

The Integrated Management of the Water Resources and Water Supply in the Metropolitan Region of Goiania

Gabriela Nogueira Ferreira da Silva, Celene Cunha Monteiro Antunes Barreira, Maurício Martines Sales, and Elaine Barbosa da Silva

Federal University of Goias, Brazil

Abstract: The populational growth and the increase in consumption cause a rise in the water demand. These factors have for consequences a greater pressure in the sources of public supply, especially in metropolitan regions, that have more population, services, and equipments what, consequently require a more complex management. In these spaces, it is important that the water resources studies happen in an integrated way with the municipalities. Once that, water supplying is a public function of common interest and, any activity or service done for a determined county can cause impact at other counties. In this context, this paper aims to analyze the integrated management of the water resources particularly in the water supply systems in the Metropolitan Region of Goiânia (MRG), located in the State of Goias, Brazil. For this purpose it is done a bibliographic review of the main concept and also a information gathering about the legislation that deals with metropolitan environments and water resources for urban supply. Census data and quantitative data are extracted from official sources available at Brazilian Institute of Geography and Statistics (IBGE), National Information System in Sanitation (SNIS) and National Water Agency (ANA). The analytical and descriptive study and its spatialization allow to observe the trend for investments in underground water collection systems. Of the twenty county members from the MRG, six have a satisfactory water supply system and 14 need adjustments to the existing systems. In relation to urban water supply, 18 counties have water supply above 90%, and the counties of Hidrolândia and Aparecida de Goiania have the lowest water supply rates. Water production systems are generally isolated and the counties do not have projects that are looking forward to integrating them. The exception is the integrated systems of Meia Ponte System and Mauro Borges System that supply Goiania, Trindade and Aparecida de Goiania.

Key words: water supply, integrated development, metropolitan region, integrated management

1. Introduction

In the city, the water, as a vital and economic resource, is used as a fundamental factor of the public health and economic development. Both the roles build a spacial specific organization and constitute administrative, technical, and financials centers, which establish a functioning network in the forms of pipes, water reservoirs, dams, plants, among other structures. The urbanization is a complex and contradictory social process. This process is characterized by the increase of the social, economical and, political relationships.

Corresponding author: Gabriela Nogueira Ferreira da Silva Beltrão, Ph.D. Student; research area/interest: urban planning. E-mail: gabriela.nfs@gmail.com.

The need of physical and social infrastructure is to ensure the production, the circulation, the control, the decision and the consumption of the urban life [1].

The consumer society confiscates natural resources to be incorporated for generating merchandise. It admits, without questioning, the private appropriation of the natural basis of the Earth, which allows the construction of the human existence [2]. The water crisis has a geographical eminently character, once that it is the result of unequal distribution through the planet that, in turn, does not follow economical, cultural or, political requirements. This crisis also must be associated with the growing demands for natural resources. It is provoked by the development of the capitalist method of production and the reduction of the

available water has been focus of discussions in the scientific medium. The necessary base for life reproduction was transformed in property, and this perspective is being driven toward the water, through privatization and distribution [3].

Water is a source of wealth and conflict. The metropolitan regions consist of territories whose characteristics of growth, uses of natural resources and infrastructure require, besides specific studies, guidelines, that are capable of indicating a type of development that allows better growth for all the municipalities without distinction [4].

In the Brazilian case, the country has a big water availability, unequally distributed in relation to its population density and *per capita* demand. On average, about 260 000 m³/s of water flows through Brazil, it corresponds to 53% of the total South American continent freshwater production and 12% of the world. Although being abundant, about 80% of this total is in the Amazon region, where the smallest population lives and the water demand is lower. The hydrography of the country is divided in 12 regions as a way to support planning on a national scale. In addition to hydrological logic, the administrative political organization has a decisive impact on water management, with the States even being geographically connected and having different characteristics regarding the quantity and quality of surface waters [5]. Some of them have a fundamental role in the delivery of water, because in their territories are located sources of important water courses that penetrate the limits of other States. In this situation, the States of Minas Gerais and Goiás are examples. Other States receive and make use of water from other supplier States, such as Rio de Janeiro and Bahia [6].

