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Environmental impact assessment in Brazil: a case study of the Belo Monte hydroelectric facility licensing process

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Abstract

The Environmental Impact Assessment (EIA) is a process that consists in the identification, prediction and evaluation of the impacts of human activities that have potential to cause significant impacts on the environment. It analyses whether certain activities have a high potential for degradation and impact, in order to judge whether or not such activities can be implemented and, if they are, mitigate or compensate their negative impacts. Therefore, the aim of this study was to analyze the applied methods on the environmental licensing of Belo Monte Hydroelectric Facility through qualitative research, investigating the Environmental Impacts Study (EIS) of this project and its impacts on the local population. Furthermore, the fulfilment of the licensing agency requirements and its posture in face of the unredeemed requirements has also been assessed. It was inferred that many of the terms that were required by the licensing agency to prove the project environmental feasibility were not accomplished, and few were just partially attended.

Keywords | Belo Monte Hydroelectric Facility; environmental impact assessment; environmental licensing; environmental impact study.

JEL Classification | O13 Q48 Q56

Avaliação de impacto ambiental no Brasil: um estudo de caso do processo de licenciamento ambiental da Usina Hidrelétrica de Belo Monte

Resumo

A Avaliação de Impacto Ambiental é um processo que envolve a identificação, previsão e avaliação dos impactos das atividades humanas, com potencial de causar danos significativos ao meio ambiente. Ele informa se determinadas atividades têm potencial de degradação e, dependendo do grau de impacto, se tais atividades podem ou não ser implementadas. Se forem implementadas, ele indica formas de mitigar ou compensar eventuais impactos negativos. O objetivo do estudo que deu origem a este artigo foi analisar os métodos aplicados no

licenciamento ambiental da UHE Belo Monte por meio de uma pesquisa qualitativa. Portanto, investigou-se o Estudo de Impacto Ambiental do projeto que deu vida à UHE Belo Monte e os impactos desta na população local/regional. Além disso, também se avaliou o cumprimento (ou não) dos requisitos do órgão licenciador e sua postura diante dos requisitos não resgatados. Inferiu-se que muitos dos prazos exigidos pelo órgão licenciador para comprovar a viabilidade ambiental do projeto não foram cumpridos, e os poucos efetivamente atendidos o foram apenas parcialmente.

Palavras-chave | Avaliação de impacto ambiental; estudo de impacto ambiental; licenciamento ambiental; UHE Belo Monte.

Classificação JEL | O13 Q48 Q56

Evaluación de impacto ambiental en Brasil: estudio de caso del proceso de licencia ambiental de la planta hidroeléctrica de Belo Monte

Resumen

La Evaluación de Impacto Ambiental es un proceso que envuelve la identificación, predicción y evaluación de los impactos de las actividades humanas, con potencial para causar daños significativos al medio ambiente. Informa si determinadas actividades tienen potencial de degradación y, dependiendo del grado de impacto, si tales actividades pueden implementarse o no. Si se implementan, la evaluación indica formas de mitigar o compensar eventuales impactos negativos. El objetivo del estudio que dio origen a este artículo fue analizar los métodos aplicados en la licencia ambiental de la Central Hidroeléctrica de Belo Monte a través de una investigación cualitativa. Por tanto, se investigó el Estudio de Impacto Ambiental del proyecto que dio vida a la Central Hidroeléctrica de Belo Monte y los impactos de esta en la población local/regional. Además, también se evaluó el cumplimiento (o no) de los requisitos de la agencia de licencias y su postura frente a los requisitos no redimidos. Se percibió que muchos de los plazos requeridos por la agencia de licencias para comprobar la viabilidad ambiental del proyecto no se cumplieron, y los pocos que efectivamente se cumplieron solo lo fueron parcialmente.

Palabras clave | Evaluación de impacto ambiental; estudio de impacto ambiental; licencia ambiental; Central Hidroeléctrica de Belo Monte.

Clasificación JEL | O13 Q48 Q56

Introduction

Environmental Impact Assessment (EIA) is a systematic approach used to identify and evaluate the positive and negative impacts that may arise from the implementation of projects, plans, programs, or policies, including their physical, biological, and socioeconomic components (GILBUENA *et al.*, 2013). In most countries, it is a legal requirement for the assessment of developing projects that

could significantly affect the environment. Therefore, it is an important tool for environmental management through a public and systematic process for the identification and design of environmentally sustainable development (SÁNCHEZ; MORRISON-SAUNDERS, 2011).

Furthermore, the EIA involves impacts examination, analysis, and evaluation of proposed activities to ensure environmentally sound and sustainable development. Thus, it is an effective planning management tool. Therefore, it is used to identify the type, size, and potential changes in the environment caused by an activity or enterprise. It also assists in the transmission of this information to decision-makers (TORO *et al.*, 2012).

In Brazil, the EIA process is linked to the environmental licensing of projects that may have significant environmental impacts. Therefore, activities such as hydroelectric facility plants are subject to the environmental licensing process. It is a multidisciplinary procedure that involves many actors and aspects that must be considered, which may result in inadequacies in the different stages that have to be followed.

