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PROPOSAL FOR BEHAVIORAL ECONOMIC EXPERIMENTS FOR THE EVALUATION OF COOPERATIONS FOCUSED ON SUSTAINABILITY

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Abstract: The present work aims to present a proposal for evaluating the intention of cooperation and measuring the trust between a hydroelectric power plant and the local stakeholders in projects focused on sustainability, based on behavioral economic theory. The case of a hydroelectric plant was used, considering the multiplicity of local groups that are influenced by this project, such as fishermen, neighboring residents, indigenous people, farmers and sediment collectors. It is understood that these are groups whose participation in initiatives aimed at sustainability can be fundamental for the preservation of the environment. Such stakeholders were identified from the analysis of secondary documents and personal interviews with managers of the Itaipu plant. For this proposal, public goods concern the preservation of the protection strip; the ichthyofauna and its commercial potential; the preservation of indigenous culture; the maintenance of water quality in the reservoir and microbasins in the region, as well as agricultural crops. It is argued that the recognition of the determinants of the decision of these groups to cooperate and trust can be fundamental, especially in moments of negotiation and bargaining between those involved, in addition to providing information for the improvement of the contractual instruments that guide the relations between the stakeholders and the plant, and to minimize the possibilities of conflicts and mismatches of expectations between the parties. Finally, the advantages of the experimental methodology are presented, especially of the field experiments in view of the heterogeneity of the groups.
Keywords: Public good game; trust game; sustainability; hydroelectric plant.

INTRODUCTION

There is a growing number of technical studies on the socio-environmental impacts caused by large undertakings in the area of energy generation. Jiang, Quiang and Lin (2016), based on a bibliometric study, found that issues related to the problems that hydroelectric plants face (among which, those based on environmental management and sustainability) have been more attractive than the technology itself, and that there is an interdisciplinary trend in research. According to these authors (2016, p.227) "the importance and complexity of hydropower development issues has attracted scholars in different disciplines, including hydrology, civil engineering, environmental science, ecology, economics and the social sciences". A similar finding was obtained by Moreira et al. (2015), which reinforce the need to use interdisciplinary analyzes to assess this subject.

Among the interdisciplinary topics, sustainability-related studies stand out, especially those that require actions based on cooperation between stakeholders (BOND et al., 2016). The success or otherwise of some initiatives may require the participation of two or more groups, and the willingness of those involved to cooperate may be decisive. Most hydroelectric projects promote actions aimed at sustainability with the support of local agents (stakeholder groups). The latter, in turn, constitute interest groups that are impacted by the activities carried out by the organization, such as small local companies, fishermen, indigenous groups, riverside farmers, farmers, among others (MME, 2015). Thus, among the possibilities of cooperation with a view to creating/preserving public goods, among which the environment, the reservoir and the resources that derive from it, initiatives aimed at sustainability with the participation of stakeholders stand out

(DICKINSON; VILLEVAL, 2008; LIU et al., 2013; MOREIRA et al., 2015; BULGACOV; OMETTO; MAY, 2015).

In Brazil, despite the purposeful movement of the public sector, initiated in mid-2001, to reconfigure the energy matrix and reduce the country's dependence on large hydroelectric plants, these still represent the main source of energy supply (MME, 2015). Given their magnitude, these undertakings transact with a series of agents distributed in the areas of energy generation, environment and sustainability, large works, among others. The multiplicity of interactions carried out, predominantly via the establishment of contractual arrangements, indicates some possibilities for research.

The behavioral economic theory consists of a possibility of evaluating the cooperation between agents through the experimental methodology (ROTH, 1995; CARDENAS 2000; CARDENAS; CARPENTER, 2005), capable of capturing nuances inherent in the willingness of those involved to cooperate that – otherwise – would not be identified. In the context of the present work, focused on the sphere of sustainability and environmental preservation, preferring to explore/not explore non-renewable resources or contribute/not contribute to their preservation, consist of dilemmas of public goods, and "the dilemma of public goods is highly focused on today's global society, as it determines how long we will have the necessary resources for sustainable development" (DU; WU; WANG, 2016, p.1432).

