

Environment Policy and Participation in the Tocantins River Basin, Brazil

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Abstract—A water generated energy is - in the context of care of the environment - an overwhelming international challenge. As far as spring water and water reservoirs are concerned - as in the savannah biome (Cerrado) area of the Tocantins river - care of the environment requires as well technological management as sustained management including participation of local population. The River Basin Management of Tocantins – RBM-TO, has developed institutional procedures in handling the technological management, there is a need to improve the participation of local population in a sustained management process concerning decision making in questions of care of the environment. Water utilization in that savannah area has often been a controversial issue; the fact is that conflicts are caused by a permanent change of climate in that area comprising aridity and inundations. Issues such as generation of energy, water supply and its utilization, and care of the environment have great influence over the quality of life of the local population. The balance and reduction of the environmental impacts, the participation of the local persons concerned must be ensured; surveys and analysis's referring to integrated socio-ecological aspects in support of managing and planning of areas in the region.

Keywords—Environment, Planning, Sustainability.

I. INTRODUCTION

Public participation in the process of environmental protection through technological projects is based on a new approach to environmental management. The central point of the discussion deals with improvements to the efficiency of existing management tools. In the case of water sources and reservoirs with multiple uses in areas of Brazil's savannah biome (Cerrado), according to Myers and Camargo "the most biodiverse Savannah in the world" (Myers; Camargo, 2019, p. 99), sustainable social-environmental policies and broader participation of the general public in matters related to environmental protection are instruments that can guarantee the better functioning of technological systems and of power relations in the governance process. Neves's contributions are relevant to the governance process, "The participation of civil society in water resources management policies occurred until the present administration through the Hydrographic Basin Committees, which foresees the participation of public powers, users and civil society, limiting to 50% of the total representation of public power. Nevertheless, the participation rights are threatened by measures recently taken by the federal government, such as a provisional measure that

extinguishes participative committees and councils." (Neves, 2019, p. 60).

Sustainable social-environmental policies make it possible to properly manage environmental risks, including analyses that support the process of participation, implementation, accompaniment, and evaluation of actions. The environmental impacts and risks are analyzed starting with the initial steps of identification, quantification, minimization and mitigation. These analytical steps generate results that can be used to formulate public policies and ensure the environmental sustainability of water sources and reservoirs for various uses by future generations. The objective of this article is not to make an analysis of environmental impacts and risks of water sources and reservoirs in areas of the savannah, which would require researching some examples of case studies, something that does not correspond to the purpose of this work. The analysis presented here focuses on studies and research, based on information and proposal specifically to manage the water resources of the watershed of the Tocantins river in Brazil.

A number of environmental problems have been identified in the Tocantins river watershed, which is notable for its diversity of water sources and for the rapid development of rural and urban areas (PINTO, 2017). The Tocantins

river basin is located in the savannah biome, being part of what is actually a complex biome that supplies the sub-watersheds of the Araguaia and Tocantins rivers. The water resources of the Tocantins river are undergoing transformations that are causing problems due to the unplanned growth of the urban population, the lack of compliance with existing environmental legislation, inadequate investment in studies and research, lack of information regarding water uses and users, informal mining activities and uncontrolled burning of savannah vegetation, among other things. Of particular note is the unregulated use of lands near the banks of the river for agricultural activities, insufficient protective vegetation along the banks of the river due to the fluctuation in water level, growing use of the adjoining land for agricultural projects, besides the release of untreated domestic sewage and the erosion process of soil and margins. Sustainable management and local participation are instruments that can enable better management of environmental impacts and the reduction of the problems identified.

The objective of the present article is to highlight the importance of social-environmental policies in the public participation process. Indeed, public participation is considered fundamental to the success of environmental protection initiatives, through technology projects and mechanism that contemplate approaches to environmental management. The research discussed herein covers environmental problems identified in the Tocantins river basin caused by the construction of hydroelectric dams, their reservoirs and multiple uses. It also corroborates distortions in water levels and various activities that can have possible environmental impacts. These impacts can occur during construction and with the initiation of operations, producing changes to the atmosphere, water supplies, animal and plant species, in the region of construction and the area affected by the artificial lake. The environmental impacts are additional to the economic, cultural and social impacts. They modify the natural system of the region, with the alteration of the quality and availability of water, provoking conflicts related to the forms of water use (TUNDISI & STRASKRABA, 1999; REBOUÇAS, 2001; TUNDISI, 2013). The minimization of conflict through integrated actions by means of sustainable policies and the participation of the society can make it possible to reduce problems related to the degradation of water quality and supply to end users, guaranteeing in this way a greater environmental sustainable for the region.