This work seeks to develop more critical analyses of the processes of environmental licensing and compliance with the logical sequence of steps that compose the Brazilian EIA process in obtaining the environmental licenses that were granted to the Belo Monte hydroelectric facility. Section 2 presented a brief theoretical foundation to situate the reader on how the EIA process is conducted in Brazil. Section 3 presents the methodology used to achieve the objective of this work: to analyze the licensing process of the Belo Monte Hydroelectric facility. The Results and Discussion section presents the analysis of each EIA step of the case study. Finally, some final considerations about the lack found in the process are made in the last section.

Theoretical foundation

In Brazil, the EIA process was incorporated into Brazilian legislation with the approval of the National Environmental Policy (Law 6.938/1981) and is linked to environmental licensing. The law granted the National Environmental Council (CONAMA) the power to regulate the EIA. In this way, CONAMA launched its Resolution Number 1 of 1986 with a series of requirements for both environmental licensing and the EIA process (SÁNCHEZ, 2013). The Brazilian environmental licensing comprises three stages, in which proponents are required, first, to obtain a viability license, known as a Preliminary License (PL), then an installation License (IL), allowing the construction of the activity, and, finally, an Operation License (OP), which grants the right to initiate operations (FONSECA *et al.*, 2017).

Among these requirements, this Resolution established general guidelines for the implementation of the EIA, through the elaboration of the Environmental Impact Study (EIS) and the Environmental Impact Report (EIR). The EIS is a technical document that assesses the possible impacts associated with a specific activity and should suggest technological and locational alternatives for it, as well as mitigating plans for the possible significant impacts. Likewise, the EIR has the function of clarifying the information contained in the EIS to the population in a non-technical way, to inform and allow public consultation. Both documents are required for the PL application and obtainment (BASSO; VERDUM, 2006).

In this context, environmental licensing is a preventive instrument that seeks to balance economic growth with environmental protection, considering social issues, to promote a balance between the rational use of natural resources and business costs (BOJÓRQUEZ-TAPIA, 2005). Licensing agencies carry out the process, such as the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), which is responsible for issuing project licenses at a national level that directly affect the territory of two or more States (PEDREIRA *et al.*, 2003). IBAMA is also responsible for licensing activities in indigenous areas, in conservation units, ports, and airports. Moreover, activities located and developed within other countries, on territorial sea, in the continental shelf, in the exclusive economic zone, and which impacts affect other countries. As well as activities intended for research, plowing, producing, benefiting, transporting, storing, and disposing of radioactive material, at any stage, or using nuclear energy in any of its forms and applications (Conselho Nacional do Meio Ambiente [CONAMA], 1997).

The EIA has established itself as the main environmental decision tool for impacting ventures and, over the decades, work methodologies have evolved in this theme, leading to significant deficiencies in environmental licensing processes, with consequences on the effectiveness of their results. In general, the more impacting and controversial the venture, the more complex the studies that compound the EIA and the requirements established in the administrative licensing process. This can often lead to poor quality of the study, which can lead to failures in the identification and evaluation of some of the main environmental impacts attributed to the project or even the desire to deviate from these main impacts and omit them as an attempt to obtaining the environmental license (BOJÓRQUEZ-TAPIA, 2005; HOLLICK, 1986; SÁNCHEZ, 2013).

Among many significant environmental impacts caused by the construction of a hydroelectric plant, several of them can be classified as irreversible. Although hydroelectric plants use a renewable natural resource (water), they have a high potential of altering the landscape due to flooding of large areas, causing numerous damages to fauna and flora: climate change, disappearance of fish species, animals escape for dry refuges, among others. In addition, there are socio-environmental impacts caused by the displacement of the local population (CARDOSO *et al.*, 2015; SHAKTAWAT; VADHERA, 2020).

