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Cooperation, the crowding out effect and the role of incentives in the study of sustainability: contributions of the behavioral economics

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COOPERATION, THE CROWDING OUT EFFECT AND THE ROLE OF INCENTIVES IN THE STUDY OF SUSTAINABILITY: contributions of behavioral economics

In studies that deal with sustainability, there is a growing number of technical analyses regarding the socio-environmental impacts caused by large enterprises in areas of energy generation. Given their magnitude, hydroelectric plants transact with a series of agents distributed in the areas of energy generation, environment, large constructions, among others. Most hydroelectric projects promote sustainability actions supported by local stakeholders (groups of stakeholders). The latter, in turn, is constituted by interest groups that are impacted by the activities developed by the organization, such as local companies, fishermen, indigenous groups, riverine farmers, farmers and others (MME, 2015). The multiplicity of interactions carried out indicates some possibilities for research.

Moreira *et al.* (2015), and Jiang, Quiang and Lin (2016) observed that issues related to the problems faced by hydroelectric power plants - among which, those based on environmental management and sustainability - have been more attractive than generation technology itself, and that there is an interdisciplinary research trend. Many of the projects addressing these issues are implemented through joint actions among stakeholders (BOND *et al*., 2016, SOEST, STOOP, VYRASTEKOVA, 2016, LIN, LIU, 2016), guided by arrangements in the form of contracts taking into consideration that the success of some initiatives of this nature require the involvement of two or more groups and - sometimes - the results are analyzed in the medium and long term (JIN, BAI, 2011).

Since it is not always possible to carry out the immediate evaluation of the results of the cooperation, Albers (2010) suggests the adoption of mechanisms of coordination, control and incentives to adjust the behavior of the parties. Among the forms of incentive, the use of reward and punishment mechanisms as tools to motivate those involved to cooperate should be highlighted (SEFTON, SHUPP; WALKER, 2002; EGAS; RIEDL, 2008; BALLIET; LANGER; MULDER, 2011). On the other hand, some studies indicate that the use of external incentives may compromise the intrinsic motivation of those involved (VOLLAN, 2008; NARLOCH; PASCUAL; DRUCKER, 2012). In this scenario, some research aspects may be useful in the evaluation of these interactions, such as the theory of behavioral economic games and crowding out theory, offering subsidies to help in understanding how these groups make their decisions and especially how they choose to cooperate (CARDENAS; OSTROM, 2004; STURM, WEIMANN, 2006; LOZANO, 2007; SOEST; STOOP; VYRASTEKOVA, 2016).

In the context of the present research, focused on the sphere of sustainability and environmental preservation, preferring to explore/not to explore nonrenewable resources or to contribute/not to contribute to their preservation, consist of dilemmas of public goods being that, "the public resource dilemma is highly focused on in today's global society, because it determines how long we will hold those necessary resources for the sustainable development" (DU; WU; WANG, 2016, p.1432). Facing the difficulties of reconciling different stakeholder interests, local contributions, opportunities for local development, reduction of environmental risks, particular interests and other tensions between the company and society (PORTER; KRAMER, 2006) the contributions of these two theoretical aspects as a mechanism of evaluation for future negotiations, bargaining and improvements in contracts should be observed. It is argued that the recognition of the determinants of the decision to cooperate and trust can be fundamental, especially in times of negotiation and bargaining among those involved, as well as providing information for the improvement of the contractual instruments that establish relationships between stakeholders and the power plant, and to minimize the possibilities of conflicts and disagreements between the parties.

It is also a research opportunity, once that, in the preliminary review of the literature on this topic, few studies have addressed simultaneously the issue of sustainability in hydroelectric plants and the cooperation between them and a group of local stakeholders from the behavioral economy subsidies and crowding out theory.

Considering the above, the problem of this research can be described as follows: How can the behavioral economy, through the use of incentive mechanisms, contribute to evaluate the intention of cooperation and the crowding out effect between a hydroelectric power plant and a group of local stakeholders in sustainability projects?

