 inhabitants, it only serves urban areas of smaller municipalities, but no rural areas. The future of FUNASA is currently under development. However, if FUNASAs responsibility is to attend rural sanitation nationwide, then the need for the division of municipalities in those over and those under 50.000 inhabitants is questionable, given that both include rural areas which are not feasible to be attended without a particular rural sanitation program.

- Municipal sanitation sector challenges

Two decades of centralized military rule in Brazil ended in 1985 and led to the weakening of municipalities as autarkic governmental entities. Nowadays, Brazil being a federal presidential representative democratic republic[191], assigned the main responsibility for the design and implementation of sanitation plans to the lowest municipal level. However, the federalism implemented in Brazil creates difficulties for uniformity of sanitation programs between federal, state and municipal institutions.

The allocation of know-how and financial resources is distributed through the governmental levels according to the top down approach: from federal to state and least, to municipal level. Planning, finance and controlling competences for sanitation are allocated on the federal level, while the execution of those actions is given to municipalities, which still lack environmental consciousness

[189] Compare: De Bonis, D. (2015): http://www.brasilpost.com.br/daniel-de-bonis/dirigentes-publicos-na-mi_b_6425760.html
[190] Compare: Telegraph 18.03.2015: http://www.telegraph.co.uk/news/worldnews/big-question-kcl/11479439/Why-is-Brazil-so-angry.html
[191] Lumby, J; Crow, G; Pashiardis, P (2008): P. 325

and the knowledge about how to develop and implement sanitation projects. The municipal capacity to develop sanitation plans and apply for state and federal funding is also low, because engineers and technicians working for municipalities earn low wages, around 2,000 RS (around U$ 580)[192] and are, on average, less qualified. Also the focus of municipal spending is rather concentrated on perpetuation of political power and visible action such as housing construction, transportation, than on sanitation or even less, rural sanitation actions. Environmental thinking did not yet reached the lowest governance level, so municipalities often lack technical know-how and understanding for the need and urgency for sanitation actions.

The disadvantage of the current sanitation politics is, that financially and organisationally strong municipalities, able to request funding and develop their municipal sanitation plans, are favoured and supported by federal and state governments in order to receive further financing. On other hand, municipalities with insufficient resources and low technical capacities presenting poor or no sanitation project applications at all, are directly sorted out of the selection process. Thus, weak and remote municipalities are not favoured for sanitation actions, if not selected, through environmental degradation and poverty criteria, for sanitation projects as a result of such programs as RIO RURAL or CBHs and CEIVAP/AGEVAP. Although receiving institutional support from CBHs and sanitation programs, municipalities show deficient organizational capacity which counteracts significantly by the implementation of sanitation projects.

Capable municipalities often develop basic sanitation plans in order not to stay in debt with the federal government. Numerous municipalities, which created a municipal basic sanitation plan to date, did not implement it due to the absence of knowledge and experience, which suggests the necessity of guiding, supporting and controlling institutions to accompany the elaboration and implementation of municipal sanitation plans.

- Lack of domestic wastewater and sludge reuse policy

Water reuse politics are advanced only in the industrial sector in Brazil. Water reuse of treated domestic wastewater arises as a topic for discussion to overcome the current water crisis in arid regions. In areas, where water is still abundant such as RJ, prevails the assumption that it is important to treat wastewater, but not necessarily reuse it.

The reuse of sludge as fertilizer in agriculture is also strongly restricted due to the risk from germs in wastewater, which can contaminate food and provoke diseases. Technologies for advanced sludge treatment in order to meet the legal requirements for the agricultural use are often associated with cost increase and are not prevalent in use.

6.2 Potentials

There is no unique and standardized solution for rural sanitation challenges in Brazil, considering the economic, social, political, cultural and environmental peculiarities of each region and the multiple composition of stakeholders. However, in order to approach the continuation of a widely water pollution of Brazilian water bodies, it is of particular importance to create an overall long-

[192] Exchange rate from 02.08.2015. Information according to the interview with Andre Marques/AGEVAP director.

term strategic planning for the rural sanitation sector and to approach a sound coordination of sanitation and rural sanitation programs through all the governmental levels. It is then to be considered, if the approach of urban sanitation first, is the appropriate line for the national sanitation agenda. Although rural sanitation is an environmental matter, the demand for spring and water body protection to secure the water supply for urban areas is delegated to rural proprietaries, without offering satisfactory conditions and incentives for environmental protection to date. Therefore, there is a need to interconnect the environmental and social agendas to create more feasible incentives combined with consciousness building and environmental education programs, which also introduce the awareness of the need for payment for sanitation services by all users. A concept not yet entirely adopted in Brazil.

The Brazilian sanitation problem can be only solved with a common and corporate approach involving governmental and social initiatives as well as interconnecting all stakeholders of the sanitation sector. In order to accomplish the requirements of the Sanitation Law it is necessary to create clear political guidelines pushing sanitation actions, and particularly the rural sanitation sector. Well-structured sanitation projects developed according to a well-designed planning logic on the state level, would also improve the effectiveness of federal funding assigned to rural sanitation measures.

In order to overcome the difficulty of municipalities to elaborate their basic sanitation plans, joint action in form of formation of inter-municipal consortia and integration of multiple stakeholders such as, CBHs, civil society, governmental institutions as FUNASA, INEA, SEA, Ministry of Agriculture, service providers, programs like RIO RURAL also including mechanisms as PES (payment for ecosystem services) and CMS-Verde are essential. Stakeholder integration and networking are also crucial for the creation of a political discourse about the development of further incentives and mechanisms for the improvement of sanitation services.

A good example for the success of joint “saneamento” action is the RJ state program “LIXÃO ZERO” (zero open dump) for solid waste management. Due to a state initiative, “an entire diagnosis of the waste management system was carried out”[193] and a creation of municipal consortia was politically enforced in order to implement the sanitary landfills in RJ by “a regulatory environment which prohibited the improper disposal of waste after 2014.”[194] The program “LIXÃO ZERO” was simultaneously developed by the RJ government with the sanitation program “RIO + LIMPO” (River + Clean) within the state “Sanitation Pact”. The great success of “LIXÃO ZERO” was based on the rapid political enforcement of joint action and formation of municipal consortia due to the urgency to eliminate visible rubbish by the commencement of the World Cup in Rio in 2014. The solid waste management example demonstrated the feasibility of political enforcement for “saneamento” actions and the importance of forming political will and joint action.

- Potential of supporting institutions for the elaboration and implementation of municipal basic sanitation plans

[193] Bufoni, A; Silva Carvalho, M; Basto Oliveira, L; Pinguelli Rosa, L (2014): P. 887
[194] Bufoni, A; Silva Carvalho, M; Basto Oliveira, L; Pinguelli Rosa, L (2014): P. 888

The difficulties to develop, finance and implement basic sanitation plans on the municipal level need to be faced by federal and state governments, through the improvement of the existing supporting mechanisms in the sanitation sector. On the one hand, state sanitation supporting programs such as PSAM in the river basin of Guanabara need to find a broader implementation in the state of RJ. On the other hand, in order to push the sanitation progress, the planning, guiding and supporting task for municipal basic sanitation plans can be assigned to water agencies, such as AGEVAP within the Paraíba do Sul River Basin. Especially, for the rural sanitation sector, the role of water agencies would be of great importance. AGEVAP is a strong skilled delegated entity with a broad experience in the sanitation sector and capable to serve both, the urban and rural sanitation sector and it has a great potential to act as supporting entity for municipalities in the rural sanitation sector. By creation and implementation of municipal basic sanitation plans, from design to long term operation and maintenance support, sustainability of the implemented solutions can be assured. Furthermore, the AGEVAP might assume the role of an intermediary between municipalities and financing institutions in order to facilitate the acquisition of funding for sanitation actions. To act on their behalf, it needs to be delegated by the municipalities first.

To support and coordinate rural sanitation actions beyond the municipal basic sanitation plans, the AGEVAP would require to coordinate its actions with FUNASA, according to the national rural sanitation plan, projected for 2017 by the national foundation.

However, AGEVAP being an executive water agency and working with collected water use fees in the Paraíba do Sul River Basin, also needs to maintain its economic sustainability. The overtaking of attendance of municipal basic sanitation plans and rural sanitation actions would lead to the need of expansion of AGEVAPS technical capacity in order to attend the additional volume of work, which may affect its economic sustainability. The economic feasibility can be ensured through the increase of the water use fee in the Paraíba do Sul River Basin, or also through an integration of financing mechanisms, which assign a part of the sanitation service fee to the agency.

CBHs are assigned a key role for the support of rural sanitation actions within the respective river basins. In order to assure the operation of river basin committees as more technical and as less political entities (the way CBHs were initially intended), formed by diverse representatives of society, technical chambers, academic institutions, the private and public sector, the federal government needs to empower river basin committees to introduce respective policy measures and resource allocation. The empowerment of CBHs would accelerate the process of development of municipal basic sanitation projects significantly, gaining scale in the project implementation, especially for rural sanitation projects, and working with adequate professional and technological solutions. The executive agencies of river basin committees can also create solutions for various municipalities and regions, in order to gain scale, funding and technical capacity. Executive agencies, such as AGEVAP or PCJ (PCJ executive water agency in river basins of Piracicaba, Capivari and Jundiai in SP) could act as supporting and supervising institution for municipal basic sanitation plans, having assigned a long-term prerogative right for municipal basic sanitation management.

However, the introduction of sanitation supporting institutions, which offer strategies, solutions and technical support for municipal basic sanitation plans (including rural sanitation actions) requires in the first instance a clear political enforcement at all levels of political formulation. The

technical support of state programs such as PSAM or river basin level agencies as AGEVAP need an explicit assignment for coordination, planning, guiding and supporting task from the municipalities.

- Potential of control mechanisms for the sanitation sector

The strengthening of monitoring and control over the adequate planning and implementation of sanitation projects, plans, programs and actions is strongly required to assure the longevity, long term operation and sustainability of sanitation actions. The accounting, economic, financial and legal control applied by the Federal Court of Accounts (Tribunal de Contas da União) and Public Prosecutor's Office on the state and federal levels does not countervail against the necessity of alternative, for the sanitation sector designed mechanisms, by now.

On the federal level, the Ministry of Cities and FUNASA already created control mechanisms through criteria for evaluation of municipal basic sanitation plans: on the federal level, further resources for the implementation of sanitation solutions are only assigned for sound and well-elaborated sanitation plans. Follow-up mechanisms assuring a long-term implementation and continuity of sanitation projects need yet to be developed.

On the RJ state level, the responsibility for control and monitoring of implementation of basic sanitation plans and rural sanitation actions could be assigned to INEA, being an environmental executive agency and acting within the State Water Resources Plan (Plano Estadual de Recursos Hídricos), river basin plans and other water management related government programs in RJ. Especially INEAs role for rural sanitation would be of particular importance, as the agency is already involved in programs such as PES, “Produtor de Agua and Floresta”, “Produtor de Agua”, “FUNBOAS” working with rural sanitation solutions. INEA is also involved into the development of municipal sanitation plans for each watershed [through] 1) infrastructure construction, 2) institutional strengthening and 3) sustainable policies”[195]. Hence, the state environmental agency meets the requirements for monitoring and control of the implementation, long-term operation and sustainability of municipal basic sanitation plans, including rural and urban sanitation, as well as rural sanitation programs and actions implemented by FUNASA or other governmental and non-governmental institutions. However, the monitoring and controlling function in the sanitation sector will require new political guidelines, pushing the assignment of the additional responsibilities of the environmental agency by a state law or directive. Additionally, INEA would require to train its technical staff in order to attend sanitation actions, projects and plans. To date, INEA has technicians specialized in licencing sanitation solutions, but no staff qualified in monitoring, consultation and control of sanitation projects.

Also control over sanitation actions in areas of sustainable use and buffer zones in state nature protection areas, such as APAs and state nature parks, should be stronger applied through INEA. Within municipal nature protection areas, municipalities are responsible for the adequate implementation of environmental control and consequently for sanitation measures.

On the municipal level, the entire responsibility to monitor and control the adequate long-term implementation of municipal basic sanitation plans and actions is assigned to municipal technical

[195] Bufoni, A; Silva Carvalho, M; Basto Oliveira, L; Pinguelli Rosa, L (2014): P. 888

chambers (by the Sanitation Law). Precisely the above-mentioned municipal weakness in the sanitation sector underlines the importance of the role of state environmental agencies such as INEA, which interconnect the environmental and water management agendas, for monitoring and control of the implementation of basic sanitation plans and rural sanitation actions.

- Potential of regulation of rural sanitation sector

Given that the PLANSAB delegates the responsibility for the development of municipal basic sanitation plans, including rural and urban sanitation, to municipalities and introduces the necessity of regulating agencies to control and overview the sanitation service provision contracts associated within the municipal basic sanitation plans; consequently, there is also an emerging need for regulation of rural sanitation services within the scope of competences of regulating agencies.