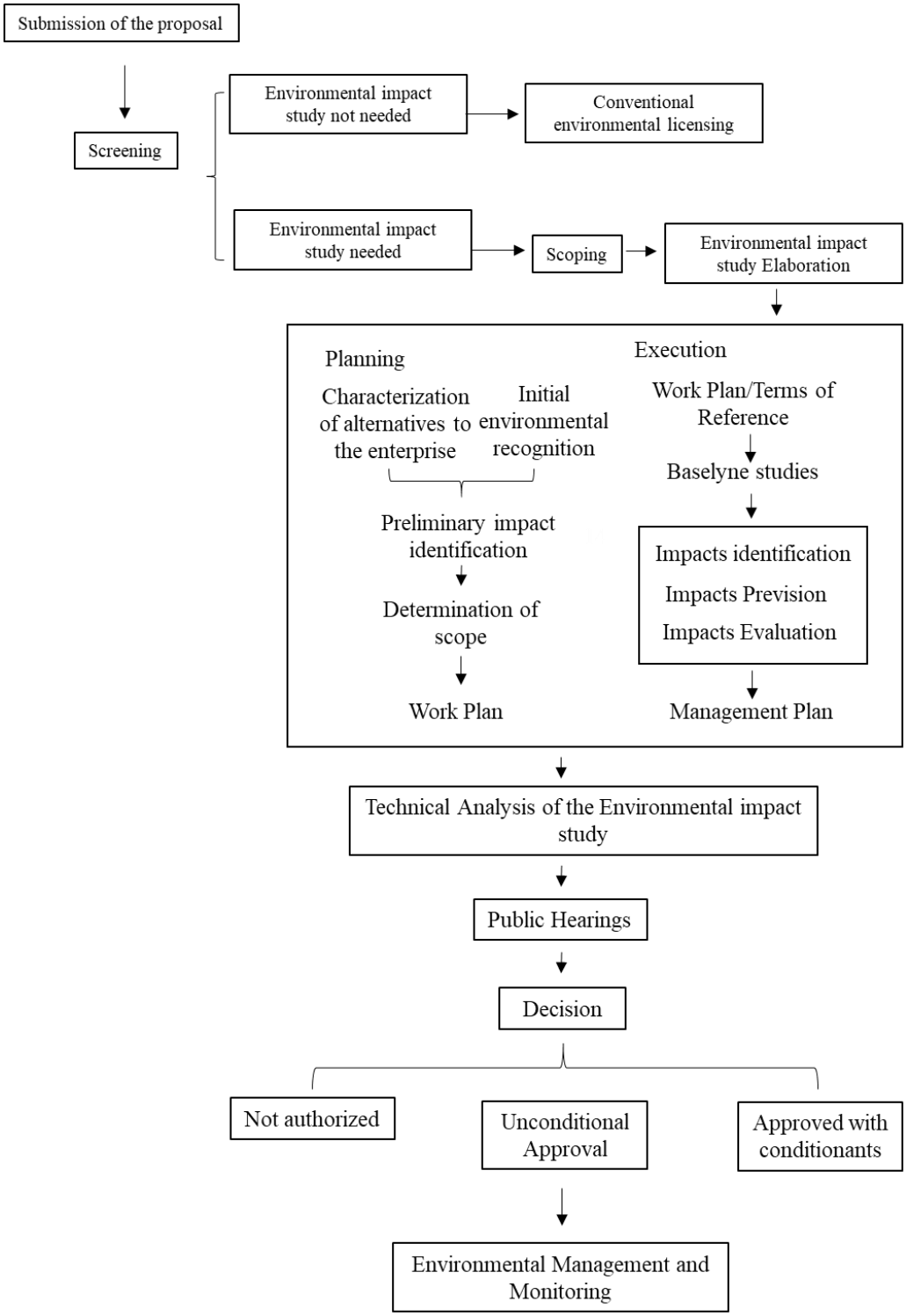
Brazilian EIA structure

The EIA process in Brazil consists of a series of sequential activities, which are logically connected. It has three stages, each grouping different activities: (i) the initial stage; (ii) the detailed analysis step, and (iii) the post-approval stage, in case of a favorable decision on the project implementation (SÁNCHEZ, 2013). Figure 1 shows a diagram with the EIA structure that must be followed to elaborate a complete environmental impact study.

The initial steps are to determine the need for a detailed assessment of the environmental impacts of future activity and, if necessary, to define the scope and focus of these studies. Activities that use environmental resources or have the potential to degrade the environmental quality must first obtain governmental authorization, without which they cannot operate. Among these, in cases where there is potential for significant environmental impacts, the EIS will be required (SÁNCHEZ, 2013).

When a given activity has the potential to cause significant impacts, the detailed analysis phase takes place. A series of activities compose this phase, beginning with the determination of the content of the EIS until its approval or not. Finally, with the project implementation, in case of approval, the EIA continues through the application of management measures recommended in the EIS as well as the possible licensing constraints stipulated by the licensing agency, aiming to monitor the real impacts caused by the activity (SÁNCHEZ, 2013).

Figure 1 – EIA Structure in Brazil



Source: Adapted form Sánchez (2013).

Methodology

Methodological strategies

The present work had the objective to analyze the EIA process of the Belo Monte Hydroelectric Facility. The EIA is an integral part of the project's licensing process, within the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA). Documents of the process from 2007 to 2015 were analyzed. The documentation is available on the IBAMA website, under the process number 02001.001848/2006-75, at the link https://servicos.ibama.gov.br/licenciamento/consulta_empreendimentos.php.

The chosen time frame for analysis, spanning from 2007 to 2015, was motivated by the significant events and developments during this period in the licensing process of the Belo Monte Hydroelectric Facility. These years encapsulate critical stages of planning, approval, and early implementation, allowing for a comprehensive assessment of the EIA process within the IBAMA.

The evaluation of the documents was performed through an analysis of each step of the EIA process, following the Brazilian structure (Figure 1). The consulted processes were confronted with the analytical criteria proposed for their elaboration, to verify if there was the expected adherence. Each document was related to the EIA step and was evaluated. In this way, the Environmental Impact Study of this enterprise was investigated to ensure that it was elaborated according to the structure applied in Brazil, namely, if all the steps were executed according to what was predicted. Moreover, each step was critically examined to see whether all impacts caused by the enterprise or mitigation and compensation measures that should have been included in the study were encompassed or not. The researchers evaluated the process, and at the end of the process, the team discussed the analysis of each process intending to standardize the evaluation.

Study area

The Belo Monte hydroelectric facility is located in the northern region of Brazil, in the Xingu River, Para state; occupying lands of Vitória do Xingu, Altamira, Brasil Novo, and 8 more municipalities.