The text begins with the literature review. Following is the construction of the proposal and at last, the final considerations.

2. THEORETICAL REVIEW

2.1 Sustainability and energy

It is recognized that companies have an impact on the places where they operate, and that attention to those places 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 only as an ancillary issue, but also by incorporating it into their strategic decision-making processes (ENGERT; RAUTER; BAUMGARTNER, 2016; MOREIRA *et. al.*, 2015) either to mitigate / avoid social and environmental impacts, to explore new markets or to reconcile the interests of various stakeholders (ZIJP *et al.,* 2015; MORRISON-SAUNDERS *et. al*., 2014). The last authors argue that this perspective aims at a better understanding of sustainability assessment processes, transparency and – especially - consensus building.

In the energy sector, many enterprises sometimes delay their operations due to the 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 mostly all other sectors of an economy, so that the availability of energy conditions the capacity of a country to provide its population of 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) forecasts a global growth in energy demand at a rate of 2.5% per year by 2030.

2.2 Hydroelectric power plants

Jiang, Quiang and Lin (2016) and Han *et al*. (2014), from the bibliometric studies, found that (i) most part of research is linked to the post-construction period and start of operation, rather than to construction projects and technologies; (ii) the themes are multidisciplinary; (iii) with rapid and exponential growth of publications about hydroelectric power plants. The relevance of hydroelectric dams as a source of renewable energy and relatively low cost when compared to other potential sources is defended. The benefits of using those, when compared to other sources, are related to (YÜKSEL, 2010):

- extent of flooded areas in some regions;
- energy conversion efficiency, with low operating costs and 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 enterprises;
- high level of reliability;

In Brazil, this has been the main source of power supply, accompanied by thermal plants, wind power plants, small hydroelectric power plants and nuclear power plants (MME, 2015). Moreira *et al*. (2015) affirm that the growth rate of the energy sector in Brazil is 4% per year, counting on the increase of the participation of other energy sources in the matrix.

Due to the size of these projects and their impact on the environments where they are installed, hydroelectric projects are often discussed with a view to sustainability. Most of the actions include economic, social and environmental assessments (LIU *et al*., 2013; KUMAR; KATOCH, 2016): local impacts, the constraints that these enterprises can generate in nearby ecosystems and communities, changes in the dynamics of the aquatic and terrestrial habitat, the deposit of sediment in the river beds, among others are considered (YUKSEL, 2010; ZHAO *et al.*, 2012). In the words of Jiang, Quiang and Lin (2016, p.235):

> Hydropower will orient the development strategy of renewable energy due to its huge development potential, economic and social benefits and proven technology. However, we cannot omit the negative impacts brought by hydropower projects in terms of environment, ecology and socio-economy.

Among the possibilities of numerical evaluation to measure the sustainability potential of hydroelectric power plants as support for decision making, it was verified that methods related to dynamical systems (MUSANGO *et al*., 2012), fuzzy analysis of hierarchical processes (KAHRAMAN and KAYA, 2010) and multicriteria analysis models (WANG, *et al*., 2009; MOREIRA *et al*., 2015) have already been used. Part of the literature suggests the use of indicators as a means of quantifying, monitoring and comparing the impacts and trajectories of social, environmental and economic issues.

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

Several are involved in the decisions for the energy generation sector, each with its own interests and attributions. The following table summarizes the main stakeholders of the sector:

STAKEHOLDERS	TYPE OF INVOLVEMENT
ANEEL	Definition and assessment of technical requirements for the granting of construction and operation licenses.
ONS and CCEE	Regulation, auctions for new projects, dispatch of energy and commercialization.
EPE	Development of prospective studies and new projects in the area.

Local governments	Support to local projects regarding social, environmental and economic impacts, issues related to collection.
Shareholders and Investors	They make their decisions based on the economic, social and environmental constraints imposed by the market, regulatory agencies and other stakeholders.
IBAMA and other local agencies	Definition and assessment of environmental requirements for the granting of construction and operation licenses.
Society	Involvement in issues related to economic, social and environmental aspects, especially in local issues, close to enterprises, including groups of fishermen, riverine farmers, coastal residents.