Recognizing the determinants of cooperation, many joint project initiatives could be facilitated, better managed and even complemented, with a view to ensuring sustainability and also reducing potential management costs. In addition, Rothstein (2005) and Osltrom (1999; 2010) argue that the willingness to cooperate is also linked to trust between the parties. Faced with the difficulties of reconciling different interests of stakeholders, regarding local contributions, opportunities for local development, reduction of environmental risks, private interests and other tensions between the company and society (PORTER; KRAMER, 2006) it is necessary to envision the contributions arising from the game of behavioral economic games as an evaluation mechanism for future negotiations, bargains and improvements in contracts.

It also constitutes an opportunity for research, since in the preliminary review of the literature on this topic, few studies concomitantly addressed the issue of sustainability in hydroelectric plants and the cooperation between them and their local stakeholders based on subsidies from the economy behavioral. According to Kumar and Katoch (2016, p.599) "the social, economic and environmental aspects of hydroelectric generation have been the favorite topic of many researchers. However, most studies have been carried out only in the context of reservoir-based hydropower projects".

Given the above, the problem of this research can be described as follows: How can behavioral economics contribute to assessing the intention of cooperation and trust between a hydroelectric plant and its stakeholders in projects focused on sustainability?

The text begins with a literature review. Next, the construction of the proposal is presented and, finally, the final considerations.

THEORETICAL REVIEW

SUSTAINABILITY AND ENERGY

It is recognized that companies have an impact on the places where they operate, and that attention to these is necessary, especially in the social, economic and environmental spheres. In this context, much has been discussed about the need for companies to

address sustainability not just as an accessory issue, but incorporating it into strategic decision-making processes (ENGERT; RAUTER; BAUMGARTNER, 2016; MOREIRA et. al., 2015) whether for mitigate/ avoid social and environmental impacts, explore new markets or reconcile the interests of different stakeholders (ZIJP et al., 2015; MORRISON-SAUNDERS et. al., 2014). The last authors defend that this perspective aims at a better understanding of the processes of evaluation of sustainability, transparency and –especially – consensus building.

In the energy sector, it is observed that many enterprises sometimes delay their operations due to disagreement between stakeholders, especially regarding the release of environmental licenses and clashes with local communities (EPE, 2014). Despite these obstacles, this sector is considered fundamental for the functioning of virtually all other sectors of an economy, so that the availability of energy conditions the ability of a country to provide its population with various services (EDOMAH, 2016) and to prosper economically (YÜKSEL, 2010; MAYUMI; TANIKAWA, 2012; PURWANTO; AFIFAH, 2016). In this regard, the IEA (International Energy Agency, 2009) predicts a world growth in energy demand at a rate of 2.5% per year until 2030.

HYDROELECTRIC PLANTS

Jiang, Quiang and Lin (2016), based on the evaluation of 1726 articles related to the topic (highly related to hydropower), found that (i) most of the research is linked to the post-chronstution and start-up period, rather than to the construction projects and technologies; (ii) the themes are multidisciplinary; (iii) with the rapid and vertiginous growth of publications on hydroelectric plants. In a similar study, Han et al. (2014) analyzed 434 scientific articles from 1991 to 2012. In addition to the findings just explained, these authors identified the main journals that address this topic (Renewable and Sustainable Energy Reviews, Renewable Energy, Energy Policy). As for the main countries that generate publications on sustainability in hydroelectric plants, there are the United States, Turkey, Brazil and China.

The relevance of hydroelectric plants as a source of renewable and relatively low-cost energy is defended, when compared to other potential sources (LIU et al., 2013). The benefits of using these, when compared to other sources, are related to (YÜKSEL, 2010; LIU et al., 2013):

- range of flooded areas in some regions;
- energy conversion efficiency, with low operating costs and already advanced technology;
- low maintenance costs;
- its main input (water) does not suffer fluctuations due to market conditions;
- possibility of operating with generation flexibility;
- ability to promote improvements in the living conditions of communities surrounding large developments;
- high level of reliability;

In Brazil, this has been the main supply alternative, accompanied by thermal and wind power plants, small hydroelectric power plants and nuclear power plants (MME, 2015). Moreira et al. (2015) state that the growth rate of the energy sector in Brazil is 4% per year, with the increase in the share of other energy sources in the matrix. The following figure illustrates the distribution of the Brazilian energy matrix, as well as the future projection:

Due to the size of these undertakings and their impact on the environments where they are installed, the actions of hydroelectric plants aimed at sustainability

are frequently debated. Of these, Jabbour et al. (2012) highlight actions of a reactive nature, arising from lawsuits, pressure from stakeholders and neighboring communities; actions of a preventive nature, resulting from decisions to monitor environmental issues sensitive to the undertaking; and actions of a proactive nature, resulting from the strategic orientation of the companies. Most of the actions include economic, social and environmental assessments (LIU et al., 2013; KUMAR; KATOCH, 2016): local impacts are considered, the restrictions that these projects can generate to ecosystems and nearby communities, alterations in the dynamics of the aquatic and terrestrial habitat, the deposit of sediment in riverbeds, among others (YUKSEL, 2010; ZHAO et al., 2012). In the words of Jiang, Quiang and Lin (2016, p.235):

> Hydropower will drive the renewable energy development strategy due to its enormous development potential, economic and social benefits and proven technology. However, we cannot omit the negative impacts brought by hydroelectric projects related to the environment, ecology and socioeconomics.

Among the numerical evaluation possibilities to measure the sustainability potential of hydroelectric plants, as a support for decision-making, it was verified that methods related to dynamic systems have already been used (MUSANGO et al., 2012), fuzzy analysis of hierarchical processes (KAHRAMAN; KAYA, 2010) and multicriteria analysis models (WANG, et al., 2009; MOREIRA et al., 2015). Part of the literature suggests the use of indicators as a way to quantify, monitor and compare the impacts and trajectories of social, environmental and economic issues. The following figure presents some of the indicators:

In Brazil, there are some enterprises with great generation capacity. Among the largest power plants, we can mention the Itaipu Power Plant (Binacional), Belo Monte Power Plant, Tucuruí Power Plant and Jirau Power Plant (MME, 2015). Given the particularities of the country, in terms of the availability of water resources, the main topics of discussion consist (MME, 2015): (a) the reduction of local and global impacts resulting from the use of energy sources; (b) in the use of renewable sources; (c) minimizing impacts on the environment; (d) in national and international discussions on climate change. Regarding socio-environmental issues, the following topics can be mentioned: (a) environmental impacts: loss of native vegetation; transformation of a lotic environment into a lentic one (running waters for dammed waters, creation of reservoirs), loss of vegetation; (b) socioeconomic impacts: affected population; interference in indigenous lands; (c) interference with infrastructure; (d) socioeconomic benefits: job creation, temporary increase in collection, permanent increase in collection.

Many of the actions developed within the scope of sustainability occur through the interaction of the plants with their environment. At this point, understanding the evolution of cooperation between individuals and groups is still an interdisciplinary challenge (PERC; WANG, 2010) and behavioral economics can contribute to this endeavor.

BEHAVIORAL ECONOMICS

Behavioral economics is a relatively recent field of research, arising from the incorporation by economics of theoretical developments and empirical discoveries in the fields of human and social sciences (WEBER; DAWES, 2005). Among the possible contributions of this theoretical approach, one can mention behavioral economic games, especially the public good game (STURM, WEIMANN, 2006; LOZANO, 2007; KHWAJA, 2009; SOEST; STOOP; VYRASTEKOVA, 2016) and the trust game (BERG, DICKAUT, MCCABE,