Its influence area is the Xingu River basin, in the Amazon Forest. This area encompasses the Xingu Indigenous Park, the first indigenous park in Brazil, besides sheltering a biological diversity of continental proportions (FEARNSIDE, 2006). Indigenous lands and conservation units form more than half the Xingu River basin area. Furthermore, there are 24 indigenous peoples distributed in 29 Indigenous

Lands. There are 190 km² of Indigenous Lands with 12,954 Indians, as well as four Extractive Reserves representing over 25,000 km² and a population of more than 10,000 families, besides the Protected Areas of Integral Protection and National Forests (ARAÚJO *et al.*, 2014; SCABIN *et al.*, 2015).

The project consists of a main dam, a reservoir, and two powerhouses: the main one in Belo Monte and a complementary powerhouse to be positioned in the main dam, which is distributed in three different places, the so-called sites. The main dam, located on the Pimental site, is located on the left bank of the Xingu River. It has about 6,200 m of total length and a maximum height of 36 m. The installed capacity is 233.1 MW, with nine bulb turbines. The main plant, located on the Belo Monte site, has an installed capacity of 11,000 MW. The reservoir has a total area of the water mirror of 516 km², and the maximum normal level of operation at the 97 m elevation. It partially covers the Xingu River channel and part of the land on the left bank of this watercourse, at the height of the stretch called Volta Grande (ELETROBRÁS, 2009; HARRIS, 2016).

Results and discussion

Screening

The idea of harnessing the potential of the Xingu River for hydroelectric power generation was initially proposed in the 1970s. However, concrete studies and development efforts started to take shape in the 1980s, and the project faced various stages of planning, environmental assessments, and public debates over the following decades (FLEURY; ALMEIDA, 2013). Thenceforth, there has been a series of protests and conflicts around this venture, which had its project approved by the Brazilian Senate from Legislative Decree No. 788, of July 14, 2005.

According to CONAMA's Resolution number 1, in Article 2º, hydraulic works for the exploitation of water resources, such as a dam for hydroelectric purposes with a capacity above 10 MW, are subject to the elaboration of the EIS and consequent EIR.

The importance of preparing the EIS for this project is enormous. Firstly, hydroelectric projects involve the construction of a dam, consequently, affecting large areas by flooding, and thus, the impacts are very significant and should be the object of research and study. Furthermore, the Belo Monte Hydroelectric Facility is located in a region of extreme importance to the world, the Amazon Forest, which has an immeasurable biodiversity. Linked to this is also the fact that this region is the habitat of several indigenous peoples and riverine populations that represent an exceptional culture and that would be directly affected by the enterprise

construction, justifying, even more, the need to elaborate environmental studies. Therefore, this phase of EIA was executed according to the Brazilian Legislation, which requests the EIS and EIR to evaluate the venture's feasibility.

Scooping

In December 2007, IBAMA issued the final Reference Terms (RT) for the preparation of the Belo Monte hydroelectric plant's Environmental Impact Study and Environmental Impact Report. The purpose of this document was to determine the scope, procedures, and general criteria to present in the studies. Thus, the representatives of IBAMA carried out meetings, workshops, and technical visits with the study co-ordination group to issue the document (SCABIN *et al.*, 2015).

The elaboration of the RT was made using data obtained in the field survey carried out by IBAMA technicians. In addition, public hearings were held in the communities of Altamira and Vitória do Xingu in August 2007, to hear the opinions, suggestions, and criticisms of these communities on the social and environmental aspects regarding the Belo Monte hydroelectric plant construction and include the results of these discussions in the RT (OLIVEIRA, 2007).

The project PL request, together with the presentation of the EIS and EIR, was held on March 16, 2009. The final environmental studies documents of the project were only published on IBAMA's website on July 21, 2009. On April 28 of that year, approximately one month after the presentation of the first version of the EIS and EIR, the licensing agency issued a document with the analysis and IBAMA technical opinion about the studies.

In this document, there is a checklist of all items that were required in the RT, evaluating if they had been presented. Among the alternatives, the information was classified as "Presented", "Partially Presented" and "Not presented according to the Reference Terms". It should be noted that the only item classified as "Not presented according to the Reference Terms" was the one concerning the indigenous populations, which highlights that: "In the EIS body only basic information on indigenous lands around influence is presented. There are also three different data on the population of the Paquiçamba Indian tribe, among others, throughout the EIS". The indigenous populations were one of the most sensitive and peculiar reached by the enterprise. Twenty-eight indigenous ethnicities live in the Xingu River Basin, representing around 20 thousand natives occupying 40% of the area (around 19.8 ha). The construction of the venture directly affected two indigenous lands, Paquiçamba and Arara da Volta Grande (FEARNSIDE, 2011). According to Fearnside (2015), the 100km section of the river above the main dam would have its flow drastically reduced, causing fish to disappear, directly affecting the indigenous lands. Therefore, all impacts on these populations and their social

aspects are and should be considered significant. In this way, they could not receive little importance or detail in the EIS. Chart 1 shows the items classified as "Partially presented".