The planning of actions for the management of watershed resources should follow criteria for use of reservoirs for the better management of environmental impact,

through integrated actions of environmental management with local participation, besides guaranteeing sustainable use for reservoirs. Some authors (TUNDISI & STRASKRABA, 1999; CAMPOS, 2006; AGOSTINHO; GOMES & PELICICE, 2007; MYERS & CAMARGO, 2019) affirm that management of environmental impacts is a strategic planning tool that can lead to decision-making for greater economic, social and environmental sustainability at the community level.

The clear identification of social-environmental problems favors the formulation and implementation of public policies that can guarantee minimization of environmental impacts. To Neves, "The social control of public sanitation services is one of the basic principles in the national guidelines: a set of mechanisms and procedures that assure civil society access to information, technical representation, and participation in the processes of policy design, planning and evaluation." (Neves, 2019, p. 60). Environmental policy has presented analyses with significant contributions in research of solutions for environmental and technological problems. The control of environmental matters should be based on social-political negotiation and evaluation, as well as the transparency of actions for the objective of overcoming the technical conceptions of environmental problems. Of particular note in this process are the interests and relationships of power of dominating groups who feel they can take isolated decisions without any public participation. Indeed, environmental and technological problems should be observed in a context that integrates the political and social diversities involving technological alternatives that consolidate environmental control.

Some factors are decisive in the process of estimating environmental problems - as much uncertainties as rational decision-making. They can be influenced by some type of forecast, according to Jänicke et al. (2003, p. 128). Insufficient information is a preponderant factor in this process. Percentages are conceived as probabilities relative to the measures of uncertainty, and the technical information presented make up part of the uncertainties involved.

The environmental problem can be defined using the concepts of Campos (2006, p. 32) as a potential threat to the environment and to man, can be transmitted by natural means or constructed and can be defined as all changes to the environment that can come to be a loss to human life. It is understood as an environmental problem, for example, a form of use of water and of soil around reservoirs in the savannah region of the Tocantins river and others. In this way, the agricultural and aquaculture activities carried out along the shores of the river and the watershed or in areas

of moist or salinized soils due to the incorrect use of techniques such as pesticides, conventional irrigation, etc. are activities considered bad for the environment.

Studies and research papers on social-environmental policy and management of water resources participatory processes are important tools of political and technical control and in the identification of environmental impacts and risks on what is referred to as quantification, minimization, and mitigation of the effects of these problems (ANA, 2009; BRUNO & FANTIN-CRUZ, 2020).

II. METHODS

The search for information sustains the data used in the research, being divided between primary and secondary data. (Fig.1).

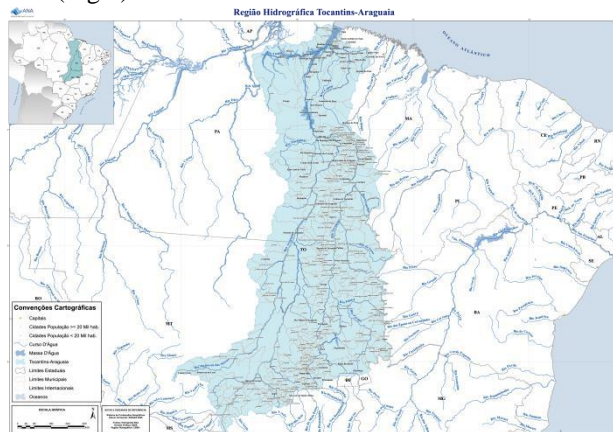


Fig.1: Location of the Tocantins-Araguaia Hydrographic Region. Source: Hidrografia ANA, 2000.

The systematic observations of direct and indirect form is in addition to interviews of stakeholders involved with relocation projects, community leaders, technicians, those being relocated, and employees of the hydroelectric dams. The secondary data were obtained through surveys of bibliographic, documentary and map sources, as well as through field visits, for the purpose of identifying the environmental problems in the areas of the watershed and reservoirs characterizing the critical and fragile areas in terms of erosion, water pollution or risk zones for eutrophication.