In the same way as the Paraíba do Sul River Basin water agencies AGEVAP assumed the competence for support for elaboration of municipal basic sanitation plans and rural sanitation actions within its river basin on its own initiative, also regulating agencies could take the initiative for regulation of rural sanitation services. There is no legal obstruction for proactive action of regulating agencies. Therefore, in case of RJ, AGENERSA could communicate with the State Secretary of the Environment (Secretaria de Estado do Ambiente) so as to develop a strategy to push the rural sanitation process and meet legal sanitation requirements related to public health, sustainable development, tourism etc., or/ and initiate a cooperation with FUNASA in order to design a state strategy for regulation of the rural sanitation sector. However, by the Sanitation Law, the regulation of sanitation services is bound on contracts with service providers, which by now only operate in urban areas. Consequently, to enable the regulation of the rural sanitation sector associated with municipal basic sanitation plans, a legal framework is needed, which includes the regulation of sanitation service provision in rural areas as a competence of regulating agencies, or which includes sanitation service provision as a competence of service providers, so regulating agencies are enabled to regulate sanitation service provision in rural areas.

Also the role of civil society participation must be strengthen in Brazil: Legal framework and institutional setting for rural sanitation provides rules, conditions and funding, but it is up to the civil society initiative to push them into action.

- Potential of funding of rural sanitation actions and programs

First of all, there is an urgency for the creation of a differentiated national rural sanitation program with sufficiently allocated resources, including well-defined and detailed rural sanitation actions according to each regions topographic, legal and administrative peculiarities, in addition to the existing urban sanitation policy. Also the allocation of governmental funding for rural sanitation programs needs to pass according to more firm conditions so as to improve the efficiency of sanitation projects. The introduction of a clear political guideline, for example, for prioritisation of formation of municipal consortia and supporting institutions, such as water agencies, for federal and state funding for implementation of municipal sanitation actions, would encourage municipalities to strengthen the partnerships and form consortia or coordinate the

municipal sanitation actions with supporting institutions such as AGEVAP. The formation of consortia or cooperation with sanitation supporting institutions would not be an obligation though, but an incentivising mechanism.

- Importance of political interest and research for rural sanitation sector

In order to negotiate the difficulties of overall coordination and long-term strategic planning for the rural sanitation sector, it is necessary to join and interconnect both, environmental and social agendas to create more feasible incentives for rural sanitation actions, combined with consciousness building and environmental education programs. It is important to involve all relevant stakeholders crucial for generation of knowledge and knowledge transfer in the sanitation sector, such as universities, research institutions, private institutes, agricultural and environment ministries, water, environmental and regulating agencies, sanitation service providers, so as to set a strategic focus on rural sanitation. A link between rural areas, and agricultural and environmental sectors must be created to develop a stronger cooperation between the secretaries of environment and agriculture, given that agricultural production often takes precedence over environmental protection and has a stronger connection to the public sector.

Crucial is also a knowledge transfer from the water management sector to the sanitation sector as sanitation lacked political interest and consequently development for a long time, whereas the water resources management sector advanced significantly in Brazil. Both, water resources management and sanitation sectors avail of similar management tools and can benefit from each other.

- Importance of national rural sanitation programs

In order to push the rural sanitation sector, more economic incentives for sanitation solutions in rural areas need to be created. Additionally to the spring preservation program “Produtor de Agua” within the PES program, further national initiatives for rural sanitation need to be launched. Just as the broadly applied national programs “Minha Casa Minha Vida” (My house my life) and “Saneamento para Todos” (Sanitation for everyone), an equivalent national program for rural sanitation, covering sanitation actions for low income families, need to be created. The program can be funded through the subsequent Brazilian growth acceleration program (PAC), just as the urban development oriented national programs mentioned above. Also the existing sanitation incentives mechanisms need to be broaden with a special focus on rural sanitation.

Rural communities lacking sanitation solutions need to mobilize municipalities through municipal secretaries of agriculture and environment in order to enforce the creation of municipal rural sanitation projects in cooperation with private institutes, foundations and universities, following the bottom-up-approach. The through joint actions of multiple stakeholders created projects are more promising for government and private sector subsidies. However, the environmental consciousness for the need of sanitation solutions and the need for payment for sanitation services can be only achieved through environmental education in rural communities. Thus, broad

environment education programs need to be created and integrated into the basic school education program in Brazil.

- Abolition of Positions of Trust (cargos de confiança)

There is a need to increase the stability of national and state sanitation programs: The state and federal government and correspondent political agenda change every four years, leading also to a change of specialists in charge of developing programs due to the system of positions of trust. In Brazil, the successful implementation of programs depends on the experts, who design concepts and push them through to federal and state programs. The replacement of persons in charge after four years leads to discontinuation of federal and state policies and programs and hinders the success of the political agenda.

In order to diminish the short-term nature of positions in charge for governmental programs and projects related to sanitation, influencing the feasibility of the existing sanitation policies and programs, it is necessary to reform the system of positions of trust in Brazil. According to the Brazilian public policy and government expert, Daniel De Bonis, it is important to eliminate the existing 13,500 positions in lower-level commission (of totalling 23,000 existing positions of trust) operating in functions such as "Head of Service" or equivalent. The candidates for positions of trust on state and federal level need to be selected in a strict selection process according to specific qualifications. Additionally, it is important to create a system of recruitment for leaders of state-owned enterprises, foundations and government agencies, forming the so-called indirect administration[196] to guarantee the longevity of governmental programs and reduce corruption.

- Potentials of national rural sanitation program by FUNASA

FUNASA, being the key institution for Brazilian rural sanitation, needs to develop a sound nationwide rural sanitation program in order to attend the given social and environmental characteristics of Brazilian rural regions and cover the unattended rural sanitation sector soon. The national rural sanitation plan is expected to be released in 2016-2017 and generates hope for nationwide integrated rural sanitation activities.

- Municipal potentials

Municipalities are responsible for all actions on respective municipal territories. Consequently, municipal governments need to be involved in all the programs and actions taking place within the municipality. Nevertheless, as mentioned in the chapter above, municipalities experience massive difficulties with development and implementation of municipal basic sanitation plans, procrastinating the responsibility to provide sanitation services in municipal rural areas. On the federal government level, the Ministry of Cities and FUNASA recognized the fact, that the delegation of the nationwide sanitation project to the municipal level results neither feasible nor sustainable. Especially for smaller municipalities with low financial resources and low professional

[196] Compare: De Bonis, D. (2015): http://www.brasilpost.com.br/daniel-de-bonis/dirigentes-publicos-na-mi_b_6425760.html

capacity, the creation of sound municipal basic sanitation plans becomes an insurmountable task. In this sense, the municipal effort to obey the Sanitation Law and resolve the precarious sanitation problem, need to place greater emphasis on joint action. The challenges to be approached by Brazilian municipalities to employ sanitation solutions are similar in their institutional organization structure (river basin as a planning unit, common use of water resources etc.). Hence, the formation of municipal consortia, inter-municipal agencies, and strong cooperation with CBHs and/ or delegation of the coordination of sanitation projects to executing agencies such as AGEVAP, would facilitate to overcome the existing organizational and financial obstacles.[197] The simplification and reduction of bureaucratic barriers would also have a positive effect on the sanitation sector due to the facilitation of planning and financing processes.

In spite of that, municipalities need first to authorize executive agencies action as intermediary and supporting institutions. Therefore, the communication between CBHs and municipalities should be strengthen through organized assemblies with high public and civil society participation. Joint solutions would also obtain increased approval for state and federal funding, providing a sophisticated organizational structure.

There is also an indispensable need for comprehensive consciousness building campaigns to push the sanitation sector (particularly in rural and remote areas), as well as for federal programs for environmental education and empowerment of civil society with the intention to secure long-term control through sound social participation.

- Incentives for rural sanitation

In order to push the progress of the rural sanitation sector, there is a need to create further economic and environmental incentives, in addition to the existing ICMS-Verde and PES. In case of ICMS Verde, the benefits from the ecological tax revenue for environmental conservation, including wastewater treatment, rather favours urban sanitation solutions, as revenues are calculated according to the percentage of the population served by a system. Also the destination of municipal ICMS revenues does not promote the reinvestment in environmental protection or rural sanitation activity. PES, on the other hand, is an important environmental protection tool applicable for watershed protection. Though rural sanitation integration has only entered as a precondition for inclusion of rural properties in PES programs such as “Produtor de Agua” in Brazil. Consequently, rural sanitation incentive programs require a broader and more self-contained application, independent of property value within an environmental program such as PES.

Incentive mechanisms for an integrated water resources management approach including wastewater reclamation and reuse is required to increase the efficiency of water use and to overcome the uneven distribution of water resources. “The reuse of water for agricultural irrigation is often viewed as a positive means of recycling water due to the potential large volumes of water that can be used. Recycled water can have the advantage of being a constant, reliable water source and reduces the amount of water extracted from the environment.”[198]

[197] Water agencies, are able to organize municipalities, contracted consulting companies for elaboration of municipal basic sanitation plans, create joint plans and apply for funding on higher governmental levels.
[198] Toze, S (2006): P.147

However, despite the current water crisis, only the Northeast of RJ experiences water shortage due to constant draughts, while the rest of the state has water reserves available. Due to this reason, wastewater reuse solutions need to be firstly introduced in arid areas of the state. Nonetheless, in Brazil the reuse of treated domestic wastewater in agriculture is not yet culturally embedded. Although it might be challenging to convince farmers to use treated wastewater for irrigation and stabilized sludge as fertilizer on fields, it might represent a suitable alternative for agricultural use in the future. That is why environmental education and sensitization programs have a great potential for the progress of the rural sanitation sector. As well as the introduction of payments for sanitation services, yet relatively unknown in rural areas in Brazil due to the historically embedded free water use.

- Possible future financing model for rural sanitation

"No system is sustainable without payments"

"Wastewater treatment is a service taken for granted by the general public, and few realize the complexity of the operation, the usefulness of its by-products and the relative bargain of this service."[199] There is no doubt, that in order to raise the consciousness for rationale water use and guarantee the sustainability of the rural sanitation service provision, all water users are liable to pay for sanitation services provided. Nevertheless, the principal challenge, is to guarantee the sustainability of rural sanitation service provision through introduction of payments for sanitation services in low-income, rural communities.

There is no uniform payment model for rural sanitation. As rural sanitation forms part of municipal basic sanitation plans, municipalities need to develop a payment model for sanitation services, corresponding to the social and economic peculiarities of each rural region within the respective municipality. Certainly, municipalities outsource the provision of sanitation services by contracting private or public companies, which do not attend rural areas due to a low cost-effectiveness. Thus, government or private subsidies, in order to guarantee the provision of rural sanitation services, would be a feasible solution. The Brazilian rural sanitation financing model could include both, non-refundable government or private subsidies to provide long-term sustainability for rural sanitation solutions and payments for sanitation service provision by benefited users, in order to cover the sanitation service provider costs. However, the government subsidies (federal, state or municipal) should be only complementary to the payment for sanitation services by rural beneficiaries. To raise awareness for a sensible usage of water, it is necessary to introduce payments for sanitation services by users to ensure sustainability of service provision. Such payments should be adjusted to the income level of a rural community and if necessary subsided.

In order to reach low-income rural communities, a special reduced tariff needs to be introduced: The so called "social tariffs" are already widely used in the Brazilian urban sanitation sector and can be determined through a municipal decree and additional contract between the municipality and the sanitation service provider. To create a rural sanitation "social tariff" it is necessary to analyse the capacity to pay for the service provision within the profited community and search for

[199] Kirschenman, T (1996): P.1

a joint solution in cooperation with municipalities, service providers and CBHs. For instance, a particular municipal rural sanitation tax can be created by a municipal law as financing mechanism for rural sanitation solutions (municipal subsidy). Though, the initiative for the creation of a municipal rural sanitation tax needs to first find approval by the federal government and the society.

State sanitation companies such as CEDAE, work with public investments and need to be forced to integrate rural sanitation within their area of operation and attend rural areas in spite of economic inefficiency. Successful examples for state sanitation companies taking over rural sanitation services already exist in the states of Paraná (state sanitation company SANEPAR in partnership with local governments and FUNASA), Espírito Santo (state sanitation company CESAN using ICMS-Verde revenues), Minas Gerais (state sanitation company COPASA in partnership with local governments). Consequently, restructuring of CEDAE and integration of alternative funding, for example from FUNASA, ICMS-VERDE and partnerships with municipalities and CBHs, would increase the feasibility of rural sanitation projects for sanitation service providers.

Overall, the development of the future financing model for rural sanitation services requires a targeted strategic modelling, political structure, a firm statutory basis, as well as better cooperation between the sanitation stakeholders, such as municipalities, CBHs, water agencies, sanitation service providers, governmental and non-governmental organizations. To secure the cooperation of all sanitation sector stakeholders, there is a need to strengthen the civil society participation. To ensure economic feasibility of the sanitation service provision in rural areas, government of private subsidies are indispensable.

PART III: LOCAL CASE STUDY

7 Case Study: Rural Sanitation Project within the INTECRAL Project in Barracão dos Mendes, NF, RJ

7.1 Study Area and field research description

In the following chapter, the analysis of potentials and constraints for rural sanitation sector in RJ will be applied on a case study for decentralized collective rural sanitation solutions, conducted within the INTECRAL[200] and the RIO RURAL[201] projects in a rural community, Barracão dos Mendes within the municipality of Nova Friburgo (NF), Rio de Janeiro. The research is conducted within a triennial[202] German-Brazilian cooperation project INTECRAL (Integrated Eco Technologies and Services for a Sustainable Rural Rio de Janeiro), "developed by the Brazilian RIO RURAL coordinating team with a proven research consortium of the Cologne University of Applied Sciences, the University of Leipzig and the Friedrich-Schiller-University of Jena" as well as in cooperation with German institutions and enterprises. The INTECRAL project is supported by the German Federal Ministry of Education and Research (BMBF) and the State Secretariat of Agriculture and Livestock Project Rio Rural (SEAPEC-PRR). Below, the results of the analysis of governmental potentials and constraints for rural sanitation in RJ are going to be applied on the study area, in the community of Barracão dos Mendes/ NF in order to reflect the applicability of the proposed decentralized collective wastewater treatment and reuse solutions from the institutional and legal as well as from the operation and maintenance model perspectives.