Chart 1 – Technical Opinion of IBAMA regarding the items partially presented in the EIS of the Belo Monte hydroelectric facility

Item	**Observation**
Speleology	The speleological survey is not presented as requested. In a meeting, the entrepreneur mentioned that mitigation measures are under study, such as the construction of waterproofing carpets and dams in the cave region, to protect them from eventual unnatural erosion processes caused by the reservoir of the channels. These procedures should be presented as a complement to the study.
Water Quality and Limnology	It was verified the non-presentation of the compartmentalization of the systems in the study, regarding the time of detention, mainly in the reservoirs of the channels and in the arms to be formed in the Igarapés in Altamira. Such studies are essential to define possible mitigating actions and should be submitted to IBAMA for completion of the merit analysis. It was also verified the lack of simulation in the predictive model of some parameters indicated in the RT. In this sense, it is their presentation for the conclusion of the analysis or a justification for their non-performance. Studies on water quality in Indigenous Lands were not found in the Main Volume of the EIS.
Terrestrial Ecosystems	Bio speleological studies were not submitted as requested in the RT. Permanent Preservation Areas that were directly affected by the project were not identified, characterized, and mapped and should be sent as supplementation.
Phytoplankton and Zooplankton	No separate sets of data were presented regarding collections at the riverbanks and center, nor was the possible vertical distribution of the organisms observed. The similarity indices between the collection points upstream and downstream of the Volta Grande do Xingu were not presented. There was no prognosis of the effect of the enterprise in these communities.

Item	Observation
Benthic Invertebrate	No separate sets of data were presented regarding collections at the riverbanks and center. The similarity indices between the collection points upstream and downstream of the Volta Grande do Xingu. No sediment and substrate analyses were presented, nor is there a correlation between the benthic community and the substrate. There was no prognosis of the effect of the enterprise in these communities.
Epilithic Microalgal	The parameters to be used for the monitoring of this community were not presented or justified. The dates of the collection campaigns were not presented, making it impossible to determine their distribution in the hydrological cycle. The variability of biotopes was not observed and only collections were made in the main channel of the Xingu River. Density and richness analysis were not extended to all taxonomic classes found. No similarity indices were reported between the different compartments of the Xingu River. No correlation was found between the biomass of the epileptic community and nutrients. No analysis of factors limiting primary production was presented. Still, the estimation of the affectation of pedaled areas presented does not contemplate the one requested in the Terms of Reference.
Aquatic Macrophytes	(...) IBAMA reported several nonconformities regarding compliance with the RT, namely no printed and digital map containing the samplings of studies of aquatic macrophytes of the year 2001. Sampling did not include marginal lagoons and the expected backwater with the formation of the reservoir; The biomass analysis was not performed for the whole community and did not consider the variation along the sample area and the seasonality. And there were no multivariate analyses that looked at the community, collection sites, and physical-chemical variables (...)
Infrastructure, Urban Equipment, and Public Services	The human resources in education and of the technical-professional staff of the prefectures qualitative and quantitative analysis was not presented. In addition, the study does not include the water quality data offered to the population of Altamira and Vitória do Xingu and the location of the urban network, the Direct Influenced Area (DIA) and the works planned for the project, the catchment points,

Item	Observation
	adduction and supply networks and treatment plants of Vitoria do Xingu. It was agreed at a meeting between IBAMA and Eletrobras that such information will be provided after acceptance of the studies, to subsidize the analysis of merit by IBAMA.
Economic Characterization	In a meeting, IBAMA questioned the non-submission of a producer's register related to mineral extraction. Eletrobras' proposal for presentation to the Directly Affected Area (DAA) was accepted, according to the studies. At the same meeting, IBAMA said that other productive arrangements for foreign trade must be verified, or their non-existence affirmed. In addition, IBAMA requested Eletrobras to present the General Fisheries Registry of the Special Fishery Secretariat, from the research area of the ichthyofaunal, to serve as a reference for fishing communities. It was agreed that such information will be provided after acceptance of the EIA, to support the analysis of merit by IBAMA.
Identification and Evaluation of Environmental Impacts	The Impact Assessment did not include the most significant changes brought by the undertaking in the indigenous communities, as requested in the RT. Information on indigenous populations concerning the IBAMA analysis should be in the body of the EIS related to the relevant themes, as requested in the RT issued by IBAMA, although compiled in a single volume.

Source: IBAMA (2009a).

Regarding the Water Quality and Limnology item in Chart 1, the lack of studies on the Indigenous Lands' water quality is a serious failure, as these populations use the resources of the rivers for subsistence. This is a region with high fishing exploitation, where fishing is a structuring activity of the community economy. Consequently, the trend is the subsequent scarcity of resources and the replacement of ichthyofauna species (Fundação Nacional do Índio [FUNAI], 2009). In the Xingu River there are several endemic species, such as the acari-zebra (Hypancistrus zebra), tucunarés (Cichla melaniae, and C. mirianae,) and pacu-capivara (Ossubtus xinguensis) (Santos, 2009). Therefore, it was crucial to measure the enterprise impacts on water quality to provide tools for an effective analysis of the consequences, but they were only partially attended.

In addition, IBAMA's technical team concluded that the EIR was not suitable for publicity, because the language used would not be appropriate to provide an effective understanding of the enterprise to the interested communities. The EIR aims to communicate the EIS's results to all interested public and, therefore, the language presented must be easily understandable. An adequate language, which should not be extremely technical and scientific, facilitates the public understanding of the enterprise and its impacts and, therefore, it will be based on possible questions and discussions about the subject.