The urban water supply service in Brazil, including production and distribution, is offered predominantly by state sanitation companies (in 69% Brazilian municipalities), besides municipalities groups and private sector companies, constituting one of the components of basic sanitation as determined by law

11.445 of 2007, that established the national guidelines for basic sanitation. The coverage of the urban supply service has been stabilized in Brazil over the last 5 years by around 93%, but this high coverage rate does not necessarily mean an assured supply of water, that is, water availability of the water source.

National Water Agency data (2017) shows that among Brazilian townships, 58% use superficial water resources predominantly for supply, while 42% has, in underground spring, their main sources. Considering the great urban centers of the country, the representativeness of surface water sources is even greater, with 69% of the water source used corresponding to the superficial water bodies and, only 31% of underground spring. The underground water springs can be considered strategic reserves and represent important alternatives in critical situations. These uses of water sources have been growing over the last few years in the country due, among other factors, to the recent water crises, which affect the surface water resource more intensely.

The current management of water resources in Brazil is based on Federal Law 9.433, 1997, which establishes the National Water Resources Policy and creates the National System for Water Resources Management. That has as an objective to ensure water in quantity and quality, rational and integrated use in a sustainable manner and the prevention and defense against critical hydrological events. The Law 9.433 indicates that the watershed is the territorial unit for the implementation of the National Water Resources Policy and performance of the National System for Water Resources Management, being defined as an area of natural abstraction of the rainfall that converges flows to a single point of exit. Considering that municipal administrative boundaries are often not linked to this physical territorial division, that is, they do not coincide with the river basin the shared management of common goods in metropolitan regions can contribute to reinforce actions to protect water sources for public water supply [7].

In metropolitan areas, the water supplying happens in integrated systems, where a group of municipalities share the same water production system. National Water Agency data (2017) shows that the integrated systems are also used for the supply of other large urban agglomerations of the country, as Belo Horizonte, Recife, Fortaleza, Curitiba, Salvador, Vitoria, Brasilia, Goiania and Belem, and many townships in the Brazilian semiarid due to the low water availability of local springs. Thus, 48% of the Brazilian population is served by integrated systems and 52% by isolated systems.

The Federal Law 10.257, 2001 [8], known as the City Statute, regulates articles 182 and 183 of the Federal Constitution of 1988 [9] establishing general guidelines for urban policy. The City Statute establishes rules of public order and social interest that regulate the use of urban property for the collective good, security and well-being of citizens, as well as environmental balance, aiming to order the full development of the social functions of city and urban property, through right to sustainable cities.

The urban policy instruments foreseen in the City Statute are administered by its own legislation and those that demand resources from the municipal public power must be subject to social control, ensuring the participation of communities, movements and civil society entities. The instruments are: national, regional and state plans and economic and social development plans; planning of metropolitan regions, urban agglomerations and microregions; municipal planning; tax and financial institutes; legal and political institutes and Environmental Impact Assessment (EIA) and Neighborhood Impact Assessment (NIA). In relation to municipal planning we have the discipline of land use planning, land use and occupation, environmental zoning and the master plan as examples of instruments

The approval of the Metropolitan Statute, as agreed by law 13.089, 2015 [10], simultaneously indicates challenges and possibilities for the management of water resources. This Law is a complement to the City

Statute by incorporating the concept of metropolis into urban and regional planning discussions. Although the City Statute has provided precious tools for municipal planning, social use of urban property and democratic management of cities, the term regional development remained absent. The Metropolitan Statute presents an Integrated Urban Development Plan, which should cover urban and rural areas, and should be reviewed every 10 years. This Statute should respect the principle of sustainable development through a interdepartmental governance structure.

The metropolitan regions consist of territories whose characteristics of growth, use of natural resources and infrastructures require, besides specific studies, guidelines that are capable of indicating a type of development that allows a better improvement for all municipalities without distinction. The Statute defines the management and execution of Public Functions of Common Interest (FPIC), among which are included the promotion of sustainability. Although this term is presented in a generic way, it is permeated by the need of water source catchment for supplying human consume. According to the Metropolitan Statute, the responsibilities and actions relating to FPIC must be shared amid metropolitan municipalities. Therefore, only through the establishment of interfederative governance of the metropolitan regions can create conditions for achieving full management of the metropolitan space [11].