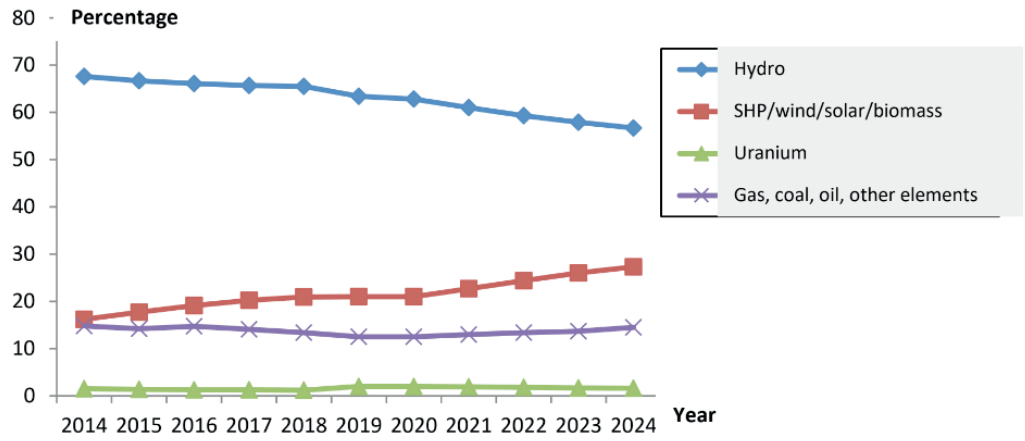

Figure 1: Distribution and projection of the Brazilian energy matrix

Source: Ministry of Mines and Energy (2015).

Author	Social indicator	Environmental indicator	Economic indicator
Bakis and Demirbas (2004)	Change in employment conditions and standard of living of the affected population	Accumulation of sediments	Maintenance costs and capital cost
IHA (2006)	Change in the quality of life of the affected population, distribution of project benefits through compensatory and lasting measures, measures to preserve the region's heritage (physical and cultural)	Air and water quality, waste management, preservation of natural habitats, preservation of fauna and flora, fish flow control and environmental monitoring measures	Capital costs, CO2 emission savings
Vera e Langlois (2007)	Poverty, change in quality of life, demographic changes	Climate change, deforestation, water and soil pollution	Rural and urban development in the region, job offer
Morinoto (2013)	Displacement and resettlement, impact on the standard of living and health of affected communities	Impact on water quality, impact on local ecosystems	Operation and maintenance costs
Scannapieco *et al.* (2014)	Employability and public acceptance	Water, land consumption/flooding, consumption of natural resources, waste generation, impact on ecosystems (flora and fauna)	Operation and maintenance cost
Dombi *et al.* (2014)	Job creation and improvements to local communities	Gas emissions, deforestation and ecological impacts	Operating costs

Figure 2: Sustainability indicators aimed at hydroelectric plants

Source: Elaborated based on the literature review

1995; DANIELSON; HOLM, 2007; BENNER; HALLDORSSON, 2010).

These can provide subsidies for understanding the cooperation between two or more groups, as well as showing which factors and conditions can interfere in the decisions to undertake cooperative actions. It is highlighted, for example, the role of anonymity in cooperation (ANDREONI, 1988; WEIMANN, 1994), the influence resulting from the reputation of the partner (MILINSK, SEMMANN, KRAMBECK, 2002; FEHR, 2004; SEGBROECK et al., 2009; ROBERT; BROMAN, 2017); the existence of feedback mechanisms (COX; STODDARD, 2015); the number of predicted interactions/ rounds (KREPS et. al., 1982; KIM; WALKE, 1984; DAVIS; HOLT, 1993; WEIMANN, 1994); the presence of punishment and compensation mechanisms (MASCLET et al., 2003; HERMANN et al., 2008; LIN; LIU, 2016); the nature of the agreement between those involved (DANNENBERG, 2016); the perception that the parties have regarding the treatment received, regarding justice and reciprocity (DUFWENBERG; GÄCHTER; HENNIG-SCHMIDT, 2011; HOUSER; VETTER; WINTER, 2012); the proximity between the participants (BOOSEY; 2017) and their payoffs during the interaction (SHAPIRO, 2008); knowledge about the other party's efforts and contributions (BAG; ROY, 2011); heterogeneity between groups (KHWAJA, 2009; CHAKRAVARTY; FONSECA, 2014); the presence of common social norms (REUBEN; RIEDL, 2009); beliefs about the behavior of other players (FOSGAARD et al., 2014); the possibilities of appropriating the donations and efforts of others (SOEST; STOOP; VYRASTEKOVA, 2016) and the type of game, with regard to contributions and voluntary withdrawals (ANDREONI, 1995; SELL et al., 2002; KHADJAVI; LANGE, 2011).