Hence, as a conclusion of the technical opinion regarding compliance with what was required in the RT, IBAMA demanded that the entrepreneur submit some items for acceptance of the studies, to make it available to the public. This additional information is presented in Chart 2. Moreover, IBAMA required other documents necessary for the merit analysis of the studies, but these could be delivered after acceptance.

Chart 2 – IBAMA requirements for acceptance of the EIS and EIR

Required documents
1) Speleological study, biotic part, according to specific RT issued by the National Center for the Study, Protection, and Management of Caves - Cecav, of the Chico Mendes Institute for Biodiversity Conservation - ICMBio.
2) Concerning water quality studies (predictive models), it is requested the modeling results for the parameters described in the RT, or to present the justification for their non-performance.
3) Information on indigenous peoples concerning IBAMA analysis should be in the body of the EIS, related to the relevant themes, as requested in the RT issued by IBAMA.
4) The Environmental Impact Report should be restated.

Source: IBAMA (2009a).

A comparative analysis of Charts 1 and 2 shows that several items that were required by IBAMA in the RT were not fully contemplated in the first version of the EIS presented by the entrepreneur. Nevertheless, as a requirement for acceptance of the EIS, IBAMA only required the submission of four documents that, although important, do not include all of the items that were previously judged, especially when considering the size of the venture.

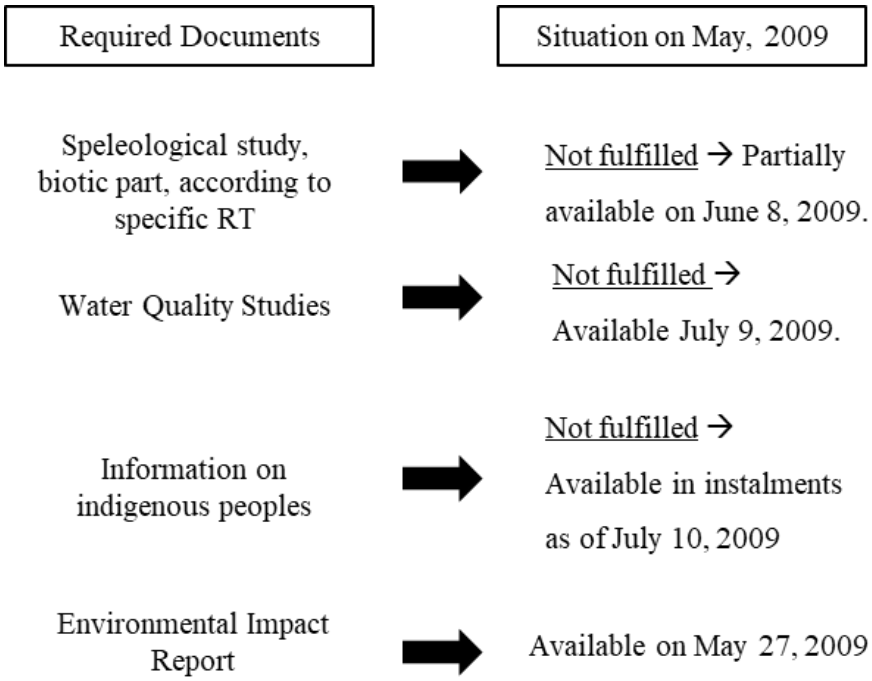
The EIS approval with some missing important information may have some consequences. Firstly, many impacts may occur that were not predicted in the studies and, therefore, would not have mitigation or compensation actions, which can cause serious implications for the environment. Moreover, it is incumbent upon the licensing agency to protect the environment and to require ventures to raise any impacts they may cause and to mitigate or compensate for these impacts to result in the least possible degradation to the environment. Following what should have been the compliance with the requirements made by IBAMA, a new EIS and EIR were presented in May 2009, and published on IBAMA's website on July 21 of that year.

Environmental Impact Studies elaboration

On May 25, 2009, IBAMA announced the receipt and acceptance of Belo Monte Hydroelectric Facility EIS and EIR. By the technical opinion emitted by IBAMA, previously discussed in this paper, the acceptance of the new EIS was subject to the presentation of four essential documents presented in Chart 2. However, until May 25, the deadline for acceptance of the new EIS, none of the constraints required by IBAMA had been presented, according to Figure 2.

Regarding the quality of the new studies, among 20 documents required by IBAMA, only 6 were completely fulfilled, 5 were partially fulfilled and 9 were not fulfilled. Among the documents not fulfilled, it can be listed: a document presenting a more detailed study about slope stability, emphasizing Altamira's urban area; a more complete and embracing presentation of the physical characteristics of the watershed and its hydrographic network; the presentation of the socio-environmental guidelines that will guide the operational rule of the enterprise. As well as it should have presented: complements of surveys of aquatic macrophytes and the evaluation of their importance in the sites, the water quality data that would be provided to the population of Altamira and Vitória do Xingu; besides some other documents. Therefore, it can be seen that not all the items required by IBAMA in the RT were included in the EIS and, nevertheless, the environmental studies presented by the project proponent were accepted by the environmental agency responsible for the process.

Figure 2 – Conditions required by IBAMA to accept environmental studies and their situation



Source: Adapted from Parecer Técnico (2009).