The case study, is a theoretical rural sanitation project in Barracão dos Mendes and was conducted within the sanitation work package of the INTECRAL obeying following objectives:

- Creation of a regional plan for sanitation, including the most suitable regions, technologies, operation and financial models for implementation of decentralized wastewater treatment and reuse solutions for a selected river basin for rural communities in the region in Rio de Janeiro.
- Development of guidelines for decentralized wastewater treatment and reuse solutions for selected micro-basins in rural areas of Rio de Janeiro. [203]

Within the cooperation of RIO RURAL and INTECRAL projects, a pilot wastewater treatment plant in Barracão dos Mendes within the municipality of Nova Friburgo was intended. The technology election was based on previous environmental and socio-economic surveys. A sample of appropriate alternative decentralized technologies was selected according to the cost-benefit analysis, conducted in cooperation with the Cologne University of Applied Scien, BDZ e.V. ("Bildungs- und Demostrationszentrum für dezentral Abwasserbehandlung) and "Tilia Unwelt GmgH".

[202] Integrated Eco Technologies and Services for a Sustainable Rural Rio de Janeiro project – INTECRAL has a duration from 2013 till 2016 and is a BMBF collaborative project funded with 2.98 billion Euro.
[203] Cardona, J., Saraiva, J., Boettger, S. & Prata, F., (2014). Contribution to the sustainable management of water resources through decentralized wastewater treatment and reuse solutions.

The case study aims to reflect the applicability of the proposed decentralized collective wastewater treatment and reuse solutions from the institutional and legal perspective as well as from the operation and maintenance model perspective with the purpose to improve the sustainable management of water resources.

The rural sanitation research within the INTECRAL project is focused on decentralized wastewater treatment solutions (cluster solutions), being a reliable alternative for small communities and rural areas[204], particularly in areas where operation and management of on-site systems must be improved and where local population cannot afford the cost of centralized systems. Decentralized wastewater treatment solutions are also suitable for communities lacking a sewer infrastructure providing a high potential for reuse[205]. In the study area, Barracão dos Mendes, all the mentioned criteria is applicable.

Advantages of decentralized wastewater treatment systems	**Disadvantages of decentralized wastewater treatments systems**
• Cost reduction for sewer network, lifting and pumping stations • Failures of single units do not collapse the whole system • Possibility of gradual development and investment • No use of water as a transportation medium • Adaptability to local requirements • Management flexibility • Low energy use • Allows integration of community and sensitization for health and environmental problems connected with the lack of sanitation	• The most common decentralized technologies such as septic tanks or ponds present a low water pollutants removal efficiency and do not meet environmental legal requirements • Maintenance of the system needs to be done by house owners, which are usually unacquainted with the relevant technology • The incorrect operation of decentralized wastewater treatment technologies can cause environmental damage and health impacts.

Table: Advantages and disadvantages of decentralized wastewater treatment systems. Source: Wilderer et al:[206]

[204] Compare: Massoud, M. A., Tarhini, A. & Nasr, J. A., (2009): P. 653
[205] Compare: Crites, R. W. & Technobanoglous, G., (2008): *Small and Decentralized Wastewater Management System,* McGraw-Hill.
[206] Compare: Wilderer, P. A. & Scherff, D., (2000) and Massoud, M. A., Tarhini, A. & Nasr, J. A., (2009) extracted from Segovia Sánchez, O (2014). P. 23

7.1.1 Problem statement of Barracão dos Mendes

The households of the community Barracão dos Mendes have simple on-site solutions such as *Fossa Negra* (septic tanks without a sealed bottom, where discharged wastewater leaches underground) or no domestic wastewater treatment systems at all. Assuming that *Fossas Negras* are allocated nearby water catchment areas, where the local population extracts drinking water from wells without any further treatment, contaminated ground water may create risk for diseases, especially for diarrhoea. In Barracão dos Mendes, there is also no extensive sewer network for the disposal of wastewater present: untreated wastewater flows, partially above ground, into a river north of the community. During summer months, the river carries little water and consequently, leads to increased concentration of microbial contamination by wastewater. Nevertheless, contaminated river water is used for irrigation of nearby fields, which also leads to an increased risk of pathogens entering the food cycle. [207]

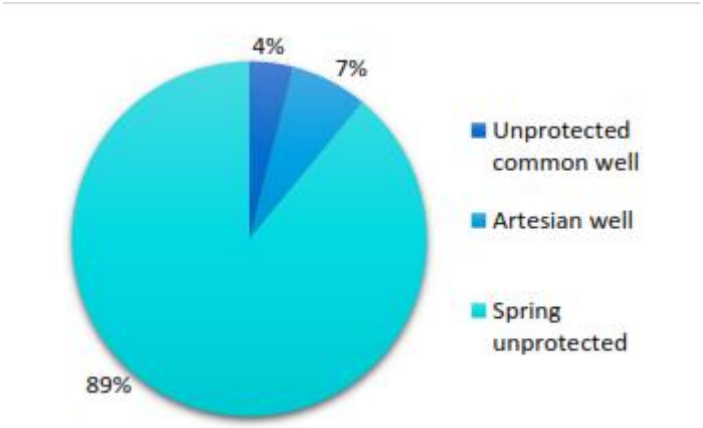


Figure 13: Principal sources of water in the community of Barracão dos Mendes. Source: Segovia Sánchez, O (2014)

On this note, sustainable development and securing of natural resources in Barracão dos Mendes requires regional planning, taking into account interactions of land and water resources use as well as local technological, environmental and socio-economic conditions.

7.1.2 Onsite investigations and technical parameters

The following parameters for the choice of appropriate wastewater treatment technology were determined through evaluation of the local conditions:

Zone	**Housing**	**Number of Residents**		
		2104	**2024**	**2034**
Concentrated urban nucleus	**135**	**675**	**709**	**2023**

[207] Böttger S., Cardona J., Saraiva J. and Prata Filho D. (2014).

Individual buildings	**125**	**625**	**656**	**689**
Total	**260**	**1300**	**1365**	**1433**

- **Assumption of population increase of 5% every 10 years[208]**

Barracão dos Mendes lacks drinking water supply, therefore there is also no information about drinking water consumption. However, the approximate average for water consumption has been estimated accoring to the number of residents and conducted interviews, by 270 l/(PT[209] per day). Consquently, wastewater volume was assumed, using the return factor of 80%, by 220 /(PT per day).[210]

Zone	Residents	Daily outflow m3/d
Concentrated urban nucleus	**675**	**148,5**
Individual	**625**	**137,5**
Total	**1300**	**286**

The demands on treated wastewater based on INEA DZ-215.R-4/2007 load control directive for organic biodegradable wastewater of sanitary origin.

Effluent Parameter of treated wastewater	DBO (BOD) in mg/L	RNFT (FS) in mg/L or SST (TS) in mg/L
Limits according to DZ 215. R-4	**<60**	**<60**

Map 5: Map of Barracão dos Mendes showing the natural drainage areas (left) and the projected sewer network base on gravity flow (right). Source: BDZ e.V.

In order to provide wastewater treatment in the concentrated urban nucleus of Barracão dos Mendes, to a school in the east part of the community (50 PT) and to scattered households

[208]Böttger S., Cardona J., Saraiva J. and Prata Filho D. (2014).
[209] PT- total number of inhabitants and population equivalents
[210]Böttger S., Cardona J., Saraiva J. and Prata Filho D. (2014).

distributed within the entire community area, the implementation of only one semi-central wastewater treatment plant (WWTP) would not be sufficient. According to initial estimates, 625 inhabitants live outside the concentrated nucleus of Barracão dos Mendes and need also to be connected to a wastewater collection system. Within the program RIO RURAL already various households have been equipped with simple bio-digester systems. Within the framework of the INTECRAL rural sanitation project, a pilot cluster solution consisting of a wastewater treatment system (WWTS) attending 1000 PT,[211] a smaller WWTS attending 50 PT (a community school) and additional 10 small individual wastewater treatment systems (bio-filter system[212]), are intended to be installed. Three best available German wastewater treatment technologies[213], suitable to the environmental and socio-economic conditions of the community and with comparable costs (investment, re-investment, operation and maintenance costs, calculated for the following 50 years), are projected as a demonstrative example for decentralized alternative WWT technologies for rural sanitation solutions in RJ. Following alternatives are suggested by the project:

1.) Up-flowing anaerobic sequencing batch reactor (UASB) in combination with constructed wetlands for wastewater treatment
2.) Activated sludge process with partial sludge stabilization (ARS)
3.) Moving Bed Biofilm Reactor (MBBR)

The project costs are intended to be shared by the Brazilian and German partners: The Brazilian part is taken over by AGEVAP through CEIVAP funding for sanitation pilot projects, while the German part is yet to be approved by DEG (Deutsche Investitions- und Entwicklungsgesellschaft mbH).

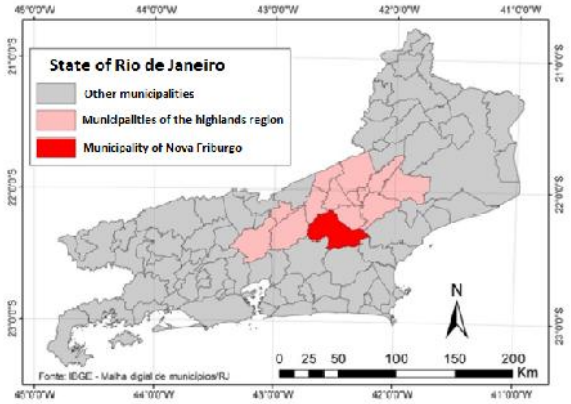
In many Brazilian sanitation projects, the issue of sludge management is not sufficiently embraced. The rural sanitation project in Barracão dos Mendes proposes the integration of sludge treatment solutions as a part of the suggested sanitation model. Two sludge management models were evaluated from the above mentioned combined wastewater treatment system solution: The conventional model, where sludge generated from the wastewater treatment process in Barracão dos Mendes is transported and disposed in the central wastewater treatment plant of the municipality of Nova Friburgo. And the on-site sludge treatment using eco-technologies (reed bed) are suggested as an alternative for further use in agriculture as fertilizer represents an interesting alternative solution. Although the use of stabilized sludge as fertilizer is restricted by the CONAMA state resolution No. 375[214] due to the risk for health hazards, the option remains controversial but open to discussion.[215] Especially, the increase of land field costs and the need for nutrients in agriculture makes the reuse option attractive for rural areas.

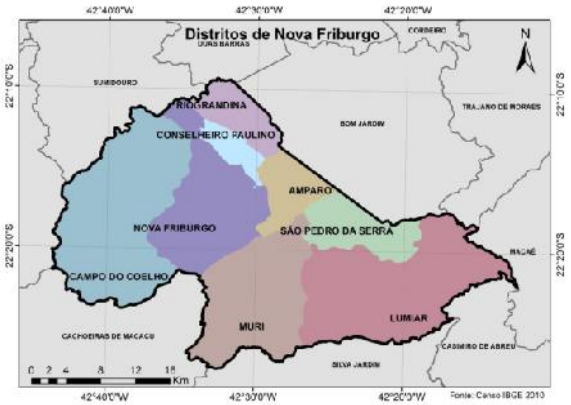
[211] PT - total number of inhabitants and population equivalents.
[212] Bio-Filter System provided by AllesKlar GmbH.
[213] Technologies in accordance with INEA DZ-215.R-4/07 directive requirements
[214]CONAMA state resolution No. 375: http://www.mma.gov.br/port/conama/res/res06/res37506.pdf
[215] Böttger S., Cardona J., Saraiva J. and Prata Filho D. (2014).

