Article

Mercator, Fortaleza, v.20,e20017, 2021. ISSN:1984-2201

HYDROELECTRIC PLANTS AND CONSERVATION UNIT IN THE AMAZON

https://doi.org/10.4215/rm2021.e20017

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Article history:
Received 23 December, 2020
Accepted 25 February, 2021
Published 15 May, 2021

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Abstract

The expansion of hydroelectric plants (HEPs) in the Brazilian Amazon region attracts attention because of its several social, economic, and ecological impacts, and because its directly or indirectly affects institutional areas in charge of protecting biodiversity and traditional populations. Among the thirteen interlinked sub-basins of the Amazon river (on the Brazilian border), there are nine hydroelectric plants in operation and an additional seventy five (75) are planned for construction, of which 60 per cent will be built in the Tapajos river basin. The objective of the article is to expose the economic appropriation of this basin, and the social and environmental expropriation taking place in the region. The analysis of these processes requires the spatial mapping of the existing and planned hydroelectric plants and areas officially protected, by hydrological basins. The result points at the confrontation between the developmentalist policies related to the construction of HEPs in the Amazon region and the environmental policies oriented, especially, to protected areas, which shows the social and environmental expropriation happening in this basin.

Keywords: Amazonia, Hydroelectric Plants, Conservation Units, Watersheds.

Resumo / Resumen

HIDRELÉTRICAS E UNIDADE DE CONSERVAÇÃO NA AMAZÔNIA

A expansão de usinas hidrelétricas (UHEs) na Amazônia brasileira chama atenção por ocasionar diversos impactos (sociais, econômicos e ecológicos) e afetar direta e indiretamente áreas institucionais destinadas à proteção da biodiversidade e populações tradicionais. Dentre as treze sub-bacias conjugadas do rio Amazonas (nos limites do Brasil), há nove (09) hidrelétricas em operação e setenta e cinco (75) usinas planejadas, sendo a bacia do rio Tapajós aquela que concentra 60% do número das UHEs planejadas. O objetivo do artigo é evidenciar a apropriação econômica da bacia do rio Tapajós e a expropriação social e ambiental que acontece na região. Para tal análise faz-se necessário espacializar as usinas hidrelétricas (em operação e planejadas) e as áreas oficialmente protegidas, por bacias hidrográficas. O resultado aponta o confronto entre a política desenvolvimentista relacionada à construção de usinas hidrelétricas na Amazônia e as políticas ambientais, voltadas, sobretudo, às áreas protegidas, evidenciando a existência de uma expropriação social e ambiental na bacia em tela.

Palavras-chave: Amazônia, Usinas Hidrelétricas, Unidades de Conservação, Bacias Hidrográficas.

REPRESAS HIDROELÉCTRICAS Y UNIDAD DE CONSERVACIÓN EN LA AMAZONÍA

La expansión de centrales hidroeléctricas (CHs) en el Amazona brasileño llama la atención por ocasionar diversos impactos (sociales, económicos y ecológicos). Esto afecta directa e indirectamente las áreas institucionales destinadas a la protección de la biodiversidad y las poblaciones tradicionales. Entre las trece subcuencas conocidas del rio Amazonas (en los límites de Brasil), hay nueve (09) hidroeléctricas en funcionamiento y planificadas setenta y cinco (75) centrales más; siendo la cuenca del rio Tapajós aquella que concentra el 60% del número de las CHs planificadas. El objetivo del artículo es evidenciar la apropiación económica de la cuenca del rio Tapajós y la expropiación social y ambiental que sucede en la región. Para el análisis fue necesario espaciar las usinas hidroeléctricas (en operación y planificadas) y las áreas oficialmente protegidas por cuenca hidrográficas. El resultado apunta el enfrentamiento entre la política desarrolladora relacionada a la construcción de centrales hidroeléctricas en el Amazona y las políticas ambientales, enfocadas, sobre todo en las áreas protegidas, evidenciando la existencia de una expropiación social y ambiental en la cuenca en estudio.

Palabras-clave: Amazonia, Centrales Hidroeléctricas, Unidades de Conservación, Cuencas Hidrográficas.

INTRODUCTION

The expansion of hydropower plants (HPPs) in the Amazon sparks discussions on the impacts (social, economic and ecological) and their respective scales (local and regional). This debate becomes more worrisome when we observe the Report of the Energy Research Company (EPE), published in 2018, which presents projections for the installation of HPPs in the region until 2050. Data from this report indicates an estimated and untapped hydroelectric potential of 52 gigawatt (GW), in 196 HPPs, considering only those with power above 30 megawatt (MW) (EPE, 2018). The same report shows that about 77% of planned projects interfere in legally protected areas, such as indigenous lands (IL), quilombola territories (QT) or conservation units (CUs).

In the Brazilian Amazon, specifically in the combined hydrographic sub-basin of the Amazon River (Japurá River Sub-basin, Jari River Sub-basin, Içá River Sub-basin, Javari River Sub-basin, Juruá River Sub-basin, Madeira River Sub-basin, Rio Negro Sub-basin, Nhamundá River Sub-basin, Paru River Sub-basin, Purus River Sub-basin, Tapajós River Sub-basin, Trombetas River Sub-basin, Xingu River Sub-basin), there are 204 territories protected by conservation units (CUs), divided into two typologies: those of comprehensive protection (about 64 units of this group) and sustainable use (approximately 140 units), which corresponds to an extensive area of environmental protection, estimated at 104,515,291 hectares, according to the Instituto Socioambiental (ISA, 2020).