In this context, this paper aims to analyze the integrated administration of the water resources, especially water supply systems in the Metropolitan Region of Goiania, located in Goias State, Brazil. The methodological procedures used for the development of this research consisted of a theoretical background review and bibliographical and documentary research in an exploratory and descriptive manner. For this purpose it is done a bibliographic review of the main concept and also a information gathering about the legislation that deals with metropolitan environments and water resources for urban supply. Census data and

quantitative data are extracted from official sources available at Brazilian Institute of Geography and Statistics (IBGE), National Information System in Sanitation (SNIS) and National Water Agency (ANA).

2. Characterizing the Study Area

Institutionalized by the Complementary Law 27, 1999, the Metropolitan Region of Goiania (Fig. 1), is

currently constituted by 20 counties and it is localized in Goias, Brazilian central-west. The municipalities that compose the region are: Abadia de Goias, Aparecida de Goiania, Aragoiania, Bela Vista de Goias, Bonfinopolis, Brazabrantes, Caldazinha, Caturai, Goianapolis, Goiania, Goianira, Guapo, Hidrolandia, Inhumas, Neropolis, Nova Veneza, Santo Antonio de Goias, Terezopolis de Goias and Trindade.

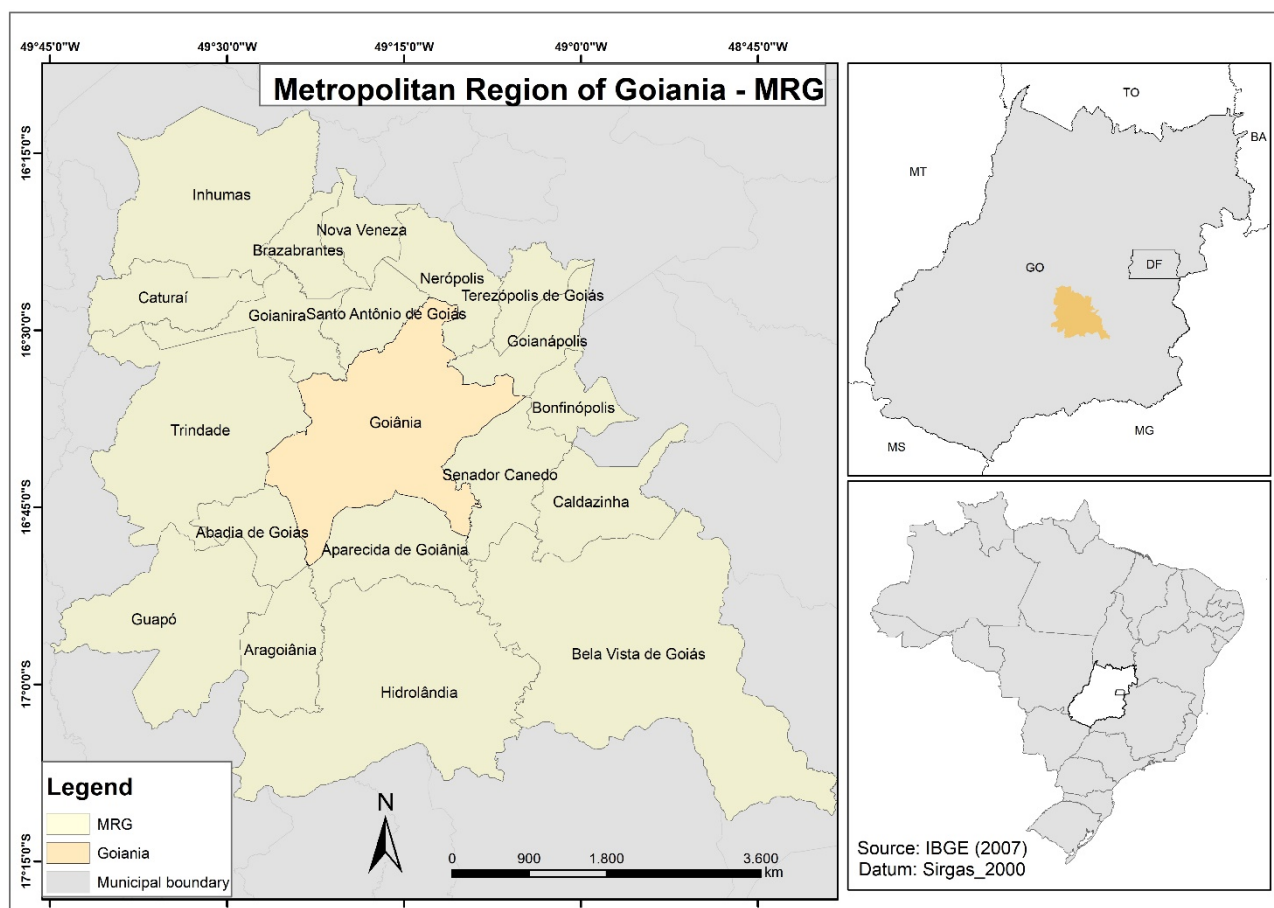


Fig. 1 Localization map of the study area.

The MRG added a population of 2,173,141 inhabitants in 2010, which corresponds to 2/3 of the State population, in an area of 7,315 km². With an urbanization degree of 98%, the region population corresponds to 36.2% of the State total. Only the main county, Goiania, which is also the State capital, has approximately 60% of the region entire population. Only four municipalities — Goiania, Aparecida de Goiania, Trindade and Senador Canedo — concentrate

about 90% of the population of the metropolitan agglomerate, more than 2.5 million inhabitants [12].

The metropolitan region of Goiania is characterized by being inserted in an area of Savana, which is composed of a vegetational complex presenting phytophysionomies that include forest formations, savannas and pastures. Important emphasis may be given to formations along the waterways, such as gallery forests, riparian forests and paths. All these forest formations play an important role in the