The public good game consists of an experiment in which agents receive a certain amount of money, being able to contribute with the purpose of maintaining the public good or taking the money for themselves (for their own benefit), and no agent can be excluded from enjoying the benefits that the public good provides. The game presupposes the existence of a dilemma for the individual or group, with the possibility of contributing/ not contributing and making use of the public good (SELL et al., 2002; SOEST, STOOP, VYRASTEKOVA, 2016). The benefits derived from the game represent a linear function of the subjects' contribution and, therefore, the aggregate returns are maximized if each subject invests all his assets in the public good, so that the amount contributed to the public account represents a measure of the cooperativeness of the participant (CARDENAS; CARPENTER, 2006). However, the proper reward maximization strategy in this game is to pocket the donation regardless of the amount contributed by other group members (SOEST, STOOP, VYRASTEKOVA, 2016). This behavior adopted by a subject to maximize the use of the public good without contributing to its provision is recognized as free riding (ANDREONI, 1988; STURM; WEINMANN, 1996).

The trust game, in turn, measures the extent to which a player is willing to send resources to a second player, who decides whether to return part of the generated surplus or take the amount for himself. Specifically, the first player's decision is a trust proxy while the second player's decision represents a reciprocity proxy (CARDENAS; CARPENTER, 2006; BENNER; HALLDORSSON, 2010). One player decides how much of a monetary amount to send to a second player, and the second player then receives that amount multiplied by a constant (usually three). As with the prisoner's dilemma and public goods games, there is a

socially optimal outcome (first player sends all, second player returns half) that is not the (Nash) equilibrium predicted by neoclassical theory (WEBER; DAWES, 2005).

METHODOLOGICAL PROCEDURES AND PROPOSAL CONSTRUCTION

The proposal for integrating themes is illustrated based on the case of the Itaipu hydroelectric plant and, in particular, its sustainability program. The choice of the organization was intentional, since it is considered the largest hydroelectric power plant in the world and has had its sustainability program in force for over a decade, being internationally recognized for its contributions to the socioeconomic development of the western region of Paraná and for the practices of water management and conservation (ITAIPU, 2015). Another selection criterion is the fact that the program has several interaction fronts with local stakeholder groups.

The main focuses of the sustainability program are: (a) water; (b) energy; (c) environment; (d) food; (e) social inclusion; (f) education; (g) citizenship; (h) sense of belonging; (i) innovative governance; (j) climate change; (l) replication of best practices. Among the topics covered, it can be mentioned (ITAIPU, 2015):

- Environmental education;
- Enhancement of regional and institutional heritage;
- Management of watersheds;
- Biodiversity;
- Sustainable rural development;
- Fish production;
- Sustainability of vulnerable segments;
- Environmental monitoring and assessment.

The program assumes interfaces between topics. It is argued that if there is communicability between the topics addressed, it would be possible to involve the community from a systemic/multidisciplinary view - characteristic of sustainability (ZIEGLER; OTT, 2011).

The investigation was conducted based on the evaluation of documents - Ten Year Energy Plan (MME, 2015), annual sustainability reports of the Itaipu plant and contractual documents from the environment area between this organization and its stakeholders, in the form of contracts, authorizations of services, agreements and cooperation agreements. The purpose was to contextualize the main initiatives aimed at environmental preservation that require the participation of local stakeholders, the time horizon of these relationships, the types of expected results and the participation demanded from stakeholders.

Next, nine personal interviews were carried out with managers involved in the aforementioned sustainability program, guided by a semi-structured script of qualitative questions (GODOY, 2006) – whose content included the validation of the researcher's findings based on the examination of secondary documents, as well as the explanation regarding the stakeholders in the West of Paraná region identified as relevant to the plant, the particularities of each project developed and the risks of eventual non-cooperation. The questions also explored topics related to relationship management, its determinants and obstacles.

PLAYER SELECTION AND GAME DEFINITION

The criterion for the identification and selection of potential players in this proposal was based on the identification of those groups,

belonging to the local society, that frequently interact with the plant. These are stakeholders with frequent interface relationships, mainly with the area of environment and environmental management. It was also considered:

- that all stakeholders involved have – directly or indirectly – contact with some contractual regiment between them and the studied organization: in an attempt to identify possible management problems arising from these interactions with a view to preserving the public good, the presence of a contractual arrangement can be useful for making comparisons. Additionally, this point consists of an attribute for cooperation: when the participants themselves agree on a work order and a punishment system, it is often not necessary to use it and the benefits of cooperation can be substantially improved (OSTROM, 2010);
- which consist of interest groups mentioned in official documents of the Brazilian electricity sector (MME, 2015) and in the constant evaluations for the construction of economic, social and environmental indicators (IHA, 2006; MORINOTO, 2013; DOMBI et al., 2014) of hydroelectric plants. In this scenario, investigations that address – to a greater or lesser extent – these audiences were carried out, almost exclusively, from qualitative research strategies (ZHAO et al., 2012; LIU et al., 2013; OLIVEIRA et al., 2016). An exception is the work of Cavalcanti, Schläpfer and Schmid (2010) who analyzed the effect of participatory processes on the willingness to cooperate in fishing colonies in Bahia. The construction of this proposal aims to complement this gap;
- that from the suggestion of fundamentals for the classification of stakeholders, the criteria of dependency ratio (LANGTRY, 1994) of small local companies, professional fishermen and farmers in relation to the plant were observed; and of legitimacy in the relationship - in the interaction with small companies, fishermen, riverside dwellers, sediment collectors and indigenous people; - guided by a contractual instrument (CORNELL; SHAPIRO, 1987; CARROL, 1989);
- that, in the sphere of sustainability, many of the participants represent local stakeholders with a low level of education;
- that such stakeholders, despite the long-term relationship with these projects, can interpret the sustainability of the public good in question in different ways regarding their relevance to themselves and to the group (CARDENAS, 2000);
- that these are mostly groups with low purchasing power, whose decisions that benefit them in the short term may override decisions aimed at long-term cooperation, even if to the detriment of sustainability and contractual regulations;

The Figure below characterizes the stakeholders identified from the data collection.

From the characterization of these groups, which sustainability projects had interaction were identified and, then, the games that best represent the dilemma that the groups face, especially regarding the public good, were proposed. As for the type of game, it is proposed to detail the gains resulting from cooperation and trust:

Checking the willingness to cooperate

Groups	Description	Relevance to the organization	Problems of possible non-cooperation
Neighboring	They are rural and urban landowners who own land adjacent to the protection areas and biological refuges of ITAIPU Binacional.	They help in monitoring ITAIPU's environmental heritage, because, due to the large extent of protected areas, the company cannot monitor all locations full time. Their communications with the power plant are fundamental for the preservation of protected areas, from the fight against deforestation and fires, illegal hunting and fishing, release of pollutants and waste in preservation areas.	Any non-cooperation would bring about the need to increase the number of employees to monitor the Protected Areas. There would also be a disconnection with the neighborhood policy encouraged by ITAIPU and a break in the network of contacts fostered since the construction of the plant.
Fishermen	They are people who descend, predominantly, from traditional riverside communities and live from artisanal extractive fishing in the western region of Paraná.	Just like the neighboring ones, they are Itaipu's sentinels. Their communications with the power plant are fundamental for the preservation of the Reservoir. In addition to participating in the research and monitoring activities that ITAIPU develops in the reservoir: fishing monitoring, monitoring of the socioeconomic performance.	As they are fundamental in certain research segments, their lack would imply a discontinuity of studies compromising long-term results. There is also the risk of lawsuits against the plant, alleging material losses resulting from the construction of the Reservoir.
Indians	They are individuals descended from indigenous peoples of various ethnic groups who maintain traces of their cultures and customs.	It strengthens, within the scope of social responsibility, the commitment that ITAIPU assumed to value the best management practices for the most vulnerable social segments.	Occasional non-collaboration generates threat and insecurity to the environmental heritage, causes tension between indigenous people and residents of the regions that – sometimes – obliges the company to act quickly, implying costs of various natures.
Sediment collectors	These are individuals who own properties close to specific points of the reservoir, who work in the monitoring of sediment stations in watercourses that supply the ITAIPU Reservoir.	They are the primary source of data that trigger strategic actions aimed at optimizing energy production and extending the useful life of the ITAIPU reservoir.	As it is a strategic activity of the company, its execution would have to be carried out by people or non-local companies, which would make logistics complex and substantially increase the value of the services provided.
Agricultors	They are rural landowners who own land in ITAIPU's area of influence (Paraná Basin 3) and who participate, directly or indirectly, in ITAIPU's socio-environmental programs.	They are partners in the realization and dissemination of the methodologies recommended by ITAIPU, among which the abandonment of traditional methods of cultivation with the use of pesticides, replacing it with organic agriculture.	Any non-cooperation would result in restriction of space for the implementation and dissemination of organic farming practices, in addition to increasing the dumping of pesticides and micro pollutants in the micro basins of the region.