Despite areas dedicated to conservation units, these territories will be affected due to the advance in the expansion of HPPS, intensifying social problems related to compulsory displacements, and environmental issues, such as floodplain loss and changes in fishing resources, among others. Thus, considering that the Tapajós river basin is the one that concentrates the largest number of planned HPPs in the Amazon, tthis article highlights the economic appropriation of this basin (from HPPs) and social and environmental expropriation (from protected areas), since the expansion of these plants change and interfere with the limits of conservation units, compromising the exuberant and unique biodiversity of the region.

The decrease and/or losses of protected areas result, among other problems pointed out by Bermann (2007) and Moretto (2012), from changes in ecological flows in the micro and macro scales and from the impacts on the traditional populations that live in them. For these populations, the river means transportation, a fishing site, and its banks, known as lowland areas, are rich in organic deposition, being the place where traditional populations grow their food.

Economic appropriation in this case means using the river to meet the interests of capitalism. According to Cavalcante (2012), these infrastructures are part of a large-scale/global logic that modifies the dynamics of the river, expels the populations in the area to be flooded by the reservoir for electricity generation, intensifies the dislocations of institutional areas for conservation, thus causing social and environmental impacts.

THE CONTEXT OF HYDROPOWER PLANTS AND CONSERVATION UNITS IN THE AMAZON

Brazil has 180 HPPs with more than 30 megawatts (MW), 29 above 1000 megawatt (MW) and only eight above 2000 megawatt (MW). In recent decades, the size of the HPPs have changed in terms of installed power – today they are in gigawatt (GW) (ANEEL, 2019). According to the data available by ANEEL, the Brazilian Electricity Regulatory Agency, the Brazilian Amazon had only seven HPPs in operation between 1970 and 1990, and from the 1990s to the present day 20 HPPs were built, reaching a total of 27 plants currently in operation in the Legal Amazon. Chart 1 shows that, among the plants in operation, three have dimensions above 3000MW of installed power: Tucuruí/Pará with 8.5GW, Jirau/Rondônia with 3.4GW and Santo Antônio/Rondônia, with 3.2GW.

Name of the Hydroelectric Project	Power output (MW)	Consortium	State
Tucuruí	8535	100% to Centrais Elétricas do Norte do Brasil S.A.	Pará
Jirau	3375	100% to Energia Sustentável do Brasil S.A.	Rondônia
Santo Antônio	3150,76	100% to Santo Antônio Energia S.A.	Rondônia
Teles Pires	1819	Companhia Hidrelétrica Teles Pires	Mato Grosso, Pará
Belo Monte	1338,8	100% to Norte Energia S.A.	Pará
São Manoel	700	Energia São Manoel S.A.	Mato Grosso, Pará
Stº Antônio do Jari	373,4	100% to ECE Participações S.A.	Amapá; Pará
Ferreira Gomes	252	100% to Ferreira Gomes Energia S.A	Amapá
Balbina	249,75	100% to Amazonas Geração e Transmissão de Energia S.A	Amazonas
Cachoeira Caldeirão	219	100% to Energia Cachoeira Caldeirão S.A.	Amapá
Ferreira Gomes	252	Ferreira Gomes Energia S.A	Amapá
Samuel	216,75	100% to Centrais Elétricas do Norte do Brasil S.A.	Rondônia
Coaracy Nunes	78	Centrais Elétricas do Norte do Brasil S/A.	Amapá
Rondon II	73,5	100% to Eletrogoes S/A.	Rondônia
Curuá-Una	30,3	100% to Centrais Elétricas do Norte do Brasil S.A.	Pará
Salto Curuá	30	100% to Curuá Energia S.A	Pará
Total 20,693.26	**20,693.26**		

Table 1 - Hydroelectric power plants installed in the states of Amazonas, Amapá, Pará and Rondônia.
Source: Brazilian Electricity Regulatory Agency (ANEEL, 2019).

Whereas the other Brazilian regions (Northeast, Midwest, Southeast and South) concentrate 80% of the installed hydroelectric potential (EPE, 2017. p2), the water potential of the Amazon region stands out as the new hydro-energy frontier and, consequently, has been strongly articulated by economic interests for its complete integration into the national electricity system. Although the Amazon concentrates most of the planned hydroelectric plants in the country, much of this hydro-based electricity is directed to serve the major producing centers in Brazil (FEARNSIDE, 2015; CASTILHO, 2019). Not only this contradiction, the Amazon has the lowest coverage of households served with electricity among all regions of Brazil, and the regional electric matrix is based on thermoelectricity (diesel), as emphasized by the Sustainable Amazon Plan (PAS) (BRASIL, 2008).

The Brazilian Amazon, besides presenting most of the country's hydroelectric potential, is home to the largest areas of protected land, where planned HPPs are close to or within the boundaries of protected areas. According to Cavalcante (2012) and Costa et al. (2017), the expansion of hydroelectric dams in the Amazon affects areas intended for the protection of biodiversity, as is the case of CUs around the Jirau and Santo Antônio HPPs on the MadeiraRiver, north of the state of Rondônia, which directly and indirectly affected eight (08) conservation units (State Forests of Sustained Yield[1], namely: Vermelho River A, B and C, the Antônio Mujica Nava and Serra Três Irmãos Ecological Stations, JaciParaná Extractive Reserve, Bom Futuro National Forest, Madeira River Environmental Protection Area) and two indigenous lands (Karitiana and Karipuna), either with the change in their limits, categories and in the administrative sphere, with exchange of areas between the federal government and states.

Faced with the rich Amazonian biodiversity, which for Moret et al. (2017) should not allow licenses, the projections and implementation of hydroelectric plants have been taking place and expanding. Thus, some concerns must to be emphasized:

•The Amazon area has an abundant and sensitive diversity, and flooding produces losses that can be irreparable to the ecosystem;

•The alteration of the Amazonian ecosystem can produce changes in a macro scale, in the rainfall regime of the region and in the intensity of cold and heat in distant places in the Amazon;

•The populations that live in the Amazonian territory are different and extremely linked to the territory. Therefore, the impacts make their way of life unfeasible;

•The construction of HPPs in the Amazon does not produce local development, worsening

poverty and job creation (MORET et al. 2017, p. 580).