protection of springs, both in rural and urban regions. In the RMG these areas are quite degraded, due to the suppression of the original vegetation for other uses of the soil.

Although the land use in the RMG is diverse, there is predominance of pasture (49%), with remnants of vegetation accounting for less than 25% of the total area, including Permanent Preservation Areas (PPAs). This dynamics of land use and pressure, mainly for urban purposes (in installments), has resulted in the suppression of the native Savana, with special impact on Permanent Preservation Areas along the waterways and areas bordering the road axes [13].

3. Results and Discussions

In the Metropolitan Region of Goiania, the Goias Sanitation Company (Saneago) supply 19 municipalities offering treated water. The exception is the municipality of Senador Canedo, whose service is under the responsibility of the Senador Canedo Municipal Sanitation Company and Aparecida de Goiânia and Trindade, where the services of collection, removal and treatment of sewage are executed by private company, the Odebracht Ambiental. Most of the municipalities have as main source of water catchment that comes from the Rio Meia Ponte and its tributaries.

The water supply in the MRG is realized by superficial (direct capture) and underground capture systems. Data from the environmental diagnosis aspects presented by the Environment, Water Resources, Infrastructure, Cities and Metropolitan Affairs Secretay (SECIMA) and Federal University of Goias (UFG), point out that, of the 20 MRG municipalities, 4 municipalities are supplied exclusively by underground catchment (Bonfinopolis, Goianira, Nova Veneza e Santo Antonio de Goias). The counties of Aragoiania, Caturai and Terezopolis de Goias have only superficial abstraction. The other counties, Abadia de Goias, Aparecida de Goiania, Bela Vista de Goias, Brazabrantes, Caldazinha,

Goianapolis, Goiania, Guapo, Hidrolandia, Inhumas, Neropolis, Senador Canedo and Trindade have mixed abstractions, that are, superficial and underground. Water production systems are generally isolated and municipalities do not have projects that seek to integrate them. The exception of integrated systems is in the Meia Ponte System and Mauro Borges System that supply Goiania, Trindade and Aparecida de Goiania.

