Title: Reasons to approve hydropower projects in Brazil

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1. Introduction:

Brazil has an electricity generation matrix of predominantly renewable origin, with hydroelectric generation responding in 2015 for 64% of the electricity supply (EPE, 2016)

However, building hydroelectric power plants can have significant environmental impacts, which are very often irreversible (WCD, 2000). The environmental impacts could be even more relevant if the hydropower plant projected is to be developed in an environmentally relevant or sensitive areas (Kumar et al., 2011 and Winemiller et al., 2016).

It is therefore important to point out that hydroelectric generation expansion in Brazil will be highly concentrated (86% in terms of installed capacity) in the Amazon region, where the water resources are quite abundant and available, however this region that represents the planet's largest biodiversity reserve (IBAMA, 2002).

Thus, it is fundamental that the planning, construction and operation of hydroelectric plants be carried out within a broad and robust process of environmental impact assessment (EIA)

In Brazil, EIA is carried out in order to provide elements for the environmental licensing instrument, provided by Law no. 6.938/1981.

Brazil's EIA procedure has 3 (three) stages, and in each of which it is necessary to obtain specific licenses: (i) prior license, when the project environmental viability is discussed, as detailed below; (ii) installation license, when the work is authorized to start; and (iii) operating license, when the enterprise is authorized to operate, which, in the case of hydroelectric plants, includes filling the reservoir and power generation start-up (Law no. 6.938/1981);

In the 1st stage, or prior licensing stage, the project is assessed in terms of location and concept, based on EIR (Environmental Impact Assessment Report) analysis. If the environmental body certifies the project environmental viability, the Prior License is issued and requirements to be fulfilled in the process next phases are established (CONAMA Resolution no. 237/97);

This paper aims to discuss how the concept of environmental viability or sustainability has been applied by The Brazilian Environmental Institute (IBAMA) to support the issuing of environmental permits of hydropower plants.

2. Material and Methods

Data was collected by reviewing 24 (twenty-four) out of all the 29 (twenty-nine) federal environmental licensing processes for hydroelectric plants that had been through the prior licensing phase. The complete research was published in Andrade and Dos Santos (2015). This paper will highlight the most important findings.

A list of all process analyses was included at Annex 1. When reviewing hydroelectric plants federal environmental licensing processes, this study looked for the most important criteria adopted in the EIA when discussing viability and the reasons to declare a project environmentally unsustainable.

3. Results

In diagnosing hydroelectric plants licensing processes where environmental viability was discussed, it was found, in practice, that there pattern both in the EIA and in the licensing body technical opinion to determine an enterprise environmental viability and to evaluate EIA quality.

In the analyzed EIRs, the main reasons to justify the environmental viability were the possibility of minimizing negative impacts forecast by adopting environmental programs and mitigating measures, followed by the possibility of generating income and boosting the region's economy (Figure 1). The reasons to justify the environmental viability at EIRs for each process analyzed is presented at Annex1.