The situation is even worse when we consider the concentration of HPPs by hydrographic basins, both in those that are in the planning phase and in those in operation, since this planning unit allows, on a macro scale, to understand in an integrated way the repercussions of the incorporation of rivers for electricity generation and the loss of Amazonian biodiversity, with the flooding of lakes and/or floodplains and forest areas, causing disastrous consequences to natural resources and traditional populations.

Since they are a public heritage, conservation units stand out for being spaces for the preservation and protection of biodiversity, regulated by Law No. 9,985, 2000, provided for in the National System of Conservation Units (SNUC), and classified into two major groups: 1) Areas of integral protection – areas for preservation, where the permanence of populations in the internal limits of these units is not allowed and 2) Areas of sustainable use – areas of conservation where the housing of traditional populations and the sustainable use of natural resources are allowed. Both areas are important for the balance of local, regional and international environmental flow (BRACK, 2011).

The loss of these areas causes major impacts and may be enough to create social imbalance with economic costs due to biodiversity loss, reduced food security with imbalance of the ecosystem and biome by invasive species, greater contact with and greater diversity of diseases, unpredictable climate, and loss of subsistence of local populations, especially traditional ones. Maintaining the preservation of these areas is elementary, not only for the environmental services provided by nature itself through ecosystems, but also for the traditional Amazonian populations that inhabit them, so that they can maintain their way of life, as Ganem (2011) points out:

> Biodiversity loss is a silent crisis. If not interrupted, it will lead to biotic homogenization of the planet. The evidence of this crisis is manifested in the decline of biological populations and the threat of species extinction, the loss of genetic diversity, the degradation of ecosystems and the extensive loss of habitats (GANEM, 2011, p.03).

Traditional communities and Amazonian peoples have their own forms of social organization: they occupy and use their territories and natural resources as a condition for their social, religious, economic and cultural reproduction, that is, they are culturally differentiated groups, and the territory is the result of relations of the real and the symbolic and in the well-living that is transmitted by tradition, use of knowledge and practices for well-being and self-sufficiency (BRASIL, 2007; ESCOBAR, 2014). Unlike the development logic to which the hydroelectric plant is part and that does not reach all social groups, in particular, traditional populations, the positive impacts fit into the Superior Circuit of economics and the negative impacts on the Lower Circuit of economics, according to Santos (2004).

The “development” propagated by HPPs, in fact, heats the local market temporarily, strictly at the time of construction. With the creation of temporary jobs, the emergence of new service companies that will leave the place after the construction, the jobs generated decrease dramatically, slowing the local economy, and the resources circulating also decrease. This is a result analyzed by Cavalcante (2012 p.3), whose thesis addresses the fragmented incorporation of the Amazon into global dynamics, in which, at the same time that certain areas are (re)structured and articulated to meet external demands, its local organization is (un)articulated, to extinguish traditional activities and other forms of organization, resulting in a scenario of environmental, economic and social instability, thus revealing the use of old models of exploitation and appropriation of Amazonian natural resources.

PRESENTATION OF THE AREA OF STUDY AND METHODOLOGICAL ASPECTS

The Amazon River basin concentrates 42.2% of the Brazilian hydroelectric potential, of which 70% have already been estimated. The basin covers the states of Amazonas, Roraima, Rondônia, Mato Grosso, Pará and Amapá, also including other countries such as Peru, Colombia, Ecuador, Venezuela, Guyana and Bolivia (CASTILHO, 2019). Considering its large size, we sought to focus on the Brazilian Amazon, especially on the limits of the hydrographic basins that compose the Amazon River basin, to

verify which basin contains the highest concentration of hydroelectric plants in full operation and those planned (which have not yet been built), evidencing the concentration of hydroelectric power plants (HEP) by hydrographic basins.

Likewise, conservation units (CUs) per hydrographic basin were mapped to obtain a better understanding and analysis of the impact of HPPs in these protected areas. This procedure (concentration of hydroelectric plants and conservation units in the Brazilian Amazon) allowed delimiting the spatial cutout for the analyses, in which the Tapajós river basin, when compared with the other basins, stood out for presenting the largest number of planned HPPs, as shown in Figure 1, becoming the unit for analysis.