The systems of Goiania, Aparecida de Goiania and Trindade are supplied by the River João Leite reservoir, thus forming an integrated system (direct capture). There are 324 underground catchment deep wells destined to the public supply are under the management of the Goias Sanitation Company (Saneago), covering the period from 1980 to 2016.

Of the 20 counties participating the MRG, 6 have a satisfactory water supply system and 14 need adjustments to the existing systems (Fig. 2). In 13 municipalities of the MRG the urban water service index is 100%. Only the counties of Aparecida de Goiania and Hidrolandia have rates below 90%, with 76.05% and 88.71%, respectively. This shows that the water supply coverage in the MRG (97.7%) is above the national average, wich is 93%. The average loss index in the distribution is 28.4% for the MRG.

According to the municipal Master Plans interpretation, there was a clear tendency for the civil society participation in the elaboration and execution of these plans. The terms participative management and democratic management appear at all Master Plans. The integration, specifically related to the systems of water supply and water resources preservation, is mentioned only in the municipal Master Plans of Bonfinopolis and Caldazinha.

4. Conclusion

From the data analysis, it was verified that the water producing systems of the MRG are majoritarilly isolate, and the municipalities do not have any projects that seek to integrate them. Although, water supply is above

The Integrated Management of the Water Resources and Water Supply in the Metropolitan Region of Goiania