For Myers and Camargo, “The geographical position of Tocantins makes it a frontier state between the Cerrado and the Amazonian regions. It is also the site of one of Brazil’s most important river basins, the Baixo Tocantins. However, due to its relatively small size, not very much attention has been given to Tocantins in comparison to other states in the Amazon region. As a consequence, Tocantins has fewer regulations governing land use and lower capacity to monitor deforestation and land

exploitation [...]. In 2017, for example, only eight percent of the Cerrado was protected and off - limits to agriculture or development, as compared to 46 percent of Brazil’s Amazon region [...]. Furthermore, 90 percent of Brazil’s field agents that monitor and control deforestation are deployed in the Amazon region, making enforcement of deforestation policies difficult.” (Myers; Camargo, 2019, p. 99-100). (Fig.2).

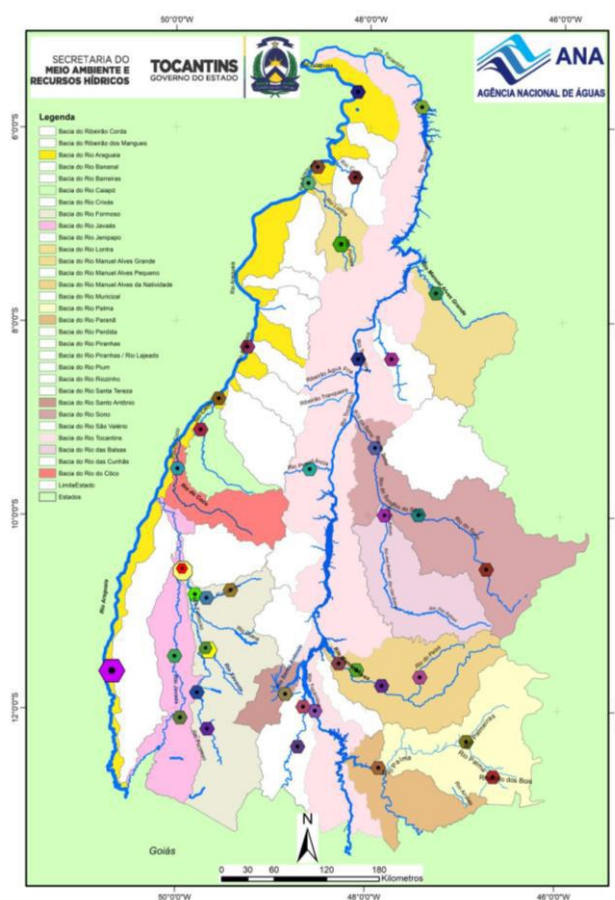


Fig.2: Location of rivers, affluent rivers, hydrographic basins and hydrographic reservoirs of the Tocantins-Araguaia Hydrographic Region. Source: SEMARH; ANA, 2020.

Das Mortes and Itacaiúnas are the four principal rivers that form the Tocantins river basin occupying a total area of 757,000 km². The region of the Tocantins watershed was colonized by Europeans between the end of the 16th century and the beginning of the 17th century and these colonizers had as their objective to settle territory, guarantee mineral wealth and enslave indigenous people. The decline of mining lead to the expansion of agriculture in

the 19th and 20th centuries and to the founding of towns and cities that could process, transport, and consume the agricultural outputs.

During the 1950s and 1960s, the Tocantins watershed suffered great impacts with the economic development of the country and the construction of Brasília. The annual population growth during the 1990s was 1.66%. The urban population grew 3.74% per year, while the rural population fell at a rate of 2.34% (MÜLLER, 1995). Urban development in cities and states in the Tocantins river basin region results in increased use of water resources, conflicts between users and deterioration in the quality of surface and underground bodies of water (HENRY, 1999).