7.2 Stakeholder description

7.2.1 General Information about Municipality of Nova Friburgo and Barracão dos Mendes

The municipality of Nova Friburgo (NF) is located in the mountainous region of the State of Rio January within an area of 9385 sq. km. The population of NF is estimated at 182082 inhabitants, of which 159372 live in urban and 22710 in rural areas, according to the IBGE Census, 2010.[216]
Nova Frigurgo is divided into eight districts: Nova Friburgo, Riograndina, Campo do Coelho, Amparo, Lumiar, Conselheiro Paulino, São Pedro da Serra and Muri.[217]

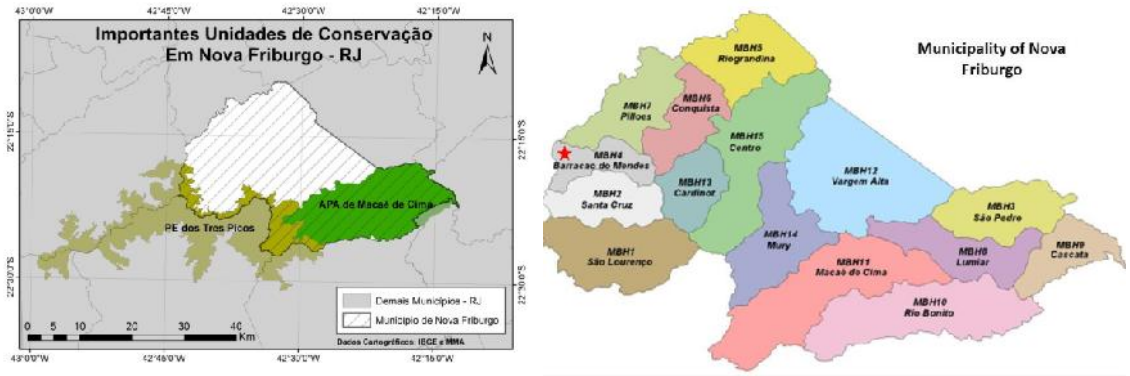




Map 6 (left): Geographical limits of Nova Friburgo in the state of Rio de Janeiro. Source: Cavallo Pfeil, L (2014): P. 19
Map 7 (right): Geographical delimitation of districts of Nova Friburgo. Source: IBGE Census, 2010, taken from Cavallo Pfeil, L (2014): P. 20

The main economic activities of the municipality are tourism, undergarment production, flori- and horticulture, and some small industries such as textiles, metal, etc.[218]
The municipality contains two state nature conservation areas: APA “Macae de Cima” and state nature park “Tres Picos”. The study area of Barracão dos Mendes is located within the buffer zone of the state nature park “Tres Picos”.
The municipal area of Nova Friburgo comprises two hydrographic regions: Rio dois Rios and Rio Macaé. The river Basin Rio Dois Rios (R2R) belongs to the Paraíba do Sul river basin and is managed by AGEVAP, while the river basin Macaé e das Ostras is managed by the inter-municipal consortium Lagos São João (CILSJ). The study area of Barracão dos Mendes belongs to the river basin of Rio Dois Rios, and consequently is directed by the CBH R2R and AGEVAP nucleus R2R.

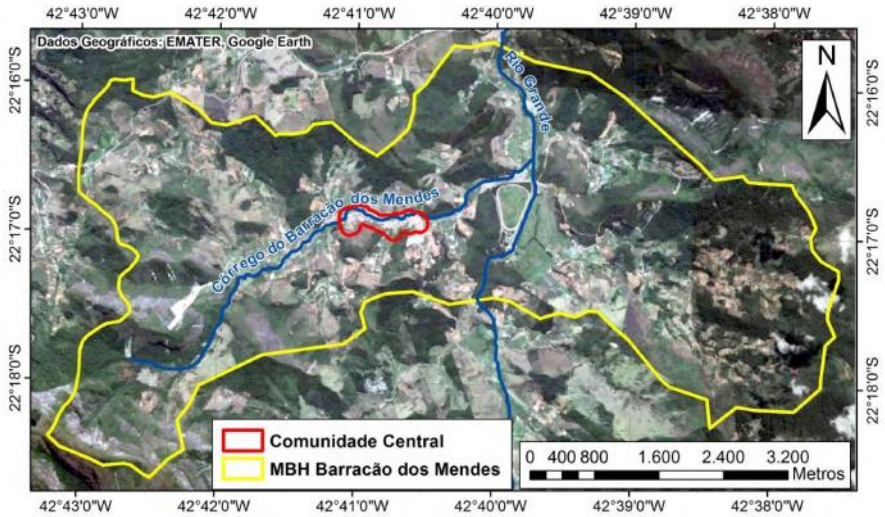
[216] IBGE (2010): http://www.censo2010.ibge.gov.br/sinopse/index.php?uf=33&dados=29
[217] Nova Friburgo Official Site: http://novafriburgo.rj.gov.br/nova-friburgo/dados-gerais/
[218] Nova Friburgo Official Site: http://novafriburgo.rj.gov.br/nova-friburgo/dados-gerais/



Map 8 (left): Important nature protection areas in the municipality of Nova Friburgo. Source: Cavallo Pfeil, L (2014)

Map 9 (right): Municipality of Nova Friburgo. Source: Segovia Sanchez, O (2014)

The river basin Rio dois Rios is divided into 83 micro-watersheds[219]. The micro-watershed of the study area Barracão dos Mendes is located in the municipal district of Campos de Coelho with a total population of 10,067 inhabitants, 7,253 of those living in rural areas, according to the IBGE Census, 2010[220]. Horticulture by small farmers is the main activity in this micro-watershed. The vegetable production is irrigated from the adjacent streams and springs, where water may contain pathogens. Consequently, sanitation measures are essential for irrigation measures in order to fulfil the health requirements, as vegetables grown in the respective region are destined for raw consumption.[221]



Map 10: Micro-watershed of Barracão dos Mendes. Source: Cavallo Pfeil, L (2014): P. 19

7.2.2 Organizational Structure of the Municipality of Nova Friburgo

The municipality of Nova Friburgo has a comparatively well-organized political and administrative structure with 19 municipal secretaries, among them the municipal Secretary of Agriculture and

[219] According to GIS data provided by Rio Rural.
[220] Cavallo Pfeil, L (2014): P.21
[221] Compare: Cavallo Pfeil, L (2014): P.21

Rural Development (Secretaria de Agricultura e Desenvolvimento Rural) and the Secretary of Environment and Urban Development (Secretaria de Meio Ambiente e Desenvolvimento Urbano Sustentável). The municipal Secretary of Environment and Sustainable Urban Development is a strong municipal organism divided in 7 sub secretaries with a municipal environmental system (Sistema municipal de meio ambiente), composed of an administrative executing agency for the municipal environmental policy (órgão administrativo executor da política municipal de meio ambiente), a municipal environment council (conselho municipal de meio ambiente), a municipal environmental fund (fundo municipal de meio ambiente) and a municipal environmental guard (guarda municipal ambiental). The municipal environmental system is linked to the federal environmental system and also represents a necessary requirement for receiving the ICMS-Verde revenues.

In 2014, Nova Friburgo was ranked first among the 92 municipalities of RJ, in receiving ICMS-Verde tax revenue (R$ 4,412,572.00). The municipality was also ranked first in the category' solid waste and landfill management', generating an ICMS-Verde increase of R$ 634,497.00 in municipal revenues.[222]

Wastewater treatment forms also an important part of the ICMS revenues. For 2015 the expected ICMS-Verde revenue through wastewater treatment by "Aguas de Nova Friburgo" will average R$ 139,242.78.[223]

Nova Friburgo ETE Olaria	R$ 72,155.71
Nova Friburgo ETE Campo do Coelho	R$ 1,744.34
Nova Friburgo ETE Centro	R$ 63,711.32
Simulation of new wastewater treatment stations	R$ 1,631.40
Nova Friburgo Total	R$ 139,242.78

Table 8: INEA

Within the municipal environmental council, the Municipal Technical Sanitation Chamber (MTSC) was created in order to represent the "social control" for the elaboration and implementation of the municipal basic sanitation plan, required by the Sanitation Law. The technical sanitation chamber of NF includes nine civil societies (Universities, NGO, and inhabitant associations) and nine governmental representatives (from which half are municipal government representatives).[224] However, the CBH R2R is neither represented within the municipal environmental council nor within the municipal technical sanitation chamber, which points out the low interconnection between the water management and environmental sector on the municipal level. The advantage of the exercise of social control for development and implementation of the municipal basic sanitation plan within the environmental council is, that

[222] Compare: G1 Globo (2014): http://g1.globo.com/rj/regiao-serrana/noticia/2014/04/nova-friburgo-rj-sobe-no-ranking-do-icms-verde-e-recebe-premio.html
[223] INEA RJ.
[224] According to the Interview with Ivson Macedo, Municipal Secretary of Environment and Sustainable Urban Development, NF.

the MTCS becomes a deliberative organ for municipal legislation. Implementation of control mechanisms outside the environmental council would only have an advising and consulting nature.[225]

According to the Sanitation Law, all the future municipal sanitation actions in NF will be formulated within the Municipal Basic Sanitation Plan (PLAMSAB NF), which in turn, will form part of the Municipal Master Plan (MMP) (Plano Diretor Municipal). MMP is a basic instrument for the development of policy and planning of the city's urban expansion. It is a law drafted by the municipality with the participation of the City Council and civil society, that aims to establish and organize the growth, operation, territorial planning of the entire municipal area and to guide investment priorities[226]. The first MMP draft for NF was already developed in 2006 and awarded as the best participative plan nationwide with the prize "Prêmio Caixa Melhores Práticas em Gestão Local 2007/ 2008"[227]. However, the draft has not yet been approved to a municipal law but reviewed in 2015. The revision was also necessary due to the landslide catastrophe in 2011[228] and the interrelated modification of landscape.[229] The MMP of NF also includes urban and rural zoning, to date only counting with division between rural and urban areas. Within the revision of the plan, the municipality intends to introduce measures in order to make rural areas more resilient through sanitation as well as through contamination and agro toxics reduction actions.[230] The new MMP, scheduled for the next 35 years, is however, rather urban focused and is intended to be approved in 2015.

The municipality of NF is to date not involved within the rural sanitation project in Barracão dos Mendes undertaken within the INTECRAL project. [231]

7.2.2.1 Municipal Sanitation Plan Nova Friburgo - PLAMSAB NF

The municipal basic sanitation plan for NF (PLAMSAB NF) is developed with federal funding from the Ministry of Cities through the Brazilian growth acceleration program – PAC. The design and development of PLAMSAB NF was granted to the "Project Coordination, Research and Technology Studies Foundation – COPPETEC", which is a private non-profit institution, created within the Federal University of Rio de Janeiro – UFRJ, in order to support the realization of technological

[225] According to the Interview with Ivson Macedo, Municipal Secretary of Environment and Sustainable Urban Development, NF.
[226] Compare: Subsecretaria de Licenciamento e Fiscalização Urbana RJ: http://www.pmsg.rj.gov.br/urbanismo/plano_diretor.php
[227] Gazeta das Cidades: http://www.gazetadascidades.com.br/site/pages/arquivos/materias/friburgo020.htm
[228] Comapare: The Guardian: http://www.theguardian.com/world/2011/jan/12/brazil-landslide-leaves-115-dead
[229] According to the interview with Ivson Macedo, Municipal Secretary of Environment and Sustainable Urban Development, NF.
[230] According to the Interview with Ivson Macedo, Municipal Secretary of Environment and Sustainable Urban Development, NF.
[231] The Barracao dos Mendes Study is and academic exercise. In order to implement the project, meetings with the municipality and other stakeholders like ANF, CBH R2R and RIO RURAL were undertaken. According to the conducted interviews with RIO RURAL, CBH R2R and AGEVAP R2R, the municipality of NF showed low interest on the project. The Municipality was informed about the projects activities and will receive the report and recommendations.

development and research projects.[232]. COPPETEC presented a sanitation project draft for NF and passed the municipal public tender. [233]

The PLAMSAB NF includes a detailed planning for sanitation services such as drinking water supply, wastewater treatment, street cleaning, solid waste management and drainage and is projected for the next 20 years (from 2015 to 2035). PLAMSAB NF was developed by COOPETEC with two different wastewater treatment approaches: 1.) Urban sanitation approach with conventional technologies use and 2.) Rural sanitation approach with the use of alternative technologies. For rural sanitation project planning, population density was taken as a factor for the technology choice, (without a classification between rural and urban). Accordingly, rural communities with high population density require collective low cost solutions with low energy and maintenance costs, and rural communities with low population density, individual wastewater treatment solutions. The INEA DZ-215.R-4/2007 directive defines that in communities with population below 1000 inhabitants, 30% of organic load needs to be removed from wastewater. Consequently, collective septic tanks (fossa septica collectiva) were selected as the most cost-effective and feasible solutions to achieve the guideline requirements in NF.

The PLAMSAB NF was developed with a strong focus on social society participation: COOPETEC organized public audiences and assemblies inviting all the stakeholders such as municipality representatives, CBHs, (CBH R2R, CBH Macae), RIO RURAL, IPPUR (Instituto de Pesquisa e planejamento urbano e regional, UFRJ), sanitation service providers (water supply and wastewater "Aguas de Nova Friburgo and solid waste management "EBMA" (Empresa Brasileira de Meio Ambiente), AGENERSA (state regulating agency in RJ), ONGs, schools working with environmental education, public health organizations, APAs, state nature park "Tres Picos", civil society, etc. Unfortunately, the public participation in audiences remained low. [234]

The control of the implementation is assigned to the Municipal Environmental Council and its Municipal Technical Sanitation Chamber. The regulation of sanitation contracts will be assumed by AGENERSA[235] after approval of PLAMSAB NF to a municipal law. All the future sanitation actions put into practice within the municipal area of NF through the municipality, CBH, NGOs, FUNASA etc. will need to correspond the regulations determined within the sanitation plan after enactment of PLAMSAB NF.

PLAMSANF development steps by COOPETEC:

1. Step: Working plan, presented by the municipal public tender.

2. Step: Review of the working plan with municipal technicians.

3. Diagnostic (Analysis of sanitation systems and future requirements)

4. Prognostic (Scenario of the municipal growth and development of adequate sanitation scenarios, goals and guidelines. Regulating agency should develop regulation indicators).