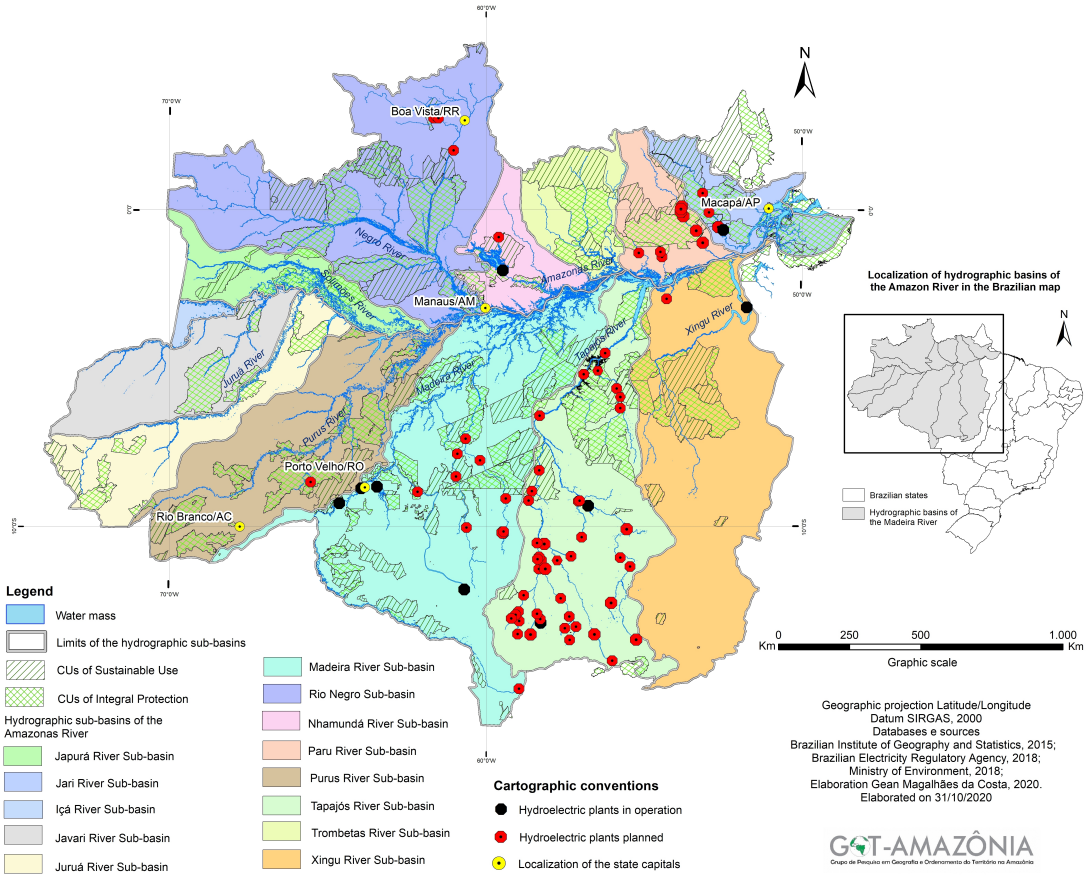

Figure 1 - Location of hydroelectric plants and conservation units in the Amazon River basin, with emphasis on the Tapajós river basin.

The Tapajós basin is formed by the Jamanxim, Teles Pires and Juruena rivers, with an area of 490,000 km2 (SCOLES, 2016). It is located in the states of Mato Grosso, Pará and Amazonas, with a small portion in the state of Rondônia. It covers 73 municipalities, being 59 in Mato Grosso, 11 in Pará, two in Amazonas and one in Rondônia (ICMbio, 2011). According to Oren et al. (1997), Caldwell and Araujo (2005), Espírito Santo et al. (2005), Buckup et al. (2010) and Britzke and Senhorini (2011), in the Tapajós basin, the Humid Tropical Forest predominates, with lush vegetation with a complex forest stratification and high biodiversity with endemic fish species, among others not yet described.

Representing around 6% of the Brazilian territory, the Tapajós river basin has ecological, scenic, social and cultural relevance (WWF, 2016). Since this hydrographic basin is the one that concentrates the largest number of future hydroelectric projects, it requires the attention of public management for actions that can minimize and foresee possible tensions and imminent social and environmental conflicts. According to Schreiber (1972 p.2.), “you cannot establish fixed rules for planning, because topographic, hydrographic, economic and sometimes political conditions are different in each

watershed." Thus, the planning or construction of HPPs in the Amazon involves a set of factors, in addition to the water potential and conditions that each stretch of waterfall presents. The juxtaposition of geographical and political contexts present favorable conditions to the negotiations established between interest groups that act on a national and international scale.

In any case, whether by natural conditions, technical or political decisions, the projections for the installation of HEPs are concentrated towards the southern center of the Amazon, where the hydroelectric potential has not yet been exploited, added to the rich biodiversity and the traditional populations present there. Such characteristics make the Tapajós river basin relevant for the approach on the repercussions of the expansion of HPPs, considering the basin as the planning unit, since it is a topographical delimitation that drains water, sediments and dissolved materials for a common exit at a certain point of a river channel or, as pointed out by Guerra (2006), because it is a system that allows understanding the changes in land use patterns and their environmental implications.

ECONOMIC, SOCIAL AND ENVIRONMENTAL APPROPRIATION OF THE TAPAJÓS RIVER BASIN

The greatest environmental threats in the Tapajós river basin were described by Scoles (2016), being mining, the advance of livestock in the state of Mato Grosso, deforestation with substantial forest losses, wood extraction, added to the construction of hydroelectric plants that figure as the potential for a greater impact, given the amount of constructions. The municipality of Santarém in the state of Pará is the largest in the basin. With an estimated population of 300,000 inhabitants, it has emerged in the last decade as an important soybean producer state. Such process indicates a worrying scenario of environmental tensions and social conflicts, since this basin, according to World Wide Fund For Nature Brazil (2016), has about 40% of its area protected by conservation units and indigenous lands: there are nine integral protection conservation units (8.1% of the basin), 20 conservation units for sustainable use (13.6% of the basin) and 30 indigenous lands (17.9% of the basin).

The density of hydroelectric dams planned for the Tapajós basin and its proximity relationship with conservation units will enhance the redefinition of the limits of protected areas already underway, such as the case with the redefinition carried out by Federal Law No. 12,678 of June 25, 2012, involving the Amazon National Park, Itaituba National Forest I, Itaituba II, Environmental Protection Area of Tapajós and Crepori National Forest, under the justifications of "public need" or "social action", which, in this case, facilitates the licensing and consequently installation of hydroelectric plants (BRASIL, 2012, RAISG, 2016). Although dislocations are relatively small, undersizing is common to minimize the impacts of the changes, as shown in Table 2.