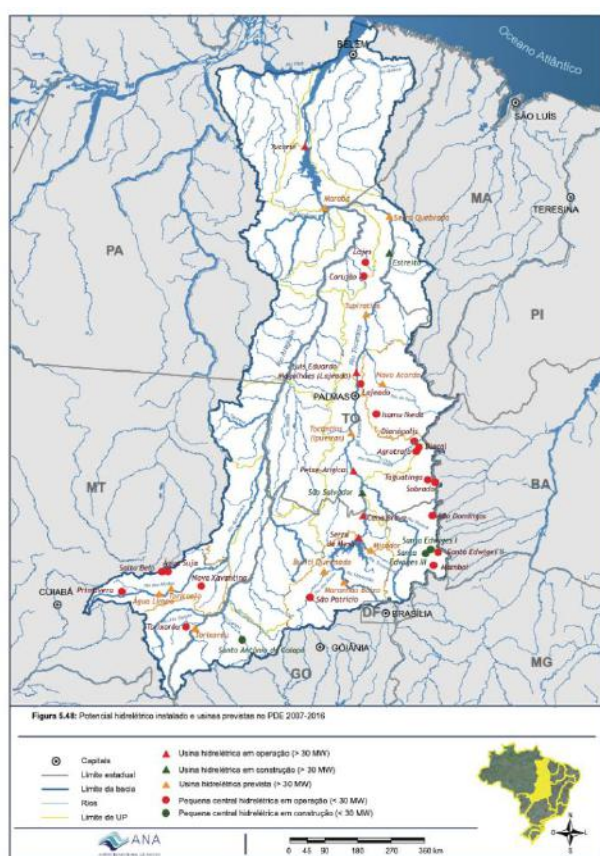


Fig.3: The hydroelectric potential of the Tocantins-Araguaia Hydrographic Region. Source: ANA, 2009.

The Tocantins river reservoirs supply the populations of the region, as well as industries, farm irrigation, aquaculture, navigation, tourism, leisure activities, dilution of sewerage, and ecological protection, in addition to electricity generation. In the document BRASIL (2004, p. 42) the predominant use of water is for farm irrigation which represents 50.5% of all uses. A rural vocation is confirmed, with predominance of the use of water for irrigated agriculture (ANA, 2009, p. 117-118).

The generation of energy is the objective of the construction of reservoirs of hydroelectric plants, it is observed that there is no planning of the reservoirs as environmental issues through environmental protection programs and participation of society are not considered. The carrying out of environmental impact studies (EIA) for reservoir projects, according to the 1986 legislation, is mandatory, thus, there is a greater concern with the environmental issue (CONAMA, 1986). (Fig.3).

III. RESULTDS AND DISCUSSION

The results presented here cover some aspects that are considered important for the consolidation of social-environmental policies. The legal and regulatory issues correspond to the National Policy for Water Resources (NPWR) through the practice of multiple uses of water and the execution of control, conservation and prevention measures. For Trindade and Scheibe, “More than 15 years after enactment of Brazil’s National Water Resources Policy and Waters Law (Lei no 9.433 of 8 January 1997), which determined that the administration of water resources be conducted through decentralization, participation and integration, this goal has still not been attained and there have been many problems that delay the realization of this law, particularly those linked to decentralization.” (Trindade; Scheibe, 2019, p. 1).

Thus it is considered a policy that promotes planning strategies and principle for integrated management of water resources with sustainability and analysis of impacts and risks (BRASIL, 2004, p. 31). This policy for water resources is indicative of public participation in making decisions related to water uses and a “politicization” of water resource management.

The institutionalization of public participation corresponds to institutional aspects of water resource management, as described by Guivant and Jacobi (2003, p. 26). The Advisory Board and the National System for Water Resources (NSWR) decide on issues and conflicts along with the Hydrographic Basin Committees (HBC) that guarantee the participation of uses, municipal governments and civil society (MENEZES & BIESEK, 2014). Society's participation in the water governance process started with the Federal Constitution of 1988, which introduced the water resources management system, “such as user-pays principles and participatory management.” (Victor; Almeida; Wong, 2015, p. 9). Also, Victor, Almeida and Wong found that “The Constitution of 1988 was important in establishing a foundation for jurisdictional authority over water bodies but it was considered only the first step in reforming the water system. Industrialization and rural-

to-urban demographic shifts throughout the 1970s and especially the 1980s brought significantly greater demand for water and also for power generation. This led to a boom in hydroelectric plant construction to meet the power demand.” (Victor; Almeida; Wong, 2015, p. 10-11).

Other issues are the socio-environmental aspects that portray the problems of the dry season, the geology of the area with sandy formations and vegetation in the savannah with the influence of the Tocantins river reservoirs. The impacts and risks relate agriculture and agriculture through irrigation projects in full expansion, on the one hand, they promote benefits to the population, on the other hand they contribute to put the health of their inhabitants at risk, in addition to the quality of water and soil through use of fertilizers. The environmental problems of aquaculture result from the lack of control in the use of reservoirs and tanks near the margins of the basin. The practice of feeding species that are grown through feed causes a certain degree of pollution in the reservoirs with the introduction of varieties of nutrients. This practice has provoked serious criticism, in South America Chile and in Europe Poland are examples of countries that use the method of cultivating species with feed and nutrients, some countries such as Germany, Denmark and Norway this method is prohibited.