[232] The audience of COOPETEC is composed of government agencies, private, multilateral agencies and national and foreign private companies.
[233] Interview with Osvaldo Rezende, COOPETEC/UFRJ/RJ.
[234] Interview with Iene Christie Figueiredo/ COOPETEC/ UFRJ and Osvaldo Rezende COOPETEC/ UFRJ.
[235] COOPETEC tries to achieve that regulating agency AGENERSA also acts as part of social control for the implementation of the PLAMSAB NF. According to the interview with Osvaldo Rezende COOPETEC/ UFRJ

5. Action plan development

6. Public audience for PLAMSAB NF (PLAMSAB NF becomes a municipal law). The regulating agency is intended to acts as part of social control for the implementation of the PLAMSAB NF.

The total costs of the PLAMSAB NF averages RS 700,000 – 1 Mio (including field research, remuneration of technicians, public hearings, environmental education and social mobilization actions).[236]

The process of the development of PLAMSAB NF was projected to take eight months. However, the plan was accomplished only after two years due to bureaucratic barriers, difficulties with technical staff of the project and lack of coordination.

After PLAMSAB NF is approved on the municipal level, it is going to be evaluated on federal level. Further funding for the implementation of the PLAMSAB NF will be only liberated, when the plan corresponds the federal PLANSAB requirements.[237]

Challenges PLAMSAB NF:

The development of PLAMSAB NF progresses very slowly due to technical, administrative and bureaucratic obstacles. Also the municipal intention to integrate the PLAMSAB NF within the municipal master plan drags the completion in favour of local political interests. Without the participation of the municipal secretary of agriculture in the development of PLAMSAB NF, a significant stakeholder with a strong connection to rural population and to the financially important agricultural sector, which might be beneficial for rural sanitation project achievement, is not involved. Additionally, not involving river basin committees in the development of PLAMSAB NF omits an important water resources management and sanitation player from the municipal sanitation agenda. The mayor challenge for the rural and urban sanitation sector of NF is however, to put the accomplished PLAMSAB NF into practice: There are no existing mechanisms forcing a fast implementation of municipal sanitation plans. Implementation control would take effect first, when further federal funding for the implementation of the PLAMSAB NF is approved.

Municipal Basic Sanitation Plan Nova Friburgo:
http://plamsabnf.wix.com/plamsabnf#!produtos/ca4p

7.3 Water supply and wastewater treatment service provider "Aguas de Nova Friburgo"

NF has a long history of sanitation services starting in 1999 with the municipality owned sanitation service provider AMAE-NF (Autarquia Municipal Água Esgoto Nova Friburgo), which became a supervisory body after granting the concession contract for water supply to CAENF (Concessionária de Águas e Esgotos Nova Friburgo),[238] which was purchased by "Aguas de Brasil

[236] Interview with Osvaldo Rezende COOPETEC/ UFRJ.
[237] Interview with Iene Christie Figueiredo/ COOPETEC/ UFRJ
[238] Compare: Nova Friburgo Official Site: http://novafriburgo.rj.gov.br/2011/10/contas-da-amae-ja-estao-sendo-executadas/

Group" forming the subsidiary "Aguas de Nova Friburgo" (sanitation service provider for water supply and wastewater treatment in the municipality of Nova Friburgo). The concession contract between the municipality and the private company is signed for 30 years, starting in 2009 and ending in 2030 and covers only sanitation service provision in urban areas. "During the concession period, the company is responsible for the collection, production and distribution of treated water, as well as for the collection, removal and treatment of wastewater. […] The utility currently has three wastewater treatment plants in operation: WWTP Olaria, WWTP Campo do Coelho and WWTP Centro, together treating 65% of wastewater collected. The performance of WWTP Olaria is worth highlighting: opened in 2010, its treatment capacity and technological setup increased the treatment rate from zero to 300 million liters/month. Three more WWTPs are planned for the coming years: WWTP Conselheiro Paulino, WWTP Ponte da Saudade and WWTP Cônego. Águas de Nova Friburgo was the first sanitation company of the state of Rio de Janeiro to use Moving Bed Biofilm Reactors (MBBR). This system removes 95% of the organic matter during the process of wastewater treatment in a relatively small space, without making noise and without emission of unpleasant odours, when compared to other technologies."[239] However, the municipality of NF did not initially invested in a separate sewage collection system, so wastewater and rainwater flow through the same pipe system, providing only 30% of treated out of 60% collected amount of wastewater.[240] Only a limited capacity of mixed rain and wastewater can be treated in the existing wastewater treatment plants while the residual wastewater flows directly to the water bodies. The separation of the combined system would require an investment in a completely new system. Neither the municipality nor "Aguas de Nova Friburgo" have sufficient funds at their disposal to invest in a separate system.

7.3.1 The gaps for rural sanitation from utilities perspective

Under the current model, the company does not provide sanitation services in rural areas, as rural sanitation is not part of the concession contract (adopted from the CAENF NF). "Aguas de Nova Friburgo" is not yet concerned to extend its services to cover rural areas of NF, as the service provision in rural, disperse areas is not cost-effective for the company. However, the urban nuclei with a high population density in rural areas would be supposable more economically feasible for the company. For instance, in Campos de Coelho a smaller wastewater treatment plant (MBBR - Moving Bed Biologic Reactors with treatment capacity: of 15 L/s) was constructed by the company in order to attend the urban nucleus of the community with a population of 2000 inhabitants[241]. According to the interview with the superintendent of "Aguas de Nova Friburgo", Christian Portugal, wastewater treatment in disperse and remote rural communities such as Barracão dos Mendes, would be only feasible in case of a significant population increase. In other case, alternative low cost collective wastewater treatment solution such as constructed wetlands and bio-digesters represent more feasible solutions.

According to the municipal decree No. 077/13, the registration of sanitation services recipients has been determined to secure sanitation service provision to low income consumers with a social tariff (Tarifa Social) provided by "Aguas de Nova Friburgo".

[239] Aguas de Nova Friburgo: http://www.grupoaguasdobrasil.com.br/aguas-novafriburgo/en/a-concessionaria/
[240] Interview with Osvaldo Rezende, COOPETEC/ UFRJ, RJ.
[241] Aguas de Nova Friburgo: http://www.grupoaguasdobrasil.com.br/aguas-novafriburgo/en/agua-e-esgoto/ete/

Current rate from 01/2015							
T.R.A.	R$ 2,3789						
				T.R.E.	50%	T.R.E.	100%
Category	Band	Factor	Water RS/m3	Wastewater (RS/m3)	Water and Wastewater	Wastewater (RS/m3)	Water and Wastewater
Residential	Minimum tariff	10,00	23,79	11,90	35,69	23,79	47,58
	0 to 10	1.00	2.3789	1.18945	3.568	2.3789	4.758
	11 to 30	2.00	4.7578	2.37890	7.137	4.7578	9.516
	21 to 50	3.00	7.1367	3.56835	10.705	7.1367	14.273
	51 a 100	6.00	14.2734	7.13670	21.410	14.2734	28.547
	Above 100	8.00	19.0312	9.51560	28.547	19.0312	38.062
Social Tariff	Minimum tariff	10,00	11,90	5,95	17,85	11,90	23,80
	0 to 10	0.50	1.1895	0.59475	1.784	1.1895	2.379
	Above 10	0.50	1.1895	0.59475	1.784	1.1895	2.379
Commercial	Minimum tariff	10,00	71,37	35,69	107,06	71,37	142,74
	0 to 10	3.00	7.1367	3.56835	10.705	7.1367	14.273
	11 to 20	5.00	11.8945	5.94725	17.842	11.8945	23.789
	21 to 30	5.99	14.2496	7.12480	21.374	14.2496	28.499
	Above 30	6.40	15.2250	7.61250	22.838	15.2250	20.45
Industrial	Minimum tariff	30,00	335,42	167,71	503,13	335,42	670,84
	0 to 30	4.70	11.1808	5.59040	16.771	11.1808	22.362
	31 to 130	5.40	12.8461	6.42305	19.269	12.8461	25.692
	Above 130	5.70	13.5597	6.77985	20.340	13.5597	27.119
Public	Minimum tariff	15,00	47,10	23,55	70,65	47,10	94,20
	0 to 15	1.32	3.1401	1.57005	4.710	3.1401	6.280
	Above 15	2.92	6.9464	3.47320	10.420	6.9464	13.893
Municipal	Minimum tariff	15,00	32,83	16,42	49,25	32,83	65,66
	0 to 15	0.92	2.1886	1.09430	3.283	2.1886	4.377
	Above 15	1.37	3.2591	1.62955	4.889	3.2591	6.518

Table 9: Social Tariff by "Aguas de Nova Friburgo". Source: Aguas de Nova Friburgo 2015.

The concessionaire "Aguas de Nova Friburgo" does not have any service regulation. The application of the future municipal basic sanitation plan would postulate the revision of the sanitation service provision contract and the introduction of a regulating mechanism. The revision of the concession contract will have to premise on a strong involvement of the municipality, of the civil society through the environmental council and the MTSC as well as of the regulating agency (AGENERSA) and the concessionaire (Aguas de Nova Friburgo) within a participative process performed through public audiences.[242]

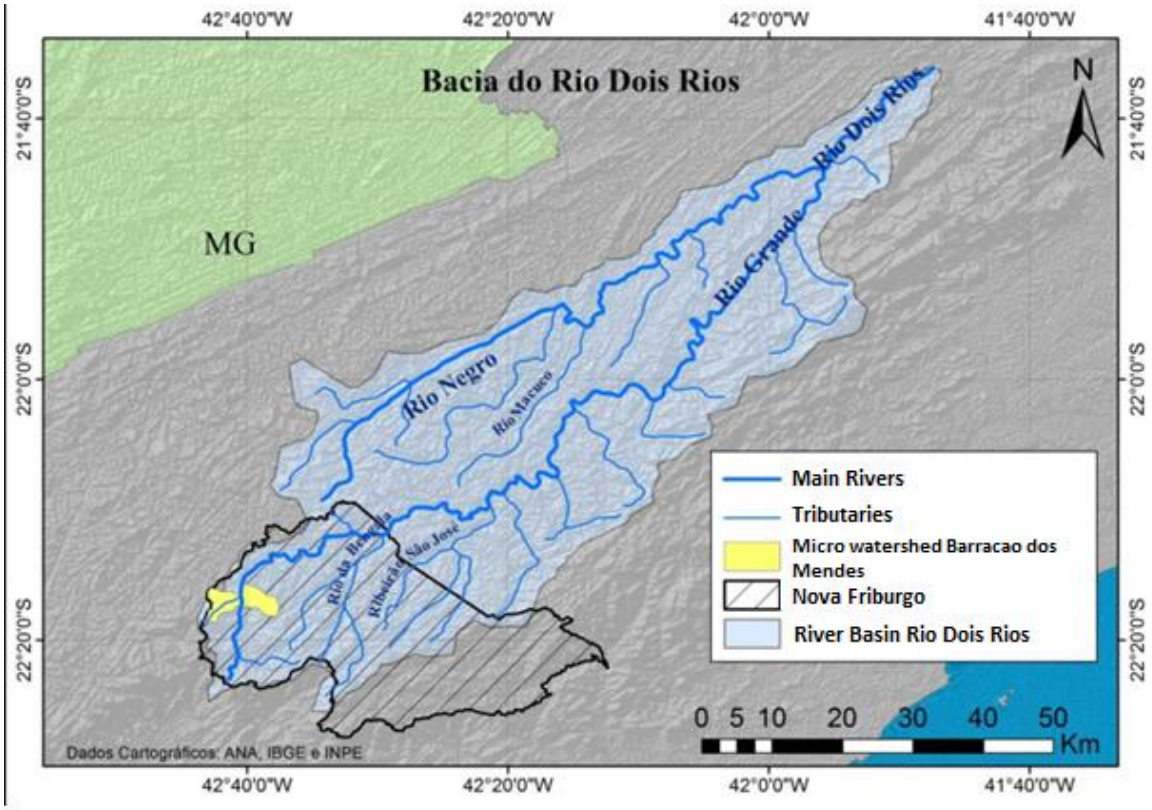
The sanitation service provider concessionaire of the municipality of NF, "Aguas de Nova Friburgo" is not involved within the rural sanitation project in Barracão dos Mendes undertaken within the INTECRAL project.

7.4 CBH Rio Dois Rios/ Water Agency AGEVAP Nucleus R2R

Rio Dois Rios is a river basin in RJ with a drainage area of 4,375.5 km2, covering 12 municipalities in Rio de Janeiro (Nova Friburgo, Cantagalo, Carmo, Cordeiro, Duas Barras, Macuco, Bom Jardim, São Sebastião do Alto, Santa Maria Madalena e Trajano de Moraes, Itaocara e São Fidélis), as

[242] Interview with Eloise Torres: State Secretary of Environment RJ/PSE, Rio de Janeiro.

defined in the CERHI resolution No. 18/2006. The river basin is situated between the rivers Negro and Grande, both flowing into the Paraiba do Sul River.[243]



Map 11: River Basin Rio Dois Rios. Source: Eduardo Cavallo Pfeil, L (2014): P.22

The CBH Rio Dois Rios (R2R) is a relatively recent river basin committee founded in 2008. In 2011 AGEVAP was signed by the committee as the executive water agency. Since CBH R2R is an integrative hydrographic region of the Paraíba do Sul River Basin, also CEIVAP/AGEVAP implement plans and actions within the river basin area. However, CBH R2R and other CBHs are independent from CEIVAP in development of river basin plans (planos de bacias) and resources management, originating from water use fees charges. The relationship between CEIVAP and CBHs is based on integrative negotiation without a subordination of administrative power.[244] However, CEIVAP receives significantly higher revenues from water use fee charges from the Paraíba do Sul River (around RS 12 Mio/ year) than integrative CBHs (around RS 700,000 in case of CBH R2R).Therefore, CEIVAP is able to invest in broader water resources management programs and actions than the smaller CBHs.