Conservation Unit	Protection Group	Area before size redefinitio n(ha)	Area after size redefinition (ha)	Area excluded (ha)	Hydroelectric project	Status after size redefinition
PARNA da Amazônia	Integral protection	1.114.496	1.070.737	43.759	São Luis do Tapajós	Reduced
FLONA Itaituba I	Sustainable use	220.034	213.238	6.796	São Luis do Tapajós	Reduced
FLONA Itaituba II	Sustainable use	440.500	412.047	28.453	São Luis do Tapajós	Reduced
APA do Tapajós	Sustainable use	2.059.496	2.039.580	19.916	Jatobá	Reduced
FLONA de Crepori	Sustainable use	740.661	739.906	856,00	Jatobá	Reduced

Table 2 - Tapajós River Basin Conservation Unit that had Limit Redefinitions in Areas Near Planned Hydroelectric Power Plants. Source: Based on the Socio-Environmental Institute - ISA, (2020).

Thus, there is an institutional flexibilization already verified by Costa et al. (2017), in which the administrative sphere uses provisional laws and measures, without specific technical studies that justify the redefinition of their limits, in favor of the installation of hydroelectric plants. Regarding the Tapajós river basin, especially in the relationship of hydroelectric plants and conservation units, the basin has a significant biodiversity of birds, amphibians, primates, forest and ichthyofauna; five conservation units have already reduced their areas (99,780 hectares), and eight conservation units are under threat of changing their limits due to planned HPPs, as shown in Chart 3. This data is a warning to society about the decrease in biodiversity that affects the lives of Amazonian populations, especially the traditional ones.

Conservation Unit	Protection Group	Hydroelectric project
Flona do Urupadi	Sustainable Use	Chacorão
Parna do Juruena	Integral Protection	Foz do Apiacás, JRN-234b e JRN-277
PES Sucundori	Integral Protection	Jatobá, Cachoeira do Caí e Jamanxim
Flona do Amanã	Sustainable Use	Jatobá
Flona do Trairão	Sustainable Use	Águas Lindas
Parna Jamanxin	Integral Protection	Jamanxin, Cachoeira dos Patos e Jardim Ouro
Flona Jamanxin	Sustainable Use	Cachoeira dos Patos
ESEC Iquê	Integral Protection	JRN-720

Table 3 – CUs of the Tapajós River Basin under Threat due to planned HPPs. Source: Based on the Socio-Environmental Institute – ISA (2020).

The impacts cannot be measured only by the percentage of lost or deforested areas, but by the decrease in biodiversity, such as the production of lakes and reservoirs and consequently alteration in the aquatic environment and fishing resource that changes the entire economic and social dynamics of the surrounding communities. In the Tapajós basin, the construction of 45 HPPs is planned, of which 12 have a direct influence on the limits of the CUs, pointing out future redefinition, and two HPPs are already in operation: the PPG – 159 (Salto Utiaruti) and Teles Pires, as shown in Figure 2.

Although energy is a structuring factor for society, it interferes in the micro and macro aspects of the economy, as Moret (2000) and Cavalcante (2012) observe when approaching the impacts caused by hydroelectric power in the Amazon. The authors call attention to the fact that studies and environmental impact assessments are not conducted individually, as determined by the National Council for the Environment (CONAMA), which mentions the criteria for environmental licensing, through CONAMA Resolution 001/1986 and 237/1997, which define that studies for the installation of HPPs should incorporate the entire basin and not just the river that will be used and also the attributions defined by Law no.10.847/2004 of the Energy Research Company (EPE), in the promotion of studies of energy potential, including inventory of watersheds, but this has not been considered. Studies must analyze the cumulative effects of the planned plants with those already in operation, considering the junction and integration of synergistic effects on the basin.

The concentration of HPPs by hydrographic basins, as is the case evidenced here, reaffirms that the basin is the best unit of analysis and, in turn, the best planning unit, because it is a geographical compartmentalization that integrates natural and social processes, being able to show possible imbalances (CUNHA; WAR, 2012 p.353). Moreover, Federal Law No. 9.433/1997, establishing the national water resources policy and system, in article 1 reinforces the importance of the basin as a unit for planning: item V – the watershed is the territorial unit for implementation of the National Water Resources Policy and the action of the National Water Resources Management System.

Generally, large infrastructure projects in the Amazon are implemented in areas with a rich biodiversity. According to Cavalcante (2012; 2018), these areas receive HPPs, waterways, ports, roads, etc., aimed at economic appropriation by the exploitation of their natural resources, causing such peripheral areas to be added and articulated to meet world circuits and not necessarily incorporated into the economic development process, promised with these major infrastructure constructions, especially HPPs, which, for Harvey (2004), would be the privatization of water as one of the forms of

accumulation by spoliation, compromising the way of life of traditional populations.