Figure 3: Description of interest groups

Source: Prepared from primary data collection

Group	Project	Public goods	Proposed games
Neighboring	Sustainable management of the protection strip along the Itaipu Power Plant Reservoir (Foz do Iguaçu, Guaíra)	Preservation of the protection strip, with native vegetation, along the edge of the reservoir, ensuring the local flora and fauna biodiversity;	**Public good game**: - cooperation through the provision of time, effort and resources to preserve protected areas; **Trust game:** - verify whether this group will comply with what was agreed, either in the actions defined jointly, or in the actions proposed by Itaipu;
Fishermen	Monitoring Yield and Socioeconomics of Fishing in the Reservoir	Fish and its potential as a commercial and subsistence input for fishermen;	**Public good game:** - cooperation through the provision of information to consolidate data on fishing income, subsidizing the formulation of environmental and social policies aimed at the development of the region and the class; **Trust game:** - verify whether this group will provide truthful information in fishing landing reports; whether they will fish only in the periods and places allowed;
Indians	Development of actions in the areas of infrastructure, agriculture, food security and culture for two Guarani villages in the municipality of Diamante do Oeste and São Miguel do Iguaçu	The preservation of indigenous culture and the sustainable development of these communities	**Public good game:** - provision of information to consolidate data regarding the reality of the ethnic group, subsidizing the formulation of environmental and social policies aimed at preserving indigenous culture. **Trust game:** - verify that this group will provide truthful information;
Sediment collectors	Support in carrying out environmental diagnoses and assessments to provide water quality parameters, guiding the multiple uses of the reservoir	The quality of the water in the reservoir and its useful life;	**Public good game**: - cooperation through the provision of time and effort in the maintenance of devices belonging to the plant installed on the properties for the collection of sediments and technical data used for the management of the reservoir; **Trust game:** - check if this group will provide truthful information to know if they will carry out the readings of the devices aimed at sedimentometric monitoring in the agreed periods, if they will maintain the integrity of the equipment;
Farmers in the region	Development of actions to support the most vulnerable segments of the rural population, in areas of interest to Itaipu, through sustainable agricultural production	The water quality of the region's microbasins as well as agricultural crops.	**Public good game**: - cooperation through the provision of time and effort for the learning and application of organic agriculture techniques, free of pesticides and pollutants; Trust Game: - verify if this group will plant in riparian zones; that they will not use pesticides; and that they will not inappropriately dispose of their crop residues in the reservoir;

Figure 4: Sustainability project to which the interest group has an interface and proposal for economic games

Source: Prepared from data collection

in actions aimed at sustainability, as well as the determining conditions, obstacles and other moderating factors is relevant for the organization to obtain subsidies for the establishment and maintenance of lasting relationships with these interest groups. The presence of trust, in turn, indicates the possibility for the local partner to comply with what was agreed with a view to preserving the local environment. For this, the possibility of communication between those involved (especially direct, face-to-face communication), the long-term horizon of the relationships and the reputation of the plant may represent factors that support the trust of the stakeholders which, in turn, raises the chances of cooperation between the parties (OSTROM, 2010).

FINAL CONSIDERATIONS

The present work sought to present a proposal for an association between two areas of research that are still not very integrated, the contributions of behavioral economics to the analysis of actions aimed at sustainability that require cooperation between a hydroelectric plant and the local stakeholders. It can be added that most research, based on the application of economic experiments, focuses on two aspects:

- analyzes decisions aimed at cooperation in public goods from a fictitious scenario – created in university laboratories – whose participation occurs predominantly with students (WEBER; DAWES, 2005; HOUSER; VETTER; WINTER, 2012; DANNENBERG, 2016; BOOSEY, 2017);
- analyzes decisions aimed at cooperation based on field experiments with rural communities (CARDENAS, 2000; CARDENAS; OSTROM, 2004; CARPENTER et al., 2004; HENRICH et al., 2005; VOLLAN, 2008; NARLOCH; PASCUAL; DRUCKER, 2012), with a view to understanding the cooperation dynamics of these groups, as well as the factors that interfere in this dynamic. In this case, research usually involves a combination of methods (qualitative and experimental) making use of certain control variables and – sometimes – considering the specific context in which such communities are inserted, in terms of social norms, resource constraints, ways of subsistence. The present proposal is inserted in this field;