Trindade and Scheibe considers that “The watershed plan is the main guide for the decisions of a Watershed Management Committee, because it provides a diagnosis of the real situation of the watershed, which allows projecting goals, objectives and actions to preserve and maintain the quality and quantity of water for the entire population, minimizing future conflicts over water use.” (Trindade; Scheibe, 2019, p. 3).

IV. CONCLUSION

The level of information regarding environmental problems, together with the lack of mastery of techniques necessary to minimize social-environmental conflicts generated by the construction of large reservoirs, in addition to the difficulties in organizing and coordinating with the local population, represents barriers in the process of negotiating between the River Basin Management of Tocantins – RBM-TO (coordination) and the affected communities.

The representatives of the institutions involved in the execution of the projects and programs together with partner entities of the State of Tocantins such as SANEATINS, CELTINS, UFT and others visualize the challenges as a big social-political construction project in which it is necessary to minimize environmental impacts and risks resulting from the productive activities, especially agriculture,

cattle-raising, and fish farming in areas close to the banks of the river and the watersheds or areas of moist or salinized soils, as well as incorrect use of pesticides, conventional irrigation, etc. (Fig.4).

The activities considered bad for the environment result on a large scale in impacts and risks of “Eutrophication” that are considered grave for the Tocantins watershed. One can observe in recent years a growing process of “Eutrophication” with environmental disturbances felt all along the Tocantins river.

The shallow areas of the Tocantins river reservoirs find themselves constantly in a process of change influenced by agricultural projects and raw sewage from urban areas. (Fig.4).

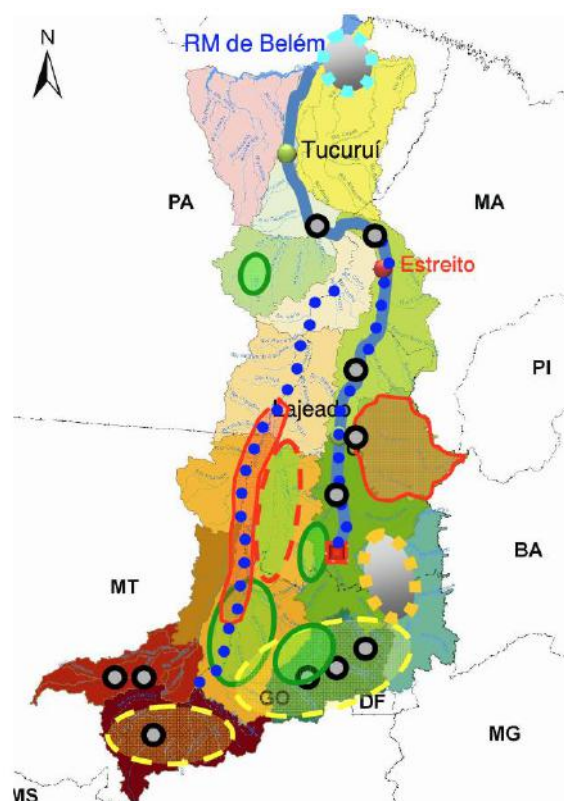


Fig.4: Eutrophication of rivers of the Tocantins-Araguaia Hydrographic Region. Source: ANA, 2009. Author's adaptation.

Nonetheless, it is important to note the existence of civic entities that are developing various programs and social-environmental projects with the participation of the local population around the reservoirs of the Tocantins river basin. The implementation of these social-environmental programs and projects has mitigated the environmental impact and risks beginning with the construction of data

banks and the participation of the local population, for the purpose of instruction and priority of meetings and seminars that promote a conscience for environmental protection (LAROCA, 1995; DEL RIO & OLIVEIRA, 1999; GUIVANT, 2002).

Some problems are identified and recognized as being social-environmental in nature. Among these are sewers to channel untreated domestic and industrial waste to reservoirs; pesticides that pollute the waters, and the soil salinization around reservoirs. These problems determine and influence the environmental survival of the Tocantins river.