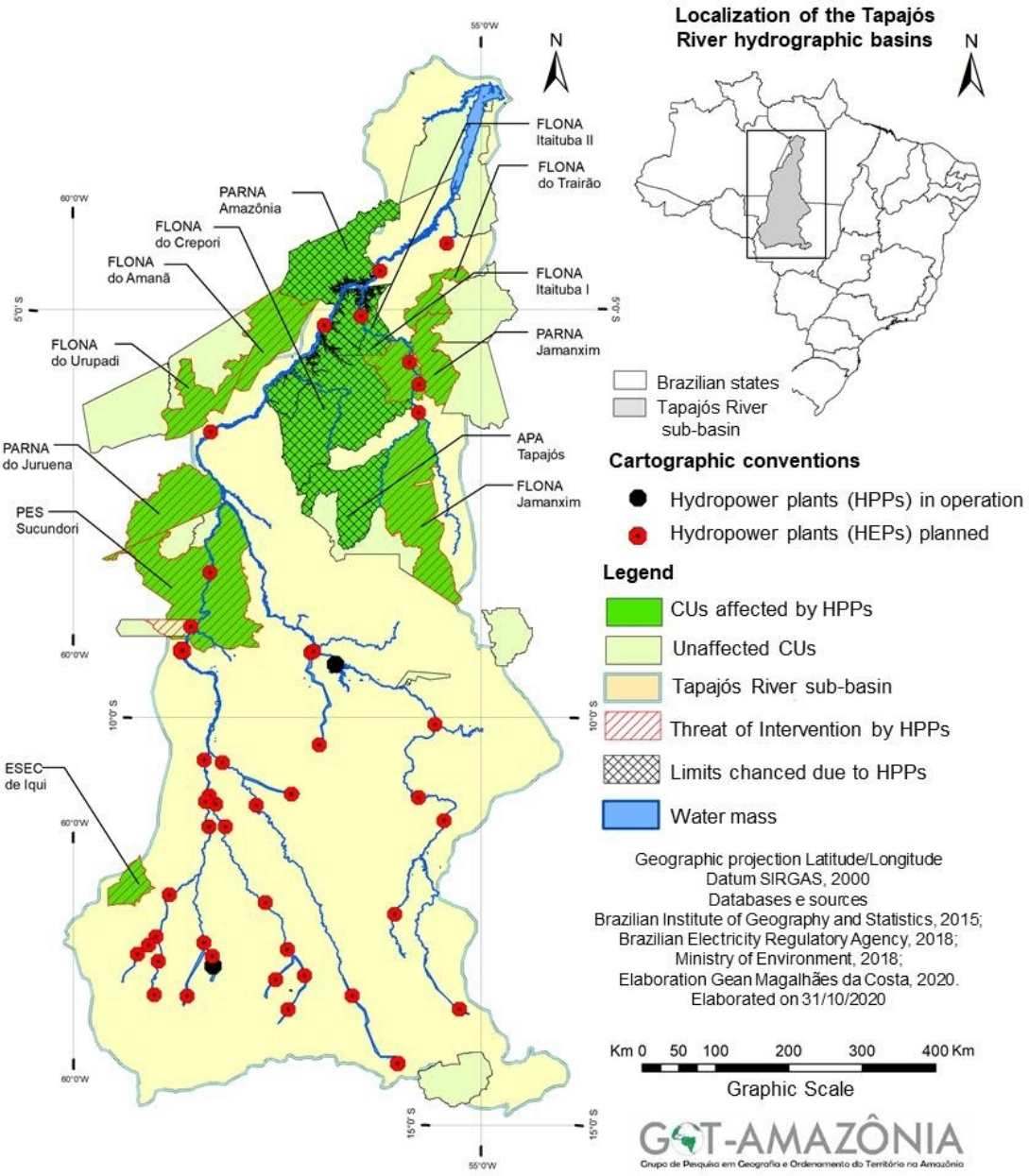

Figure 2 - Hydroelectric Power Plants and Conservation Units in the Tapajós River basin.

The Amazonian peoples encompass diverse cultures that have developed and develop under the various conditions and possibilities that the natural environment offers, giving condition to their social reproduction. Porto-Gonçalves (2017) points out that the metabolic strength and wealth of knowledge of its peoples/ethnicities/nationalities make the Amazon a unique territory, and that the loss of its natural resources also reflects on the economic perspective (especially local), on climate change and ecosystems, among others.

The maintenance of natural resources and populations that depend on it can be predicted and should be mitigated by reconsidering the projection of several HPPs in the same basin and sub-hydrographic basin, since this unit facilitates identification, monitoring and control, besides allowing the prioritization of management actions, avoiding that the productive forces that model the Amazon region impose themselves on its dynamics, thus appropriating and expropriating it from rivers

seen only as a good deal.

CONCLUSION

The growing expansion of HPPs in the Brazilian Amazon goes beyond the water potential, it is linked to the fulfillment of market logic and the interests of capital, so that the environmental and social impacts produced by hydroelectric plants interfere in the installation sites, and the gains of electricity generation are distributed to other regions.

Considering the hydrographic basin as a unit of analysis, based on the spatialization and concentration of hydroelectric plants and conservation units in the Amazon basin, the combined hydrographic sub-basin of the Tapajós River proved to be the most worrisome for the social and environmental aspect, given the amount of constructions planned. Although normative elements already established, such as Federal Law No. 9.433/1997, establishing the National Water Resources Policy and System; CONAMA Resolution 001/1986 and 237/1997, which define that studies for the installation of hydroelectric plants should incorporate the entire basin into the criteria of environmental licensing, and Law No. 10,847/2004, which deals with the creation of the Energy Research Company responsible for promoting studies of energy potential, including the inventory of hydrographic basins, with regard to the planning and management of the Amazon territory, considering its size and complexity, there are gaps about which basin management practices have been thought for the Amazon.

In the case of the Tapajós river basin, the concentration of hydroelectric projects (planned/active) and the considerable number of protected areas under direct influence of HPPs in the planning phase evidence the conflicts between developmental policies (linked to their construction) and environmental policies (focused on protected areas) in the Amazon. Some laws has been disregarded to facilitate the economic appropriation of the basin by materializing these infrastructure constructions that are linked to a large-scale/global logic to meet economic interests, which modify the dynamics of the rivers where these hydroelectric plants are installed, socially and environmentally, expropriating the basin of traditional local populations and conservation areas.

REFERENCES

ANEEL. Agência Nacional de Energia Elétrica. Sistema de Informações Geográfica do Setor - SIGEL, 2019. Disponível em: https://sigel.aneel.gov.br/portal/home/index.html. Acesso: 18 de março de 2019.

BERMANN, C. Impasses e controvérsias da hidreletricidade. In: Estudos Avançados, v. 21, n. 59, p. 139-153, abr. 2007.

BRACK, P. Crise da Biodiversidade, Ainda Distante da Economia. Ciência e Ambiente, n 42, p. 147-162, 2011.