[243] Compare to: CBH R2R: http://www.cbhriodoisrios.org.br/regiaohidro.php

[244] Interview with Interview with André Bohrer Marques/ Nucleus coordinator of water agency AGEVAP in the executive secretary of the hydrographic watershed of Rio dois Rios and Licius de Sá Freire, President of CBH Rio Dois Rios.

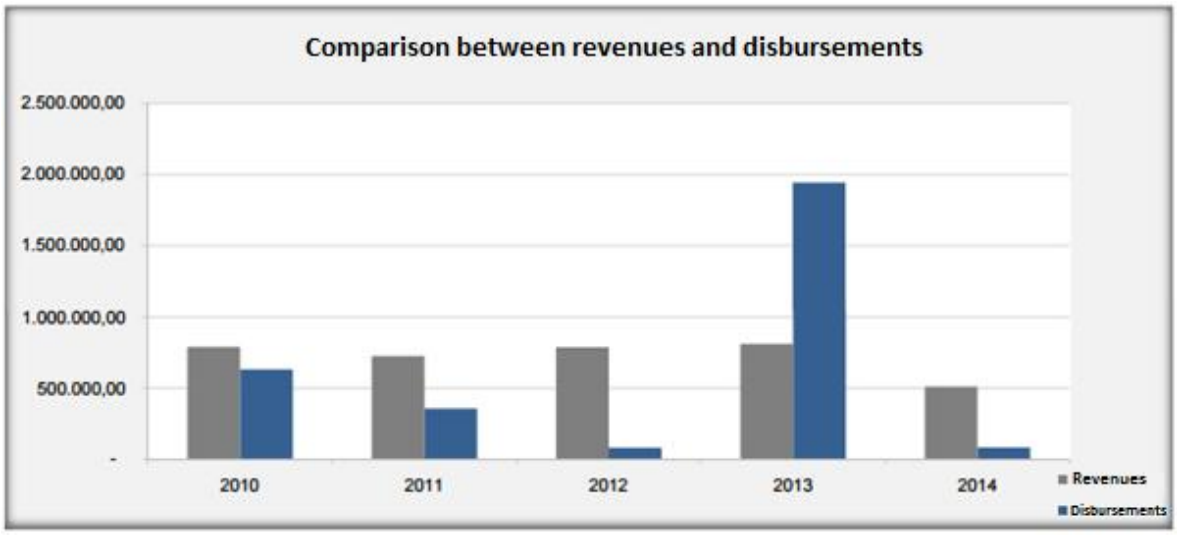


Figure 14: Comparison between revenues and disbursements of the CBH R2R from 2010-2014. Source: CBH R2R.

CBHs act as "water parliaments", bringing together stakeholders of the water sector in order to articulate the needs and concerns of the water users in the respective watershed and representing therefore the civil society sector within the Brazilian water management system. Accordingly, CBH R2R approved in December 2014 a resolution (Resolução No. 036/14), which expresses interest for sanitation actions within the river basin management plan, privileging project design and development (projeto executivo) for wastewater collection and treatment[245]. However, the integrative CBHs within the Paraíba do Sul River Basin are sanitation stakeholders, without sufficient financial power for the implementation of river basin wide sanitation programs and actions. Therefore, CBHs focus their actions rather on financing of project design and development (projeto executivo) for scattered sanitation actions within the river basin area. For instance, CBH R2R, integrating 12 municipalities within its area and having a budget of around RS 700,000 per year through water use fee charge, does not hold sufficient resources for the installation of even one collective rural sanitation solution such as one planned in Barracão dos Mendes within the INTECRAL project. The financial strength of integrative CBHs is however low, which hinders their function as more technical and as less political entities (the way CBHs were initially intended). Due to low financial power and weak connection to the municipality, CBH R2R does not have a direct connection to the development of municipal basic sanitation plans. Generally, sanitation actions planned by the CBHs are included within the respective river basin plans, but those are rather simplified in comparison to the municipal basic sanitation plans.

The role of R2R AGEVAP nucleus is an institutional, technical one: The committees (CBH R2R and CEIVAP) deliberate actions, and AGEVAP nucleus operates as an administrative, executive organ (arranging contracts and terms references with the municipality and other stakeholders, announce public tenders for projects etc.)[246].

[245] Compare: Resolutions No. 036/14 CBH R2R: http://cbhriodoisrios.org.br/resolucoes/resolucao-036-cbh-r2r-4-12-14.pdf

[246] Interview with André Bohrer Marques/ Nucleus coordinator of water agency AGEVAP in the executive secretary of the hydrographic watershed of Rio dois Rios

For the rural sanitation project in Barracão dos Mendes the CBH R2R granted around RS 100,000[247] for the elaboration of the sanitation project design and development (projeto executivo). The previous field research for the "executive project" has been undertaken by RIO RURAL in cooperation with the Fluminense Federal University (UF) in order to develop an executive technical project.

7.5 Other stakeholders: AGEVAP and INEA

Barracão dos Mendes is situated within the buffer zone of the state nature park "Tres Picos", however, the park management plan (plano de manejo) does not define any rural sanitation requirements. Further, the national park staff barely is able to guard the area of permanent protection, so the control and monitoring of sanitation actions within the park buffer zone, turns into an overly demanding duty due to understaffing.

The environmental state agency INEA has a weak integration in the rural sanitation sector, because it does not have any competence for support of rural sanitation projects. INEA will intervene in the Barracão dos Mendes rural sanitation project by the beginning of construction of the proposed technological solution through the environmental policy administration and licencing. Although RIO RURAL intended to incorporate INEA for organizational support of the collective wastewater treatment project financed by FECAM, the cooperation ended without any outcome. Subsequently, AGEVAP (Paraíba do Sul River Basin level) boarded the project, being the executive agency of CBH R2R, and by invitation of RIO RURAL. AGEVAP held available CEIVAP funding for the elaboration of pilot projects and overtook the executive part of the rural sanitation project in Barracão dos Mendes in 2015.[248]

8 Constraints and Potentials for the rural sanitation project Barracão dos Mendes

8.1 Constraints for the rural sanitation project Barracão dos Mendes

- Low cooperation of the municipality in the project

The biggest obstacle for the successful implementation of rural sanitation projects is situated on the municipal level. The assumption that implementation of sanitation actions in rural areas is not urgently required due to still good water quality,[249] drags the importance for rural sanitation actions backwards. The municipality of NF does not yet present efficient controlling organisms to guarantee an adequate implementation of rural sanitation services, as the municipal environment council and the municipal technical sanitation chamber are both deployed and elected by the

[247] Interview with Jarbas Saraiva– former coordinator for infrastructure at Rio Rural/ BID advisor/ RIO RURAL employee for rural sanitation actions.
[248] Interview with Jarbas Saraiva– former coordinator for infrastructure at Rio Rural/ BID advisor/ RIO RURAL employee for rural sanitation actions.
[249] Interview with Ivson Macedo, Head of municipal secretary for environment NF.

municipality and may pursue municipal political interests. CBH R2R, being a well-organized river basin committee and an important stakeholder for water resources management in the municipality of NF, is not presented in those municipal institutions. All attempts by CBH R2R and RIO RURAL/ INTECRAL to involve the municipality of NF within the Barracão dos Mendes project resulted as difficult to date. However, the municipality of NF is the legal owner of the municipal territory and has the right on land use. Nonetheless, all the actions related to the rural sanitation project in Barracão dos Mendes were developed without any intervention of the municipality to date due to insufficient interest for rural sanitation actions. Though, in the course of the project, there will be a moment, where the municipality will have to intervene. Particularly, by acquisition of land for the construction of the wastewater treatment plant, development of the contract for the construction company, or assignation of responsibility for operation and maintenance of the constructed wastewater treatment plant.

- Willingness to pay for wastewater treatment service

The ability and willingness to pay for wastewater treatment within the community of Barracão dos Mendes might also constitute a difficulty, given that the rural population has never paid neither for water supply nor for wastewater treatment. The previous cost-benefit analysis for decentralized wastewater and sanitation technologies, realized within the INTECRAL project, resulted from "47% of the interviewees requested better wastewater treatment. Almost 70% of them are willing to pay (WTP) for improvements in their wastewater treatment system, but they were not able to set an amount of money as incomes are variable […] depending on agriculture revenues"[250]. "The limitation to establish a WWTP for sanitation improvements could be explained by three main reasons: (I) Limited income level of the population; (II) Lack of knowledge in the population related to sanitation importance; [and] (III) The population is more interested on health and infrastructure improvements"[251]. However, the necessity of sustainable sanitation systems require sustainable financing mechanisms, based on payment for the provided services. It is important to investigate whether the wastewater treatment rate calculated by the INTECRAL project, propose an economically feasible solution for the population of Barracão dos Mendes or which further solutions and subsidies can be found.

- Complex technological solution for a low income rural area

The rather complex organizational INTECRAL project structure, involving multiple stakeholders facing various difficulties and sophisticated technology for rural sanitation do not correspond entirely the PLAMSAB NF requirements for rural sanitation actions, suggested by COOPETEC, demanding alternative collective low cost solutions with low energy and maintenance costs, such as constructed wetlands and collective bio-digesters. Low cost collective sanitation technologies could be also easily operated by the community members without a special technical knowledge. Constructed wetlands, for example, can be operated by farmers, but are sensitive to high land prices. Collective bio-digesters also produce gas, which can be used for cooking and heating in the community, but show high technical and organizational complexity. However, the "simple low

[250] Segovia Sánchez, O (2014): P. 79
[251] Segovia Sánchez, O (2014): P. 79-80

costs systems" in urban nuclei in rural areas do not always fulfil the current Brazilian environmental standards thoroughly. The technological choice strongly depends on the investment, operation and maintenance costs aside from environmental requirements. Certainly, the rural sanitation project in Barracão dos Mendes is designed as a pilot project, pointing out the necessity of appropriate rural wastewater treatment solutions in rural areas of RJ and introducing an economically feasible example of best available wastewater treatment technologies, fulfilling technical and environmental standards, and also introducing an alternative option for sludge reuse.

8.2 Potentials for the rural sanitation project in Barracão dos Mendes

- The executive water agency of the Paraíba do Sul River Basin assumes the executive project in Barracão dos Mendes in order to speed up the project development and overcome the low municipal participation within the project

AGEVAP (Paraíba do Sul River Basin level) boarded the rural sanitation project in Barracão dos Mendes in order to speed up the processes and to push the implementation of the executive project. The participation of a strong and experienced water agency pushed the project process significantly in a short time. However, the implementation depends on multiple procedures interrelated with the municipal administration. AGEVAP assumed various tasks depending on the municipality of NF and CBH R2R, thus speeding up the organizational processes.

- Pilot-project opportunity

The opportunity to launch a pilot project with German decentralized wastewater treatment technology, opens access to new markets for the German project participants. Also the Brazilian rural sanitation sector benefits through implementation of the innovative technologies, while both take advantage of sharing knowledge. The framework of a pilot projects allows the implementation of different technological approaches compared to the mostly practiced solutions in Brazil, such as collective septic tanks and constructed wetlands. Furthermore, the implementation of a semi-decentralized wastewater treatment solution, provides the opportunity to prove the economic and technical sustainability of the applied technology in rural communities of RJ.

- ICMS-Verde revenue

The wastewater treatment solution in Barracão dos Mendes will contribute to the municipalities ICMS-Verde revenue. Considering the served population of 1,300 inhabitants and the secondary treatment technology provided by the project, the total ICMS-Verde revenue obtained through wastewater treatment in NF would increase by 1,1% and consequently by RS 15,780.90[252] per

[252] Calculation by INEA, RJ

year[253]. In comparison with the total ICMS-Verde revenue received by the municipality, the returns made by the rural sanitation solution, represent an insignificant amount. However, in accordance with the municipal administration, the amount gained through the wastewater treatment plant in Barracão dos Mendes could be contributed to the operation and maintenance cost.

- Agricultural reuse of sludge

The pilot project also offers the possibility of agricultural re-use of stabilized sludge, generated by the WWTP. For an agricultural area such as Barracão dos Mendes the option of sludge reuse would be an economically feasible solution contributing to additional revenues through the sale of stabilized and treated sludge as fertilizer for agricultural use, which could contribute to the reduction of operation and maintenance costs of the WWTP. On the other hand, the costs for transport and disposal of sludge in a landfill, using the infrastructure of "Agua de Nova Friburgo" could be also avoided through on-site sludge treatment. Furthermore, the reuse of stabilized sludge as fertilizer would reduce the use of agro-toxics in local agriculture, fulfilling an aim pursued by RIO RURAL for sustainable rural development. Nonetheless, the direct agricultural use of sludge from wastewater treatment is strongly restricted by the CONAMA state resolution No. 375/06[254]. Sludge can be used in agriculture only, if strict quality requirements, as stated in Art. 11 of the resolution, are met. However, considering the planned future increment of rural sanitation solutions through application of municipal basic sanitation plans, only the most cost-effective solutions would be feasible for rural sanitation and sludge management. Sludge transport to landfills could result pricier than on-site treatment, considering the large scale of rural communities to be attended. Otherwise, by disposal of stabilized sludge in landfills, nutrients, useful for agriculture, get lost. A revision of the existing sludge management state resolution would be relevant in order to find feasible solutions for future sludge management and re-use in agriculture of RJ. The rural sanitation pilot project in Barracão dos Mendes introduces the concept of sludge treatment with the aim to open a debate on the importance of sludge reuse in agriculture.