One of the criticisms of the failure to comply with all the RT requirements in the preparation of environmental studies is that this corroborates a large number of environmental licensing constraints. According to a technical report issued by the Brazilian Court of Audit, a significant number of the constraints stipulated in environmental licenses are issued by IBAMA. The technical team found that this is due to the fact of poor quality of environmental studies and for these reasons, technical analysts, as a precaution, require a great number of constraints to fill the deficiencies of the studies. That was the case of the Belo Monte hydroelectric licensing process, as it will be seen later.

Social, Economic, and Cultural Diagnosis. According to Magalhães *et al.* (2009), the EIS presented is devoid of the basic foundations that are required for this type of study, to provide a basic knowledge and orientation in the intervention of social space. Analyzing the social, cultural, and economic diagnosis section, there is a lack of bibliography that provides a specific view on the region, ignoring the vastly published national and international bibliography about the study area, essential to understanding actors and social processes that have had and still take place in the region.

Fearnside (2011) affirms that there are 28 indigenous ethnicities in the Xingu watershed, with two of them being directly affected by the construction of the hydroelectric. However, according to the National Office of the Human Rights to

the Environment, 24 of these groups were not heard during the licensing process, violating their constitutional right to be previously consulted. This is indicative that the scope and intensity of the impacts of the enterprise, which did not consider a significant number of affected groups, were not correctly and effectively measured.

Impacts Evaluation. Analyzing the significant impacts listed in the EIS, regarding the enterprise planning and construction stages, positive social impacts listed include, among others, the generation of expectations in the local and regional population, increase of income, and the expansion of labor supply. Negative impacts listed are, for instance, intensification and disordered land use occupation, especially in the surroundings of the residential part of the town, as a consequence of the increased flow of people due to the city's growth. Another listed impact, due to this city's growth, is the possible increase in the spread of endemic diseases and the possibility of introducing new ones.

In addition, the compulsory population reallocation was also addressed, due to the filling of the reservoir culminating in the loss of socio-spatial and cultural references, the impact was considered reversible in the long term. The population, forced to leave their place of residence, can suffer irreversible impacts. These immaterial goods, are difficult to replace, considering that the culture and traditions of these people are linked to the locals. It should be noted that little discussion about these social impacts is found in the EIS, especially regarding the impacts on indigenous populations. This reflects the low importance given by the project proponent to these issues, which are the most significant and should be addressed with priority.

Management Plans. According to Magalhães *et al.* (2009), the EIS was organized in a way that a great part of the efforts was carried out in the environmental diagnostic stage of the studies, while the mitigating measures were reduced to only one volume. In addition, indigenous societies are treated only in the penultimate volume before the last volume of references.

Mello (2009) analyzed that the Plans and Programs presented only refer to the function of mitigating the impacts on population, vegetation, and fauna. For instance, it is stated that in the municipality of Altamira, floods can occur up to quota 100, due to the Xingu reservoir, directly affecting 5,000 properties. As a mitigating measure, it is stated that "all these establishments will have to work in other places" and refers the solution of this problem to the Plan of Attention to the Attained Population.

Another example is that the studies assert that the change in water quality will compromise fishing, which is a source of subsistence and an essential income for the indigenous peoples of the region, a fact that is referred to as the monitoring of the Water Quality Monitoring Program (MELLO, 2009).

Public participation

The Belo Monte Plant had its reservoir filled in December 2015, and the additional 233 MW plant and the first turbines of the main 11,000 MW plant are operating. The process was finalized without any measures being taken to protect the indigenous territories (land regularization and inspection) and to mitigate other impacts. The result is that people have lost control over part of their territories and natural resources. They have suffered from several impacts, such as increased deforestation, food security risks, and worsening health care, among others (Instituto Socioambiental [ISA], 2015; SULLIVAN, 2016).

The construction of the Belo Monte Hydroelectric Power Plant in the Xingu River Basin was challenged from the outset in 1985. Experts have warned about the unprecedented impact that the activity would cause on the region's ecosystem, with the reduction of water volume in the stretch known as Volta Grande, irreparably affecting wildlife and fishing, which will essentially disappear from a 100 km stretch below the main dam, including in two indigenous areas (Fearnside, 2015). In addition, some 510 km² of forest were flooded (FEARNSIDE, 2012).

The mandatory public hearings that preceded the project passed through a process of investigation by the Federal Public Prosecutor's Office because they did not include the participation of the population of the Xingu and all its indigenous communities (REDE BRASIL, 2009; SULLIVAN, 2016). However, the licensing process, despite a series of disputes, went ahead and culminated in the operating license granted in 2015.

Decision

The issuance of the PL took place on February 1, 2010, with 40 (forty) constraints related to water quality, fauna, basic sanitation, affected population, social compensation, and recovery of already degraded areas, among others (IBAMA, 2010a). Before its issuance, IBAMA technical staff launched a technical opinion (IBAMA, 2010b) opposing the PL approval (FEARNSIDE, 2017).