BRASIL, Conselho Nacional do Meio Ambiente. Resolução n.001, de 23 de janeiro de 1986. Dispõe sobre critérios básicos e diretrizes gerais para o Relatório de Impacto Ambiental – RIMA. Disponível em: http://www2.mma.gov.br/port/conama/res/res86/res0186.html. Acesso: 17 em julho de 2020.

BRASIL, Conselho Nacional do Meio Ambiente. Resolução n.237, de 22 de dezembro de 1997. Regulamenta os aspectos de licenciamento ambiental estabelecidos na Política Nacional do Meio Ambiente. Disponível em: http://www2.mma.gov.br/port/conama/res/res97/res23797.html. Acesso: 17 em julho de 2020.

BRASIL. Lei n. 9.433, de 08 de janeiro de 1997, que institui a Política Nacional de Recursos Hídricos, cria o Sistema Nacional de Gerenciamento de Recursos Hídricos. D.O.U de 09/01/1997, pág. nº 470. Disponível em: https://legislacao.presidencia.gov.br/atos/?tipo=LEI&numero=9433&ano=1997&ato=a12ATVU90MJpWTbaf Acesso: 17 em julho de 2020.

BRASIL, Lei nº 9.985, de 2000, que institui o Sistema Nacional de Unidades de Conservação (SNUC). Disponível em:

https://www.mma.gov.br/images/arquivos/areas_protegidas/snuc/Livro%20SNUC%20PNAP.pdf. Acesso: 17 em julho de 2020.

BRASIL, Lei nº 12.678, de 25 de Junho de 2012. Dispõe sobre alterações nos limites dos Parques Nacionais da Amazônia; altera a Lei nº 12.249, de 11 de junho de 2010; e dá outras providências. Disponível em: https://www2.camara.leg.br/legin/fed/lei/2012/lei-12678-25-junho-2012-613462-publicacaooriginal-136828-pl.html. Acesso: 18 de março de 2020.

BRASIL, Decreto nº 6.040, de 7 de Fevereiro de 2007. Institui a Política Nacional de Desenvolvimento Sustentável dos Povos e Comunidades Tradicionais. Disponível em: http://www.planalto.gov.br/ccivil_03/_ato2007-2010/2007/decreto/d6040.htm. Acesso: 17 em julho de 2020.

BRASIL, Plano Amazônia Sustentável: diretrizes para o desenvolvimento sustentável da Amazônia Brasileira / Presidência da República. – Brasília: MMA, 2008. Disponível em: https://www.mma.gov.br/estruturas/sca/_arquivos/plano_amazonia_sustentavel.pdf Acesso: 20 de junho de 2020.

BRITZKE, R; SENHORINI, J. Inventário da ictiofauna no rio Tapajós. Relatório Interno. Pirassununga, Centro de Pesquisa e Treinamento em Aquicultura, 2011.

BUCKUP, P. et.al. Ictiofauna da ecorregião Xingu-Tapajós: fatos e perspectivas. Boletim da Sociedade Brasileira de Ictiofauna, n 98, p. 3-8, 2010.

CALDWELL, J e ARAUJO. Amphibian faunas of two eastern Amazonian rainforest sites in Pará, Brazil. Occasional Papers Sam Noble Oklahoma Museum of Natural History, n 16, p. 1-41, 2005.

CASTILHO, D. Hidrelétricas na Amazônia Brasileira: Da Expansão à Espoliação. Simposio Internacional de la Historia de la Electrificación. Barcelona. La electricidad y la transformación de la vida urbana y social. Barcelona: Universidad de Barcelona/Geocrítica. 2019. p. 68-87. Disponível em: http://www.ub.edu/geocrit/Electricidad-y-transformacion-de-la-vida-urbana/DenisCastilho.pdf. Acesso: 20 de maio de 2020.

CAVALCANTE, M. M. de A. Hidrelétricas do Rio Madeira- RO: território, tecnificação e meio ambiente. Tese (Doutorado em Geografia) – Programa de Pós-Graduação em Geografia da Universidade Federal do Paraná, UFPR. Curitiba-PR, 2012. Disponível em: https://acervodigital.ufpr.br/handle/1884/29821 Acesso: 18 de março de 2020.

CAVALCANTE, M. M. de A. et.al. Hidrelétricas e (Re) ordenação do Território: Uma Comparação entre os Povos Amazônicos (Brasil) e as Montanhas da Catalunha (Espanha)". Confins, n 36,p 1-12, 2018. Disponível em: https://journals.openedition.org/confins/14107. Acesso: 18 de maio de 2020.

COSTA, G. M. et.al. Hidrelétricas e Unidades de Conservação: Análise das contradições ambientais na Área do Entorno das Usinas de Jirau e Santo Antônio no Rio Madeira-Rondônia. In: Hidrelétricas na Amazônia: Interpretações geográficas sobre as usinas do Madeira e Xingu. Cavalcante, M. M. de A.; Herrera, J. A. (Org) 1.ª ed- Belém: GAPTA\UFPA, 2017. Cap 3. Pág 41 a 70.

CUNHA, S. B. de; GUERRA, A. J. T. Degradação Ambiental. In: GUERRA, A. J. T.; CUNHA, S. B. de (org.) - Geomorfologia e Meio Ambiente. Rio de Janeiro: Bertrand Brasil, 2012.

EPE. Empresa de Pesquisa Energética (Brasil). Balanço Energético Nacional 2018: Ano base 2017, 2018. Disponível em: http://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-303/topico-419/BEN2018__Int.pdf. Acesso: 20 de março de 2020.