9 Course of action

9.1 Procedures

For the implementation of the rural sanitation project in Barracão dos Mendes various steps should be followed, from project planning to the wastewater treatment plant construction. The elaboration of the "projeto executivo" is a phase of the project, where various components of the work, including descriptive memorials, structural calculations, project design, technical and executive specifications, budgeting and basic schedules are clearly defined[255]. "Projeto executivo"

[254] CONAMA Lei No. 375/06: http://www.mma.gov.br/port/conama/res/res06/res37506.pd
[255] Compare: E-Civil: Projeto Executivo: http://www.ecivilnet.com/dicionario/o-que-e-projeto-executivo.html

bases on previous studies of the project area and subject, and envronmental and technical studies in order to elaborate a basic and then an executive project plan.

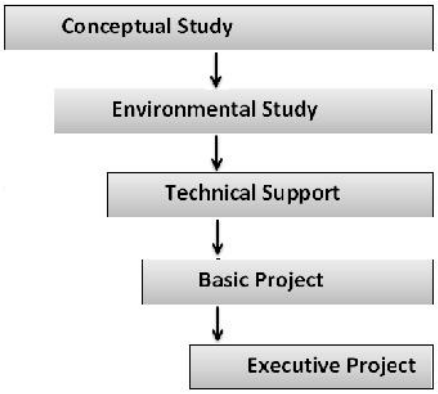


Figure 15: Elaboration steps for the sanitation executive project. Source: AGEVAP[256] (Adapted by the author).

9.1.1 Executive project plan

In general, in river basins attended by AGEVAP, the approval of the completed executive project needs to pass five administrative steps to contract a company for construction work.

1. CBH organizes a hierarchy off all localities/ communities to be attended in the project.
2. AGEVAP defines the budget for the projects.
3. AGEVAP and the participating municipalities sign a technical cooperation agreement and hand over the term of reference of the sanitation project.
4. The municipality and Caixa Economica Federal sign a contract for the tendering process for the selection of a construction company.
5. AGEVAP and Caixa Economica Federal open a tendering process for contracting a company for the implementation of the project through the municipality.[257]

In case of the rural sanitation project in Barracão dos Mendes, the procedures for the approval of the executive project, involving the municipality, advanced very slowly due to the lack of interest on the municipal level. After CBH R2R approved around RS 100,000[258] for the Barracão dos Mendes project, AGEVAP (Paraíba do Sul River Basin level) overtook the executive project realization. In order to bring forward the implementation in Barracão dos Mendes, AGEVAP overtook all the project responsibilities of the municipality of NF.

9.1.2 Land acquisition

However, the plot for the future wastewater treatment plant in the community of Barracão dos Mendes needs to be chosen in agreement with the municipality of NF.

[256] AGEVAP: Manual de Referencia: P.6
[257] According to the interview with Andre Bohrer– AGEVAP nucleus Rio Dois Rios River Basin.
[258] According to the nterview with Jarbas Saraiva– former coordinator for infrastructure at Rio Rural/ BID advisor/ RIO RURAL employee for rural sanitation actions

Map 12: Barracão dos Mendes. Source: BDZ e.V.

The area selected by the project for the installation of the wastewater treatment plant (WWTP) is an area of permanent protection (APP) and cannot be used for agricultural production. According to the Modification of the Brazilian Forest Code (Novo Codigo Florestal), wastewater treatment plants are allowed within APPs. After the environmental agency (INEA) undertakes a hydrological calculation to confirm, that the plot does not belong to a flood zone, INEA grants a licence for the construction of the planned wastewater treatment plan. [259]

In case the plot is public land (municipal, state, federal), only a permit for construction from the corresponding government is necessary.

9.1.3 Construction

After the approved executive project, land acquisition and designation of a construction company through a public tender by AGEVAP, Caixa Economica Federal and the municipality of Nova

[259] In case that the plot selected for the construction of the WWTP is a private property and the owner is not willing to sell, the plot can be expropriated by the municipality. The municipality issues a decree, defining that the area to expropriate is an area of public interest and explain the reasons for expropriation. After the expropriation, the owner becomes a note from the municipality and receives a payment (which is usually below the actual market value). In case the plot owner wants to charge the municipality with the expropriation, a legal process against the paid-off value for the expropriated plot, but not against the expropriation can be initiated.
For instance, in case the selected plot is major than the area needed for WWTP construction, but the WWTP prevents the access and / or use of the remaining property, the entire property needs to be purchased or expropriate or donated. Also the municipality needs to possess sufficient budget for purchasing the land for the WWTP. The municipality need to have an assigned value for land acquisition in the municipal annual budget; surplus of annual funds or use the "residual value" for emerging actions. Otherwise, the municipal government would need to wait till the next year in order to assign budget for the land acquisition for the construction of a WWTP.

Friburgo, the construction of the WWTP can commence. INEA acts as an environmental agency issuing permits and licences.

9.2 Alternatives for operation and maintenance of the wastewater treatment plant in Barracão dos Mendes

The major challenge of the rural sanitation project in Barracão dos Mendes is to assign the responsibility for the operation and maintenance of the WWTP. Thus, several options will be presented in the following chapter. The municipality of NF has the responsibility to find proper solutions for the operation and maintenance of the WWT in Barracão dos Mendes, as it is responsible for all the sanitation actions within the municipal territory. However, the municipality of NF was not involved in the project development from the beginning, which makes the assignment of responsibility to the municipality rather difficult. The solution for operation and maintenance of the WWTP in Barracão dos Mendes will have to be found in a negotiation process between the municipality, AGEVAP, INTECRAL/RIO RURAL, sanitation service provider "Agua de Nova Friburgo" and the community of Barracão dos Mendes. The role of the municipality is nevertheless crucial in the negotiation and decision making process.

The operation and maintenance of the WWTP Barracão dos Mendes needs to be defined within the executive project plan. Generally, operation and maintenance of a WWTP can be executed by the municipality through municipal sanitation technicians or the municipality negotiates the operation and maintenance of the WWTP with the sanitation service provider. AGEVAP offers another alternative by pledging to assume the responsibility for technical training of the operation staff of the WWTP for two following years after the construction. Technical training for the operation of the WWTP by AGEVAP can be given to municipal technicians, technicians of "Aguas de Nova Friburgo" or community members of Barracão dos Mendes can be trained as WWTP operators. Considering the distance to travel to the wastewater treatment plant and the associated costs, it can be assumed that the operation of the WWTP by the community members is a more feasible solution. However, the maintenance of the WWTP needs to be undertaken by higher skilled and specialized technicians. Certainly, PLAMSAB NF will define the responsibility of the operation and maintenance of collective alternative rural sanitation solutions by assigning municipal technicians or transferring it to the service provision concessionaire. Prior to that, taking into account the absence of specialized sanitation technicians on the municipal level, the responsibility of WWT maintenance in Barracão dos Mendes needs to be transferred to "Aguas de Nova Friburgo" through an addition to the existing concession contract. Therefore, the control of a proper service provision of the wastewater treatment service would be undertaken by the municipal technical sanitation chamber.

The complete adoption of the WWTP in Barracão dos Mendes by the municipal service provider "Aguas de Nova Friburgo" would be a further operation and maintenance option. In this case, the WWTP would be handed over to a private company under the condition to take responsibility of full maintenance and long term operation. The concessionaire would gain a new technology and will be able to charge for the provided service without having made initial investments. Considering that the maintenance cost of the planned technology are low, the taking over of the WWTP in Barracão dos Mendes might represent a cost-effective solution for the concessionaire.

However, the overtaking of the WWTP in Barracão dos Mendes by “Aguas de Nova Friburgo” will need to be negotiated and determined within an additional contract. The tariffs charged by the concessionaire in this case will need to be adjusted by the regulating agency in order to provide fair prices for the community, when PLAMSAB NF enters into force.

In a previous project meeting in 2014, the municipality of NF considered the possibility to negotiate with “Aguas de Nova Friburgo” the maintenance of the WWTP in Barracão dos Mendes. The most feasible option would be to generate a partnership between the community of Barracão dos Mendes, AGEVAP, the municipality of NF and “Aguas de Nova Friburgo”, in order to provide a long lasting sustainable operation and maintenance of the WWTP. The solution must be developed within a negotiation process with all the stakeholders involved.

Another challenge regarding the operation and maintenance of the WWTP in Barracão dos Mendes is the sludge disposal. Sludge disposal can be operated using the existing infrastructure of “Agua de Nova Friburgo”, where the stabilized sludge is brought to a central landfill. Thereby, many processes linked to sludge disposal, such as monthly payments for landfill disposal, tariff collection system etc, would be facilitated and optimized. Though, sludge management through “Aguas de Nova Friburgo” might generate additional costs, which will be needed to be passed to the community end users. Alternatively, treated sludge, which contains organic nutrients, could be used as a fertilizer in an agricultural region such as Barracão dos Mendes. However, agricultural use of sludge is restricted and the within the project selected technologies do not fulfil the required quality standards. Though, the framework of the pilot project can be used as a basis for discussion for the modification of the existing quality parameter to develop a new legal framework for reuse of stabilized sludge in agricultural practices. Also an additional technological solution for high quality sludge suitable to the requirements of the CONAMA resolution No. 375/06 can be introduced within the pilot project. The on-site sludge treatment would reduce transportation and landfill disposal costs, generate income for the community through organic fertilizer (hummus) production and consequently lead to the reduction of agro-toxics.

9.3 Possible wastewater treatment payment mechanisms

For the urban nucleus in rural areas, the most convenient way to finance collective sanitation solutions, is dividing operation and maintenance costs within the community to secure the sustainability and durability of the sanitation technologies. The introduction of service fees comes with the introduction of a fee collection system. In order to make the fee collection and payment system more efficient and cost effective, the introduction of economies of scale would be a considerable solution.

The economic and management sustainability is an important component of the rural sanitation project in Barracão dos Mendes. Within the INTECRAL project the annual operation and maintenance costs, as well as reinvestment costs for the entire wastewater treatment technology were calculated and transferred to the number of inhabitants and households in the community in order to determine a tariff, which ensures a sustainable service infrastructure. The social tariff offered by the municipal sanitation service provider “Aguas de Nova Friburgo” for low income users, was taken as reference for the comparison of wastewater treatment tariffs. The most favourable wastewater treatment tariff provided by the concessionaire amounts to RS 0.58 per

m³. The wastewater treatment tariff in Barracão dos Mendes costs RS 0.55 / m³ relating to a waste water volume of 220 l/ (PT per day), and represents a lower price than the social tariff in NF.

Further cost estimates showed that operating costs for both, local treatment as well as sludge disposal in the central landfill in Nova Friburgo, do not show significant differences. However, the financial benefits of the substitution of fertilizers were not considered in the project calculations.[260] The WWTP of Barracão dos Mendes will not have the same parameters for the tariff calculation as the conventional water supply and WWTPs in NF because of two reasons: First, there will be no initial investment into the construction and infrastructure building of the WWTP on the part of the service provider ("Aguas de Nova Friburgo or municipality). The costs would be reduced by maintenance (or operation and maintenance in case that "Aguas de Nova Friburgo" assumes the full responsibility for the WWTP). And second, a particular wastewater treatment tariff, separated from the water supply tariff needs to be introduced, as a wastewater treatment tariff is always bound on water supply to date, which hinders the fair calculation for a separate wastewater treatment price in many rural communities in RJ.

Also the amount gained through the tax revenue from ICMS-Verde can significantly contribute to the reduction of the wastewater treatment costs of the community. Through the ICMS tax revenue generated by the WWTP in Barracão dos Mendes, the annual maintenance and operation costs would be reduced to 60% based on calculations developed by INEA. However, the possibility that ICMS tax revenues return to the community of Barracão dos Mendes needs first to be negotiated with the municipality of NF.

To support low income rural communities in payment for sanitation services, municipal, state or federal subsidies can be introduced. On the municipal level, rural sanitation subsidies can originate from the municipal environmental fund (fundo municipal de meio ambiente), created as part of the municipal environmental system. As the municipal environmental system is linked to the federal environmental system, a top down approach for rural sanitation subsidies can be created.

10 Discussion and conclusions

10.1 Case study based conclusions

There are no unique solution for rural sanitation projects due to the differences and peculiarities of preconditions and factors of each region, project and stakeholders involved. The INTECRAL rural sanitation project was developed as a German-Brazilian academic research project in cooperation with the state program RIO RURAL. The implementation of the pilot wastewater treatment plant will need to be undertaken within the framework of a separate project as INTECRAL did not designate resources for the WWTP construction. The development and the success of the project will depend on the joint action of the involved stakeholders, such as the municipality, AGEVAP, CBH R2R, RIO RURAL, "Aguas de Nova Friburgo", and availability of funding for the project realization from both, the German and the Brazilian site.

[260] Böttger S., Cardona J., Saraiva J. and Prata Filho D. (2014).