According to Fearnside (2012), in the following months after the PL issuance little effort was made to fulfill the requisites. On June 11, 2011, the IL was issued, with only 5 of the PL's constraints attended according to the NGOs and 16 according to IBAMA. The launch of the IL allowed the construction of dams, dikes, powerhouses, bypass channels, spillways, main water intake, vessel transposition systems, and vessel systems. The license was valid for 6 years and had constraints about the implementation of the programs and projects included in the

environmental management plans presented in the EIS, as well as the presentation of semi-annual reports related to these plans, among others

IBAMA technical staff issued, on September 10, 2015, a document with 242 pages with a formal opinion detailing a series of conditions that still had not been met, that should be fulfilled before granting the operation license (FEARNSIDE, 2017). Nevertheless, despite the socio-environmental impacts caused by Belo Monte and most of the stipulated conditions not being met, on November 24, 2015, the OL for the project was granted. With 34 constraints, it allowed Norte Energia, the company responsible for the construction of the hydroelectric facility, to begin filling the plant reservoir. The reservoir was filled in December 2015, and the 233 MW supplementary plant and the first turbines of the main plant began to be used commercially (RITTER *et al.*, 2017).

Monitoring

The OL of the enterprise has 34 constraints, with actions referring to several Plans and Projects that were proposed in the EIS, among other conditions. It is worth mentioning the item which concerns the water quality. In this item it is requested that daily monitoring should be performed in-depth profile at the points defined in the Reservoir Fill Plan, considering parameters such as dissolved oxygen (DO), biochemical oxygen demand (BOD), nitrogen, phosphorus, E. coli, pH, turbidity, electrical conductivity, and temperature. These results should be sent to IBAMA for follow-up. However, in seeking these reports on the IBAMA website, nothing regarding this item was found.

IBAMA, as a licensing agency, should demand compliance with the conditions of the license, and cannot be omitted if these are not being complied with. However, there are few actions taken by the agency regarding the supervision and collection of compliance with the conditions by the entrepreneur. Most of them have already expired and have not yet been finalized, causing numerous impacts on the environment and the population affected by the construction and its effects.

More than seven years after the start of its operation, a stark disparity emerges in the fulfillment of stipulated conditions for the Belo Monte Hydroelectric Facility. An in-depth technical review by the IBAMA has revealed that out of the 47 specified conditions, a mere 13 have been satisfactorily met (SANSON, 2023). Another 21 are still in progress and eight pending issues have been completed, such as making household connections to the sewage network in Altamira, the main city in the area (BECHARA; CANIATO, 2023).

Adding to the legal intricacies surrounding Belo Monte, the Ministério Público Federal (Federal Public Prosecutor's Office) has raised serious concerns through at least 29 legal actions, exposing various irregularities in the construction and

operational processes of the hydroelectric plant. Most notably, in 2022, the Supreme Federal Court (STF) acknowledged that the federal government had violated indigenous rights by failing to conduct the mandatory prior, free, and informed consultations as outlined by the International Labour Organization's Convention 169 (SANSON, 2023).

Problems persist regarding the facility, particularly in crucial areas. Housing remains a central concern, with over 10,000 families forcibly displaced, and even now, a thousand families await the promised new accommodations, highlighting unfulfilled commitments. Additionally, the severe depletion of fish populations due to altered water flow in the Xingu River, impacting a critical 130-kilometer stretch called Volta Grande do Xingu, underscores an irreversible loss of aquatic biodiversity. Moreover, reduced water flow has led to the drying of alluvial forests, disrupting fish reproduction and emphasizing the urgent need for a comprehensive reassessment of the project's impact on both the environment and affected communities (BECHARA; CANIATO, 2023).

The license renewal for the Belo Monte Hydroelectric Plant has been overdue since November 2021, creating a crucial situation. Deciding its fate involves a deep technical dive, a crucial step to check if the project still follows the environmental rules and promises. However, it's not happening quietly - there's a lot of attention and pressure from different groups, like environmentalists and the local communities who are directly impacted. The delay in license renewal and all the attention on this project highlight the urgent need for a thorough and open evaluation. It is essential to make sure that this project lives up to what it promised and takes care of the environment and the people, especially considering the evolving challenges.

Final considerations

Based on the results presented, it can be highlighted that the main problems in the EIA process of the Belo Monte hydropower facility were:

- The impacts on the populations should be considered the most significant ones, especially when regarding the size of the enterprise, which affected different people, with different customs from each other. Despite this, it was noticed in the licensing process, that little detail of these impacts, whose magnitude was not considered or suitable evaluated, besides underestimating the local population's importance to the country.

- It is worth mentioning the role of IBAMA and the entrepreneur in this process. The EIS was presented without having dealt with several items that were requested by the licensing agency. Although it required the presentation of some of these items, IBAMA accepted the final EIS without the presentation of its requirements.

This resulted in licenses with a great number of constraints, but there was no effective monitoring of them since several constraints had not been finalized when the OL was emitted.

- Moreover, the entrepreneur used IBAMA's endorsement to leave aside along the EIA process a series of items that should have been considered as a priority. The most important of these are the indigenous peoples, the most sensitive population to be affected, who have been neglected in this process and have not all been heard, nor have their impacts assessed to allow measures and actions that could have been directed exclusively to these people.

Thus, it is noticed that many items required by the environmental agency for the viability of the project were not fully complied with, and some were only partially attended. The construction of the hydroelectric facility affected the entire biome in an area of thousands of km², as well as provoked alteration of the river flow regimes. It also disrupted the lives of hundreds of communities that lived in the place, without providing them with suitable subsidies to maintain their customs before the enterprise.

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