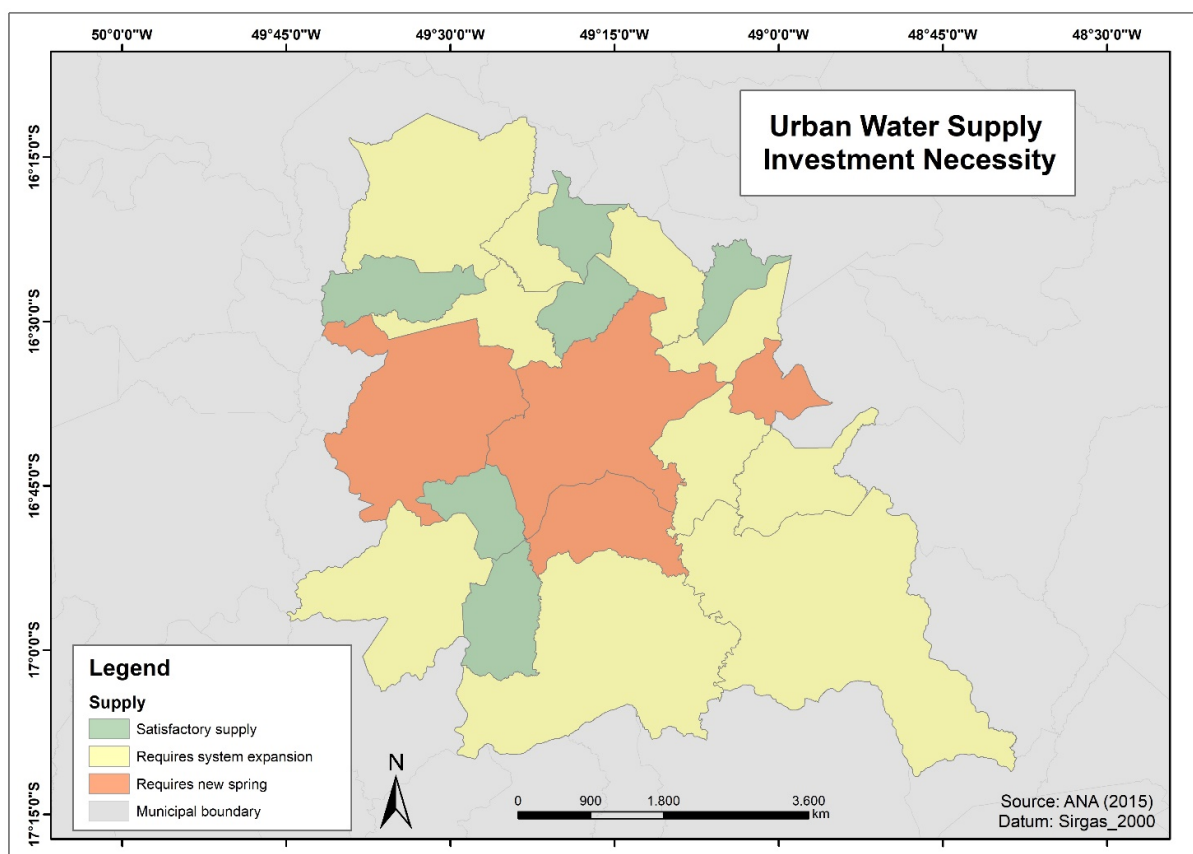


Fig. 2 Urban Water Supply, Investment Necessity.

the national average, most systems need expansion and four municipalities require new springs.

The underground springs can be considered strategic reserves and often represent important alternatives in critical situations. The analytical and descriptive study and its spatialization allow to observe the trend for investments in underground water collection systems. The trend in investments in underground water collection systems is due to two reasons: the first is due to the cost, because the method is cheaper, once, they are more protected from external contamination agents, they demand less investments with treatments. The second reason is because these springs are less vulnerable to periods of drought. In contrast to the previous explanation we have the concern about the underground water reserve overexploitation without taking into account the aquifer capacity of recharging which can cause the activity unsustainability.

The system integrations is present in only three municipalities and even those that already need new sources and adjustments in the system do not have the water resources integrated management in their instruments of urban policy planning and management, in the case analyzed in this research, the Master Plans. Another factor to be observed is that, although members of the same region, these municipalities exhibit heterogeneous territories, especially with regard to socioeconomic and environmental aspects, which generates different demands and justifies the need for the adoption of integrated policies such as Integrated Urban Development Plan being prepared in the region.

References

- [1] V. Custódio, A relação cidade-água nos artigos dos anais da Associação de Geógrafos Brasileiros (AGB), GEOUSP: Espaço e Tempo (online), 2009.

- [2] W. C. Ribeiro, Geografia Política da Água (1st ed.), São Paulo, Brasil, Annablume, 2008.
- [3] C. E. M. Tucci, Controle de Enchentes, in: Tucci C. E. M. (Org.), *Hidrologia: Ciência e Aplicação*, Rio Grande do Sul: UFGRS Editora, 2009, pp. 621-652.
- [4] I. T. C. P Nunes, S. D. Sacho, K. R. H. Hora, N. C. Ferreira, M. M. Sales, Desafios para a gestão de recursos hídricos na bacia hidrográfica dos Rios Turvo e dos Bois nos municípios da Região Metropolitana de Goiânia, Simpósio Brasileiro de Engenharia Ambiental, ENEAAmb, 14., 2016. *Anais... Brasília* (2016) 1-8.
- [5] ANA, Agência Nacional das Águas, 2017.
- [6] J. G. Tundisi and T. M. Tundisi, Recursos Hídricos no Século XXI, Oficina de Textos. São Paulo, 2011.
- [7] Brasil, Política Nacional dos Recursos Hídricos Lei 9.433 de 08 de Janeiro de 1997.
- [8] BRASIL, Estatuto da Cidade e Legislação Correlata Lei nº 10.257, de 10 de julho de 2001, 2. Ed., atual. – Brasília: Senado Federal, Subsecretaria de Edições técnicas, 2002.
- [9] BRASIL, Constituição da República Federativa do Brasil, atualizada até a Emenda Constitucional nº 0, de 15-12-1988.
- [10] BRASIL, Estatuto da Metrópole, Lei 13.089 de 12 de janeiro de, 2015.
- [11] C. M. R. Martins, Aplicação do Estatuto da Metrópole e elaboração do Plano de Desenvolvimento Integrado na Região Metropolitana de Porto Alegre in Brasil Metropolitano em foco: Desafios à implementação do Estatuto da Metrópole. B. O. Margut, M. A. C Costa, B. Favarão, *Brasília* (2018) 435-458.
- [12] IBGE, Instituto Brasileiro de Geografia e Estatística, Censo, 2010.
- [13] PDI-RMG, Análise dos Aspectos Ambientais na Região Metropolitana de Goiânia, 2017.