Also one notes in recent years, a growing number of irrigation projects and programs along the Tocantins river. The expansion of these projects and programs produce, on the one hand, real benefits to the population of the Tocantins river basin in terms of new business opportunities and consequent increases in family income. On the other hand, these projects generate certain risks to the survival of local people and communities in terms of a healthy quality of life. Indeed, one can say that the quality of water and soil in the areas of the Tocantins river are threatened, as result of the constant use of commercial pesticides, agricultural "protector" products and chemical fertilizers.

A quite serious problem is the various uses for different purpose of water that provoke social-environmental conflicts among users (BICUDO; TUNDISI & SCHEUENSTUHL, 2010). Activities related to agriculture, cattle-raising, and fishfarming are considered important for the development of the Tocantins river region. However, the economic benefits can be more than offset by the harm done to local communities in terms of degraded water quality, which affects both local people and other life in the watershed (MORETTI & MARINHO, 2013; SPINOLA; VITORIA & CERQUEIRA, 2016).

This work shows conclusively that, despite studies on environmental impact and risks done in accordance with Resolution n. 001/1986 of the National Environmental Council (CONAMA) and the National Environmental Policy, which mandate the preparation of environmental impact studies in the case of various human "interventions" relative to natural resources, such as construction of dams and reservoir, the problems identified in terms of environmental impact and risk continue to occur in the regions of the Tocantins river basin (CONAMA, 1986).

According to CONAMA Resolution n. 001/1986 of the guidelines of the National Environment Council for the assessment of environmental impact, determines the law that, "Considering the need to establish the definitions, responsibilities, basic criteria and general

guidelines for the use and implementation of the Environmental Impact Assessment as one of the instruments of the National Environment Policy, resolves:

Art 1. For the purposes of this Resolution, any change in the physical, chemical and biological properties of the environment, caused by any form of matter or energy resulting from human activities, which directly or indirectly, affects:

I - the health, safety and well-being of the population;

II - social and economic activities;

III - the biota;

IV - the aesthetic and sanitary conditions of the environment;

V - the quality of environmental resources."

(CONAMA, 1986, p. 636).

The results of studies and research show that Tocantins river basin is a great water source, but that also its use depends on efficient form of exploitation through integrated development for the region as a whole. Clearly, the water resources of the Tocantins river should not be used exclusively for the generation of electricity. Other functions should be explored for the purpose of economic development, including irrigation, navigation, supply of water, tourism, fishing, etc.. Nonetheless, all of these activities should be properly managed to ensure the overall environmental protection of the region.

One of the mechanisms that can favor new concepts for the efficient use and an integrated development of the region is the management and planning with participation of the local population in the decision-making process of socio-environmental policies (VICTORINO, 2003; LEAL, 2004; GUIVANT, 2015). The participation of the local population can be exercised through the process of forming committees that are still unsustainable in the Tocantins river basin.

A watershed committee should be composed of various regional stakeholders that have involvement in regional development projects and programs and have the main objective of promoting the process of managing social-environmental policies and environmental impacts and risks, based on best practices of environmental management.

Thus, Trindade and Scheibe say that "It is up to Watershed Management Committees to perform a strategic role in the National Water Resources Policy, because they are the entities that materialize the decentralization of management, include the participation of governments, users and civil society and have

watersheds as the units of management. They are also proponents of public policies. Thus, the success of their operation to a certain degree signifies the success of the water policy itself.” (Trindade; Scheibe, 2019, p. 1).

The watershed committee is an instrument to develop and implement integrated management strategies as part of a larger local community-based governance process (PORTO & PORTO, 2008; EMPINOTTI; JACOBI & FRACALANZA, 2016), which would stimulate and demand the participation of federal, state and city governments in partnership with representatives of civil society and users in the formulation and implementation of social-environmental policies. In this sense, Victor, Almeida and Wong considers that “This new approach provided an integrated way to view and manage water and also introduced three important changes: the river basin was designated as the territorial unit for water resources planning; water was defined as a finite resource with an economic value; and national water management was defined to be a decentralized and participatory system.” (Victor; Almeida; Wong, 2015, p. 11).

The conclusions of this work show that the Tocantins river basin as quite favorable to the development of agriculture, cattle-raising and other forms of animal husbandry, and fish farming, as well as related agribusiness and population growth. These, however, will tend to degrade the environment and result in reduced water resources affecting the region's biodiversity. Accordingly, the development of social-environmental programs with policies that stimulate public participation, an open planning process and best practices for water resource management can facilitate the integration of studies and research in the Tocantins river basin.

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