EPE. Empresa de Pesquisa Energética (Brasil). Plano Nacional de Energia 2030. Brasília: MME: EPE, 2007. 454p. Disponível em: https://www.epe.gov.br/sites-pt/publicacoes-dados-abertos/publicacoes/PublicacoesArquivos/publicacao-165/topico-173/PNE%202030%20-%20Gera%C3%A7%C3%A3o%20Hidrel%C3%A9trica.pdf

Acesso: 05 de novembro de 2020

ESCOBAR, A. Sentipensar con la tierra. Nuevas lecturas sobre desarrollo, territorio y diferencia. 1 ed. Medellín: Unaula, p.1-84, 2014.

ESPÍRITO-SANTO, F. et. al. Análise da composição florística e fitossociológica da floresta nacional do Tapajós com o apoio geográfico de imagens de satélites. Revista Acta Amazonica, vol 35, n 2, p. 155-173, 2005.

SCHREIBER, G. P. Usinas Hidrelétricas. Edgard Blücher Ltda.1978. 250p

FEARNSIDE, P. M. Hidrelétricas na Amazônia: impactos ambientais e sociais na tomada de decisões sobre grandes obras - Manaus: v. 2, Editora do INPA, 2015. 296p. Disponível em: http://philip.inpa.gov.br/publ_livres/2015/Livro-Hidro-V1/Livro%20Hidrel%C3%A9tricas%20V.1.pdf Acesso: 05 de novembro de 2020

GANEM, R. S. Conservação da Biodiversidade: legislação e políticas públicas (Série memória e análise de leis, n. 2). Brasília: Câmara dos Deputados. 2011.

GUERRA, J. T. Geomorfologia e Meio Ambiente. 6. ed. Rio de Janeiro: Bertrand Brasil, 2006. 392 p.

HARVEY, D., O Novo Imperialismo. São Paulo: Loyola, 2004. 197p.

IBGE. Instituto Brasileiro de Geografia e Estatística. Atlas nacional do Brasil. 3. ed. Rio de Janeiro: 2000.

ICMBIO. Instituto Chico Mendes de Conservação da Biodiversidade. CEPTA. Levantamento da Ictiofauna, Caracterização Genética e da Fauna Parasitária da Bacia Hidrográfica do Rio Tapajós, 2011. Disponível: https://www.icmbio.gov.br/portal/images/stories/o-que-fazemos/proj_apoiados/resumo_projeto_313.pdf. Acesso: março de 2019.

ISA. Instituto Socioambiental. Placar de Unidades de Conservação. Pará - Belém do Pará. 2020. Disponível em: widgets.socioambiental.org/placar/ucs/674. Acesso: 15 de janeiro de 2020.

MORETTO, E. M. et al. Histórico, Tendências e Perspectivas no Planejamento Espacial de Usinas Hidrelétricas Brasileiras: a antigo e atual fronteira Amazônica. In: Ambiente e Sociedade, v. XV, n. 3, p. 141-164, set.-dez. 2012.

MORET, A. de S. Biomassa Florestal, Petróleo e Processo de Eletrificação em Rondônia: Análise das Possibilidades de Geração Descentralizada. Tese (Doutorado em Física Mecânica) - Programa de Pós Graduação em Planejamento de Sistema Energético da Universidade Estadual de Campinas, UNICAMP. Campinas-SP, 2000.

MORET, A. de S. et. al. Síntese do modelo de implantação de projetos hidrelétricos no Brasil: críticas às opções do planejamento do setor e à implantação de UHEs. I Seminário Internacional Meio Ambiente, Dinâmicas Regionais e Planejamento Territorial na Amazônia e no Cerrado, Porto Nacional, vol. 1. UFT. p. 578-591, 2017.

OREN, D. et. al. Avifauna of the Tapajós National Park and vicinity, Amazonian Brazil. Ornithological Monographs, American Ornithologists' Union, n 48, p 493-525, 1997.

PIMENTA, F. e et. al. An update on the distribution of primates of the Tapajós-Xingu interfluvium, Central Amazonia. Neotropical Primates, Arlington. Conservation International, n. 13, p. 23-28, 2005.

PIMENTEL, H. V. et. al. Hidrelétricas e Unidades de Conservação na Amazônia: Redefinições de Limites de UCs a Partir das Implantações de Usinas na Bacia do Rio Tapajós/PA e Madeira/RO. In: VERAS, A. T. de R.; GALDINO, L. K. A.; SEABRA, G. de F. (Org.). Agroecologia, Políticas Públicas e Desenvolvimento Sustentável, Tomo II. Boa Vista/RR: UDUFRR; p. 175-183, 2020.

PORTO-GONÇALVES, C. W. Amazônia: encruzilhada civilizatória, tensões territoriais em curso. – 1. Ed. – Rio de Janeiro: Consequência Editora, 2017. 112p.

RAISG. Rede Amazônica de Informação Socioambiental Georreferenciada. Cartografia Histórica de Áreas Naturales Protegidas y Territorios Indígenas en la Amazonía, 2016. Disponível em: https://www.amazoniasocioambiental.org/pt-br/publicacao/cartografia-historica-de-areas-naturais-protegidas-e-territorios-indigenas-na-amazonia/. Acesso: 21 de março de 2020.

SANTOS, M. O Espaço Dividido. Os Dois Circuitos da Economia Urbana dos Países Subdesenvolvidos. São Paulo: Edusp, 2004. 440p.

SCOLES, R. Caracterização. Ambiental da bacia do Tapajós. In: ALARCON, D. F. BRENT M. e Torres M. (Org.). Hidrelétricas, conflitos socioambientais e resistência na bacia do Tapajós. 1 edição.Santarém\PA: International Rivers; p. 29-42, 2016.

World Wide Fund For Nature Brasil - WWF. Uma visão de conservação para a bacia do Tapajós. Brasília, 2016. Disponível em: https://d3nehc6yl9qzo4.cloudfront.net/downloads/wwf_brasil_tapajos_uma_visao_de_conservacao_25abr2016_port_web.pdf . Acesso:18 de março de 2020.