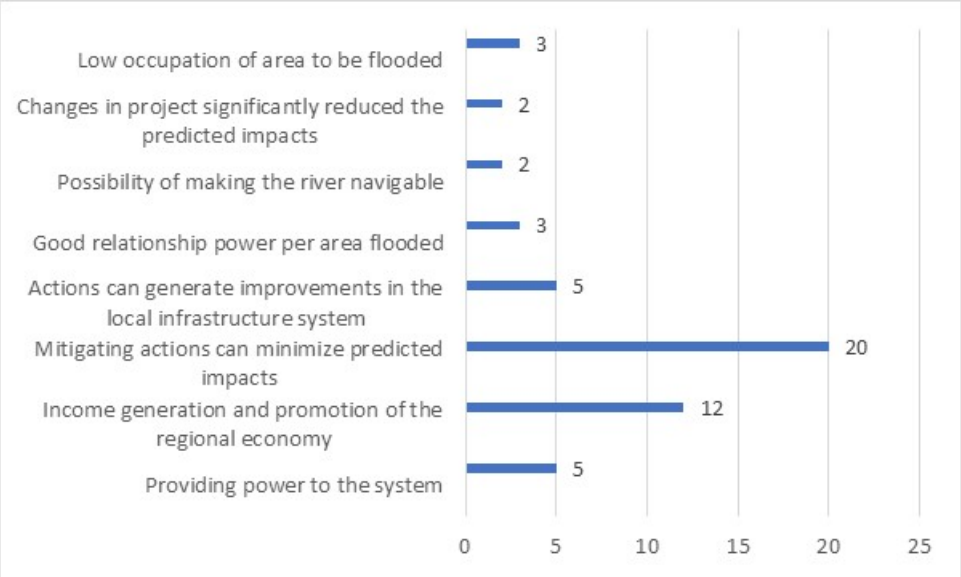

Figure 1 - Reasons to justify the environmental viability at EIRs

It was observed that diagnosis and prognosis presented are very often non-conclusive, so the licensing institution frequently resorts to the precautionary principle as a justification for an environmental license request rejection, or the need for additional information to complement the study.

In 79% of the cases (19 out of 24 projects), complementary information was requested, what contributes to the delay in the entity's final position announcement regarding the enterprise's prior license issuing. According to this research, it takes, on average, 5 years and 4 months to the federal agency to give the final answer to the prior license request.

In the processes in which environmental viability was discussed, it was found that certain information types are very often requested. Subjects that are usually requested is depicted in figure 2.

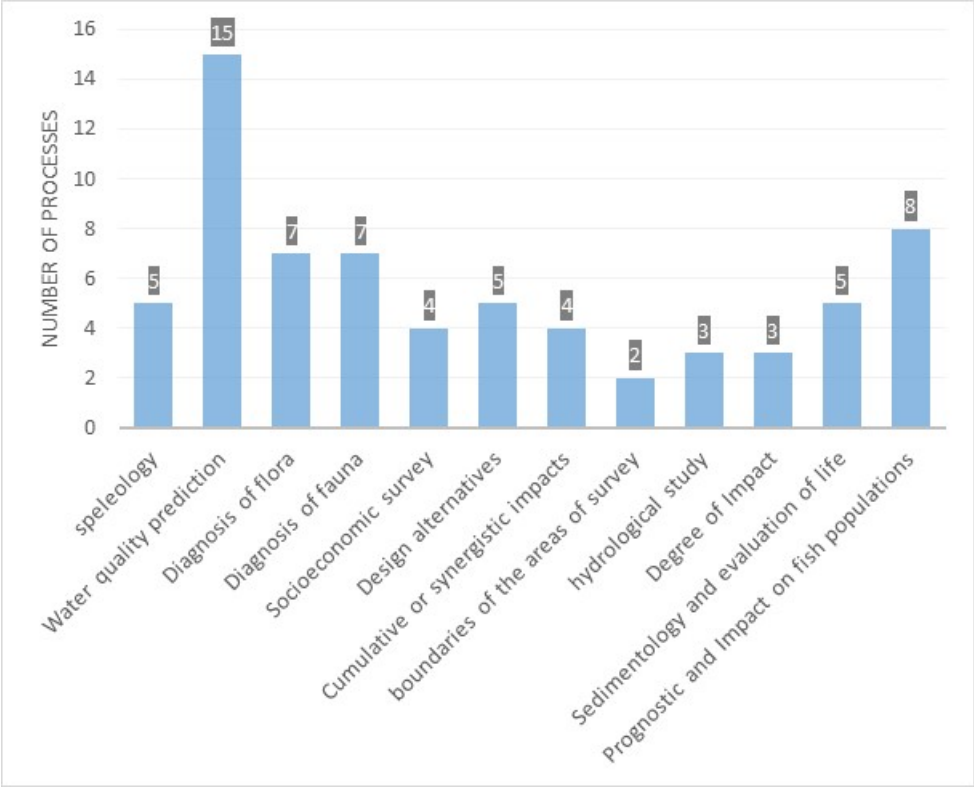

Figure 2 – Usually requested complementation

It was verified that IBAMA´s final decision if often qualitative, subjective and discretionary even though based on environmental studies. Some criterias were used to check if the hydropower project was environmental viable or sustainable:

- verification if the installation or operation of the project would result in the violation of any law or legal rule;
- evaluation if is being proposed the better locational and technological alternative for the project;
- assessment if the most significant environmental impacts are mitigated, reversible or temporary;
- review if the environment can withstand the impact of the installation and operation of an enterprise and maintain a minimum environmental quality;
- assessment if there is a positive balance between gains and environmental costs;
- assessment if the scenario that considers the installation and operation of the project is more promising than the scenario in which the project is not built.

It was also identified the reasons by IBAMA to reject or suspend Prior Licenses (Annex2).