Potential players were selected based on dependency (LANGTRY, 1994) and legitimacy (CORNELL; SHAPIRO, 1987; CARROL, 1989) criteria, identifying: neighboring residents, fishermen, farmers, indigenous peoples of the region and sediment collectors, representing groups with a direct interface in sustainability actions developed from the Itaipu sustainability program, whose cooperation is crucial.

For the development of this proposal, it is recommended the use of two behavioral economic experiments, the public good game and the trust game (CARDENAS; CARPENTER, 2006), in order to measure the propensity to cooperate in social dilemmas, trust and reciprocity (CARDENAS; OSTROM, 2004). Public goods, in these games, concern the preservation of the protection strip, with native vegetation, along the edge of the reservoir; the ichthyofauna and its potential as a commercial and subsistence input for fishermen; the preservation of indigenous culture and the sustainable development of these communities; the quality of the water in the reservoir and its useful life and; the water quality of the region's microbasins as well as agricultural crops free of pesticides. In this context, all goods have an interface with

social, environmental and economic aspects (LOZANO, 2007).

It is recognized that economic field experiments lose part of their internal validity and replicability potential when compared to laboratory experiments (ROE; JUST, 2009), however, approaching the reality of local organizations, as well as identifying the heterogeneity of stakeholders with which this hydroelectric plant interacts represents a relevant point to be considered in decision-making regarding cooperation (KHWAJA, 2009; CHAKRAVARTY; FONSECA, 2014). According to Reuben and Riedl (2009, p.1) "the need for cooperation between people with heterogeneous characteristics is an undeniable fact of social and economic life". According to Henrich et al. (2005), the study of groups other than university students is a research opportunity. In the authors' opinion:

> Existing experimental research cannot answer all questions because virtually all investigations have been carried out with university students. While there are modest differences among student populations around the world, these differences in subjects and contexts are small compared to the range of social and cultural environments (HENRICH et al., 2005, p.797).

Still regarding the proposal to use behavioral economic experiments, it is justified by the nature of the information to be obtained, which would be difficult to obtain through predominantly qualitative studies or with the exclusive application of questionnaires. Cardenas and Carpenter (2005), for example, recommend the adoption of this procedure in order to assess issues linked to the decision-making of agents and groups, especially in themes related to preferences, risks, willingness to cooperate. These authors defend the possibility that players respond more faithfully to real situations than to questionnaires (hypothetical bias), and still not try to respond the way they imagine the researcher wants (idealized persona bias). The respondents' interpretation limitations are another point at which it is advantageous to use the experiment as a collection strategy.

Due to this methodological option, care needs to be taken with regard to strict compliance with the variable manipulation protocol and the actual operation of the experiment, involving procedures in the recruitment phases of potential participants, explanations and stimuli prior to the game, running the game and even after the experiment (KREPS, 1990, HENRICH et al., 2006; 2010; CARDENAS, 2000; CARDENAS; CARPENTER, 2006).

This proposal, finally, aims to contribute to the improvement of research on the willingness to cooperate and trust of hydroelectric power plant stakeholders, representing this theme as an opportunity for research still in development. From a practical perspective, this study helps to obtain relevant information about factors that determine cooperation between the plant and the local stakeholders, either to support future negotiations and agreements, or in bargaining situations when these groups present their demands. It is also expected to improve the management of contractual arrangements based on cooperation between companies and local stakeholders in projects focused on sustainability; reduce any transaction costs, especially in long-term relationships; complement the content of the contracts, the wording of the obligations/attributions of those involved, the applicable penalties and incentives for contractual compliance; and minimize the possibilities of conflicts and mismatches of expectations between the partners.

Conducting similar studies in other plants with recent impacts on local communities, such as the Belo Monte plant (OLIVEIRA et. al., 2016), and with other players can also

help validate the proposal. As limitations of this research, the relatively low number of respondents and the consequent need for continuity to validate and confirm the public goods of each game stand out.

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