The theoretic case study underlines the importance of the municipal involvement for the successful implementation of the rural sanitation project in Barracão dos Mendes in all project spheres: from the executive project development to land acquisition, to the operation and maintenance and development of financing mechanisms. On the other hand, the intervention of AGEVAP, operating as an enforcing and executing institution within the project emphasized the need for the introduction of supporting organisms for the progress of the rural sanitation sector.

The INTECRAL project also stressed the importance of rural sanitation actions through non-governmental institutions due to the lack of cross-level governmental solutions and underlined the necessity of the integration of all the sanitation sector stakeholders into the project in order to find a common feasible long term solution. However, the issue of operation and maintenance of such projects resulted as the most challenging one and requires regulation in advance.

The case study highlighted the importance of the introduction of a tariff system to provide long term sustainability of the sanitation service provision in rural areas. For low-income rural communities with low ability to pay for sanitation service provision, there is a need for the development of particular sustainable financing mechanisms, such as subsidies and tailored tariffs. Especially on the municipal level, the ICMS-Verde tax revenue increases the municipalities' income through wastewater treatment and consequently favours the implementation of collective rural sanitation solutions. ICMS-Verde tax revenue can be used by municipalities to subsidize the rural sanitation sector without cutting the municipal budget.

The study in Barracão dos Mendes also showed the need for a particular wastewater treatment tariff, separated from the water supply tariff. Especially in rural communities, where wastewater treatment measures have priority to drinking water supply, the ligation of the water supply tariff to the wastewater tariff hinders the fair calculation for a separate wastewater treatment price in many rural communities in RJ. Additionally, the pilot rural sanitation project also introduced the option for agricultural sludge reuse as a financially rewarding alternative for the rural sanitation sector.

10.2 Major findings

This study identified the institutional setting for the rural sanitation sector in Brazil, in the state of Rio de Janeiro and in the municipality of Nova Friburgo, where the rural sanitation case study was undertaken. The analysis covered a broad range of institutions due to the lack of an overall integrative national rural sanitation policy and a deficient institutional division between the rural and urban sanitation sector. On the federal level, FUNASA is responsible for municipalities with population below 50.000 inhabitants and the Ministry of Cities for municipalities with over 50.000 inhabitants. However, in the state of RJ, both institutions serve only urban areas. In general, it can be said that there is a great discordance regarding the responsibility for the rural sanitation sector on all governmental levels. Despite from scattered national, state and private institutions driven sanitation actions, the responsibility for rural sanitation was transferred from the federal to the municipal level by the Sanitation Law, so that all sanitation activities need to be included within municipal basic sanitation plans. However, municipalities struggle on the deficiency of financial resources, know-how and environmental consciousness, also prioritizing urban to rural sanitation and lacking technical and financial support. The study revealed that the rural sanitation sector is not covered on the national level, given that the national rural sanitation policy by FUNASA is not

yet developed. The most municipal basic sanitation plans are also in a development stage and need to be finished until the end of 2015. However, the completion of the municipal basic sanitation plans does not assure the correct and adequate implementation. Additionally, despite of the civil society control mechanisms, which are still weak in Brazil, there are no controlling and monitoring mechanisms for adequate and long term implementation and functioning of the sanitation plans on higher governmental level. Brazil has a firm sanitation legal framework, where no significant overlapping could be located within this analysis. The absence of overlapping can be particularly ascribed to the insufficiency of rural sanitation actions across all the governmental levels. However, there is a lack of organisms, which enforce the implementation of the existing rules. Some weak points of the legal framework could be determined in the domains of water losses and domestic wastewater and sludge reuse.

The indistinctness around rural sanitation on the governmental levels was also evident on the rural sanitation project level in the community of Barracão dos Mendes. The importance of municipal intervention and political goodwill for the advance of rural sanitation was strongly emphasized within the project in Barracão dos Mendes. Also the relevance of supporting and enforcing institutions for the rural sanitation progress was highlighted through the intervention of AGEVAP within the project development process. The creation[261] of supporting and control mechanisms for long term implementation and operation of rural sanitation solutions is therefore crucial for the successful development of the Brazilian rural sanitation sector.

10.3 Conclusions

Brazil struggles currently with numerous environmental challenges such as industrial pollution, deforestation, soil erosion and droughts. However, the most urgent challenge in the field of water resources management remains domestic wastewater being the most important factor for pollution of rivers. Despite the recent national political focus on water sources protection, which underlines the importance of rural areas as water sources for urban centers, the environmental politics continue to privilege urban sanitation first. Additionally, rural polluters are spread and dispersed, and therefore possess low purchasing power and political concern. Nevertheless, it is arguable, if solving urban sanitation problems first, will facilitate rural sanitation: Water resources are at a continuous flow, bringing untreated polluted water from rural areas to the urban water treatment plants, and emitting urban wastewater to the rural areas downstream. As long as there is a lack of a uniform, nationwide rural sanitation policy, alternative rural sanitation solutions are strongly required. Urban sanitation in Brazil might depend intensively on governmental solutions; though rural sanitation depends commonly on public incentives run by private initiatives, NGOs, institutes, universities and associations working together with governmental institutions.

The development of a nationwide rural sanitation program covering the entire sector is a challenging assignment: Brazilian rural communities experience strong economic, social and environmental issues to a greater or less extent, depending on the respective region. The success and the feasibility of rural sanitation programs depend on attending various dimensions of economic, social, political, cultural, ethical and environmental sustainability, which require wide

[261] There is no necessary need for creation of new supporting and controlling institutions. The responsibility can be allocated within the existing institutional setting as explained in the chapter 6.2.

education and empowerment of the rural population. Consequently, Brazil would need to change the holistic political approach towards rural development, which considering the country's orientation on economic growth and rural development to date, is unlikely to be expected.

However, Brazils' water and sanitation politics are recent ongoing with still developing infrastructure - water use fee charges, CBHs, water, environmental and regulating agencies - are at the outset. The Brazilian sanitation legal framework leaves space for initiative action while institutional setting shows gaps, which can be filled through restructuring, formation and specialization of the existing institutions. However, the development of the Brazilian rural sanitation sector depends strongly on the enforcement of long-term orientated and strategic policy measures and correspondingly, continuous funding.

10.4 Further research demands

This study brought up various questions, which could not be fully embraced within the scope of the analysis and need to be further researched within continuative studies. Following challenges, addressed within this thesis could be approached:

- Supporting institutions for the rural sanitation sector

There is a need for creation of new supporting institutions to support municipalities to overcome their difficulties to develop, finance and implement basic sanitation plans and develop appropriate rural sanitation activities within the municipal basic sanitation plans. The institutional and legal possibilities as well as the economic feasibility would form an interesting topic for further studies.

- Possible control mechanisms for the sanitation sector

Also the research on the possible control and monitoring mechanisms for the implementation and long term operation of sanitation solutions needs to be deepened within the Brazilian institutional setting. The possibility to integrate regulating and environmental agencies within the sanitation sector and extension of their field of activity needs to be investigated from the institutional, legal and economic point of view.

- Expansion of the regulation on the rural sanitation sector

PLANSAB determines regulating organisms for the regulation of sanitation services. As rural sanitation is part of the municipal basic sanitation plans, the possibility that regulating agencies, responsible for the regulation of the municipal sanitation services, also assume the regulation of the sanitation service provision in rural areas. Institutional, legal and economic feasibility of this approach needs to be investigated.

- Financing model for rural sanitation service provision

The rural sanitation sector requires the implementation of a particular financing model in order to provide economic feasibility and sustainability of the service provision. The development of a municipality driven model through creation of a new municipal tax, or integration of the ICMS-Verde tax revenue would be interesting within the future investigation scope. However, this subject could not be sufficiently addressed within this work and needs to be approached in a distinct study.

- Incentives to advance the rural sanitation sector

There is a need for the development of new incentives and advancement of the existing ones in order to bring forward the rural sanitation sector. The enhancements of the PES for the Brazilian rural sanitation sector, for instance, would be an interesting model for the future research. Also the creation of new economic and environmental incentives would have a significant importance for the development of the sector and require further investigation.

- Integration of wastewater and sludge reuse

The case study in Barracão dos Mendes introduced the possibility of sludge reuse in agriculture in rural areas. An analysis to compare the costs and benefits of sludge disposal in landfills and the reuse in agriculture, fulfilling the environmental standards, would pursue the purpose of this study.

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ANNEX I: Interview partners

Federal and State Level	Position	Name
National Water Agency (AGENCIA NACIONAL DE AGUA) - - ANA	Superintendence of resources management support by ANA (Superintendência de Apoio à Gestão de Recursos da ANA)	Osman Fernandes da Silva
National Health Foundation (Fundação Nacional da Saúde) - FUNASA	Coordination of Sanitation and Edifications in Special Areas (Cosan) by FUNASA (Coordenação de Saneamento e de Edificações em Áreas Especiais (Cosan))	Juliana de Senzi Zancul

State Level	Position	Name
State Institute of Environment (Instituto Estadual de Ambiente – INEA	Representative of the Water Management and Territory Director at INEA (Representante da Diretora de Gestão das Águas e do Território	Moema Versiani Acselrad
AGENERSA - Regulatory agency for energy and sanitation of the State of Rio de Janeiro	Civil Engineer, employee of AGENERSA, manager of the Solid Waste Chamber	Pedro Alexandro Pequeno
State Council for Water Resources of the State of Rio de Janeiro – CERHI	President of CERHI, executive director of CBH Guandu	Decio Tubbs Jr.
National Health Foundation (Fundação Nacional da Saúde) - FUNASA	Representative of the FUNASA superintendent, RJ	Cláudio Manoel de Faria Moreira
Program RIO RURAL	• Adriano Lopes, employee by Project RIO RURAL/ • Jarbas Saraiva– former coordinator for infrastructure at Rio Rural/ BID advisor/ former RIO RURAL employee	• Adriano Lopes • Jarbas Saraiva

	for rural sanitation actions.	
Program PSAM (Environmental Sanitation Program for the Surrounding Municipalities of the Guanabara Bay)	• Eloisa Torres, coordinator of municipal sanitation policies, COPSA, program PSAM, State Ministry of Environment RJ • Victor Zveibil, Consulter of the SCC consortia, Secretary of Environment RJ	• Eliosa Torres • Victor Zveibil

Municipal Level	**Position**	**Name**
Municipality of Nova Friburgo	Sub-secretary for urban planning within the municipality of Nova Friburgo, also member of CBH Rio Dois Rio, also representative of ONG CECNA (within the CBH R2R, as representative of CECNA)	Viviane S. Gomes Melo
Secretary of Environment and Urban Development of Nova Friburgo	Municipal Secretary of Environment and Sustainable Urban Development, Nova Friburgo.	Ivson Macedo,
Water supply and wastewater treatment service provider of Nova Friburgo “Aguas de Nova Friburgo”	Superintendent of “Aguas de Nova Friburgo”	Christian Portugal

River Basin Level Institutions	**Position**	**Name**
Water Agency of Paraíba do Sul – AGEVAP	• André Luis de Paula Marques, President of the water Agency of Paraíba do Sul River Basin, AGEVAP • Juliana Fernandes, Water Resources Manager by AGEVAP	• André Luis de Paula Marques • Juliana Fernandes
River Basin Committee R2R	President of CBH Rio Dois Rios	Licius de Sá Freire
AGEVAP nucleus R2R	AGEVAP nucleus Rio Dois Rios River Basin (UD3)	André Bohrer Marques

Cross-level and indirect Stakeholders	Position	Name
Areas of Environmental Protection – APA	Head of state APA Macae de Cima/ INEA, RJ.	Victor Niklitschek Urzua
State Nature Park “Tres Picos”	Forrestal engineer, administrator of the State Nature Park “Tres Picos”	Maria Manuela Alves Lopes

Civil Society Organizations	Position	Name
Project Coordination, Research and Technology Studies Foundation – COOPETEC	• Iene Christie Figueiredo/ COOPETEC/ professor at the UFRJ • Osvaldo Rezende, postgraduate, COOPETEC/ UFRJ Both working on the development of PLAMSAB NF	• Iene Christie Figueiredo • Osvaldo Rezende
Instituto Terra de Preservação Ambiental” – ITPA	Technical manager at ITPA	Abilio Vilela Neto
Instituto Trata Brasil	Executive director of Instituto Trata Brasil	Edison Carlos

Experts of the Water and Sanitation Sector	Position
Rosa Maria Formiga Johnsson, PhD	Professor at UFRJ, former Director of Water and Land Management Department, RJ, inter alia
Francisco José Vela, PhD	WWTP project planning company “Aquarum”, SP

ANNEX II: Questionnaire

Questionnaire

1) What is your involvement with rural sanitation, in particular with the wastewater treatment in rural areas?

¬ organizational involvement

¬ financial involvement

¬ institutional involvement

¬ responsibility by law

¬ implementation of control mechanisms

2) What does a rural community need in order to implement and operate a decentralized wastewater treatment system? (Procedures)

- Which institutions would be involved in the decision-making process and achievement?

- What would be the economic incentives for wastewater treatment solutions in rural areas?

3) Are there any ongoing reforms in the rural sanitation sector?

4) Financing mechanisms

- Which opportunities do exist for financing of decentralized sanitation solutions in rural communities?

- Which financing model is the most feasible for the rural sanitation in the future in your opinion?
- Are there plans to establish a tariff structure for sanitation services in rural areas in the future?