When analyzing the processes that were evaluated for environmental sustainability by the federal licensing body, it was found that in 85% of hydroelectric plant processes in which the prior license was granted, significant environmental improvements were identified due to environmental sustainability discussion. Such improvements resulted in project alterations or in the inclusion of mitigating programs or measures that were not initially present. The most frequently identified environmental improvements are shown in Figure 3.

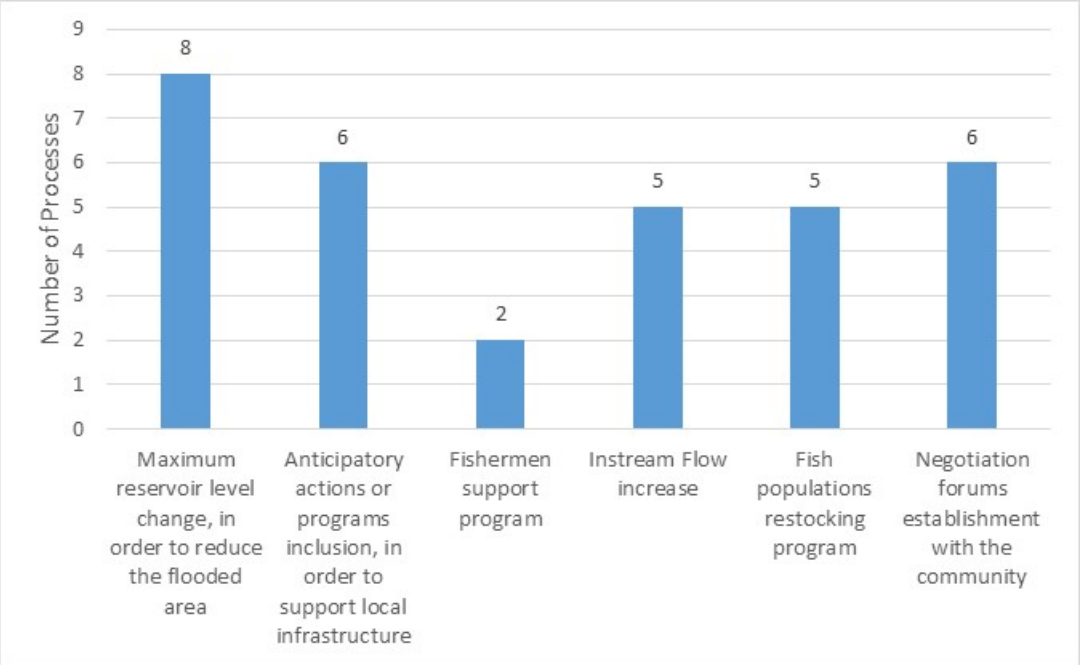

Figure 3 - Environmental improvements identified in hydroelectric plants licensing processes

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5. Annex 1 - Reasons to justify environmental viability at EIAR

Nº	Hydropower	Reasons to justify environmental viability at EIAR
1	Aimorés	Entrepreneurship will generate positive ecological and economic impacts in order to motivate the preservation and creation of other planned options of use and exploration in the area, which minimizes the negative impacts caused.
2	Batalha	Implementation of the enterprise can accelerate the dynamics of the region's economy; Negative effects should be minimized by the implementation of the environmental programs proposed in the EIA

3	Belo Monte	Pressure for deforestation of the region will continue to occur in the event of non-installation of the development; (PDRS - Xingu, contributing to the sustainable development of the region, anticipatory actions in support of local infrastructure can minimize the effects of expected migration, environmental compensation actions may contribute to the protection of areas Changes in design and proposed mitigating measures are able to reduce most of the predicted impacts and the energy to be generated will be quite significant.
4	Cachoeira	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population
5	Castelhanos	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population
6	Couto Magalhães	Change in project considerably reduced the environmental impacts of the project, positive impacts arising from the generation of energy and dynamism of the local economy, possibility of reducing the environmental impacts predicted through the adoption of proposed mitigating measures
7	Davinópolis	Region where the enterprise will be inserted is a fairly anthropized area, impacts may be minimized, possibility of the enterprise boosting the region's economy, construction of the enterprise will increase the water availability for the Davinópolis AHE region and will provide multiple use of river
8	Estreito (Parnaíba)	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population
9	Estreito (Tocantins)	Possibility of improvements for the region's population, in the areas of health, education, resettlement infrastructure, increase of revenue for municipalities, possibility of mitigation and compensation of the foreseen impacts
10	Foz do Chapecó	EIAR not available
11	Ipueiras	EIAR not available
12	Itaocara	With the adoption of mitigation programs and measures, it was not envisaged the occurrence of impacts of great relevance
13	Jirau	Good relation reservoir / power area, possibility of building locks to make river navigable in the stretch, possibility of mitigation of the most significant adverse impacts, positive impacts considered relevant
14	Pai Querê	Mitigating measures and environmental programs are able to mitigate predicted environmental impacts
15	Ribeiro Gonçalves	Not specified
16	Santo Antônio (Jari)	Alteration of the project resulted in a significant decrease in the magnitude of the impacts, vegetation to be suppressed and the reduction of habitat imposed will not be limiting for the preservation of the local fauna, especially if it is considered the continuous widths of similar vegetation in the area of influence, waterfall to be affected already Represents a natural obstacle to the migration of fish, few families to be relocated.
17	Santo Antônio (Madeira)	Good relation reservoir / power area, possibility of building locks to make river navigable in the stretch, possibility of mitigation of the most significant adverse impacts, positive impacts considered relevant
18	São Manoel	Sparsely populated region; Possibility of local development and generation of jobs, possibility of minimizing environmental impacts through the adoption of mitigating measures and environmental programs
19	São Salvador	Possibility of minimizing the negative impacts and relevant positive impacts from the socioeconomic increase of dynamism of the region
20	Serra do Facão	Possibility of minimizing negative impacts, suggested environmental programs can improve the region's environmental quality, relevant positive impacts resulting from the availability of energy and construction of two bridges over the reservoir to facilitate access

21	Simplício	Positive impacts resulting from the availability of energy and socioeconomic dynamism of the region, most of the adverse impacts are temporary and can be mitigated through the execution of mitigation actions.
22	Teles Pires	Positive balance between negative and positive impacts resulting from the project, low human occupation of the area directly affected, excellent power / flood ratio, possibility of minimizing negative effects arising from the installation of the project.
23	Tijuco Alto	Changes in the project have reduced the negative impacts and can generate positive impacts (control of floods in the river valley, possibility of navigation in the reservoir and use of the lake for tourism purposes), an enterprise can induce regional economic development, predicted impacts can be mitigated through implementation of environmental programs
24	Uruçui	Possibility of generating income and local development, energy to be made available to the system, mitigating measures can guarantee environmental quality of the region, programs to mitigate impacts on the population can result in improvements for the affected population

6. Annex 2

Nº	Hydropower	Reasons of IBAMA to justify the suspension or rejection of Prior License
1	Couto Magalhães (150 MW)	Reduced flow instream flow passage does not allow aquatic ecosystems maintenance.
2	Ipueiras (460 MW)	Flooding of large areas of cerrado with significant importance, flooding of marginal lagoons, unfavorable power / flooded area ratio, intention of establishing a protected area in the area to be flooded.
3	Itumirim (60 MW)	Direct interference in Emas National Park.
4	Marabá (2160 MW)	Flooding of indigenous land.
5	Pai Querê (292 MW)	Possibility of endemic species extinction, interference in the priority area for biodiversity. conservation, intention of establishing a protected area in the area to be flooded, interference in archaeological heritage area (Passo de Santa Vitória).
6	São Luiz do Tapajós (8000 MW)	Flooding of indigenous land.and lack of presentation of requested information
7	Santa Isabel (1087 MW)	Potential impact in a Conservation Área (Serra dos Martirios State Park, interference in caves, areas of endemism and scenery of the Araguaia guerrilla.
8	Serra Quebrada (1328 MW)	Flooding of indigenous land.
9	Tijuco Alto (144 MW)	Reason for the initial rejection: Interference in caves, quilombola communities, Atlantic Forest remnants, risk of species extinction, poor diagnosis of vegetation to be removed, fish populations to be affected. Possibility of lead contamination. Lack of integrated impacts assessment.
10	Tupiratins (620 MW)	Affects indigenous land.
11	Uruçui (134 MW)	Unfavorable installed capacity/flooded area ratio. Need for removal of riparian populations and flooding of large cerrado fragments with importance to local wildlife. Interference area of great importance for Ichthyofauna breeding (flooding of marginal lagoons).