Box 1: Main stakeholders in the sector
Source: Adapted from Moreira *et. al.* (2015).

In short, many of the actions developed in the field of sustainability occur through the interaction of the power 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.

2.3 Behavioral economics, crowding out effect

The behavioral economy consists of a relatively recent field of research, derived from the incorporation by the economy, of theoretical developments and empirical discoveries in the fields of human and social sciences (WEBER; DAWES, 2005). Among the possibilities of contribution of this theoretical part, we can mention the behavioral economic experiments, especially the public goods game (STURM, WEIMANN, 2006; LOZANO, 2007; KHWAJA, 2009; SOEST; STOOP; VYRASTEKOVA, 2016).

Regarding behavioral economic experiments, Cardenas and Carpenter (2006) classify them into four types: (a) experiments that measure the propensity to cooperate in social dilemmas; (b) those that measure trust and reciprocity; (c) those that measure the impact of justice and altruism; (d) those indicating the risk-inclination and preferences. In order to meet the objective of this research proposal, we will restrict it to the suggestion of using the experiments that measure the propensity to cooperate, especially from the use of the public goods game.

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

In this respect, Weimann (1994, p. 186) summarized the main findings of his experiments:

> […] the following observations have been made: (1) Subjects begin with an average contribution of about 50% of their endowment to the public good. (2) Contributions decay if the game is repeated. (3) Even in the last round (number of repetitions known) strict free riding (the dominant strategy in this round) is seldom observed.' (4) Although contributions in the last round significantly differ from zero, there is a clear 'final-round-effect': contributions reach their absolute minimum in the last repetition of the game.

Some authors argue that the game of the public goods is a viable possibility to evaluate the agents willingness to cooperate with a view to sustainability (LOZANO, 2007; SOEST, STOOP, VYRASTEKOVA, 2016; ROBERT; BROMAN, 2017). However, a branch of cooperation studies defends the need to consider the local collective construction of solutions to certain environmental problems (FREY; STUZER, 2006; VOLLAN, 2008). Cardenas, Stranlund and Willis (1999) and Cardenas and Ostrom (2004) analyzed the effect of government intervention to regulate timber extraction in Colombia. Recognizing that the extraction of this material accelerates local erosion, the authors - considering neoclassical economic theory - hoped that regulation would bring better results to local groups. However, they observed that when the extraction was marked by informal norms defined by the residents themselves, the extraction decision was balanced between the egoistic and the collectivist behavior. By the time the government took over this responsibility, residents no longer felt co-responsible for extraction, adopting a more selfish stance.

The authors note that the crowding out effect in this case stems from the application of modest (although well-intentioned) control policies to local environmental problems instead of informal rules already institutionalized by residents (and conceived by the group itself) for the exploitation of natural resources. From the individual perspective, Vollan (2008, p.560) thus contextualizes the crowding out effect:

> In many instances, individuals engage in activities for their own sake, without obvious external incentives. They are intrinsically motivated. They, for example, pursue a hobby that either brings them pleasure, or they think it is important, or they feel that what they are doing is morally significant. In many cases governments or other organizations are giving additional external incentives to reinforce the intrinsic motivated behavior or to induce people to follow the good examples of other individuals. However, an external incentive can lead to the crowding-out of intrinsic motivation […] This class of problem is often encountered in real life situations. In many areas of the world natural resources are jointly managed by a community of local resource users, local and senior governments, and other stakeholders. Co-management arrangements cover both informal pragmatic deals as well as formal legal agreements […] External intervention through rule imposition reduces self-determination and leads to the crowding-out effect as the locus of the decision-making is shifted away from the individual or the group to an outside entity (VOLLAN, 2008, p.561-563)

It is observed that when individuals interpret external intervention as restrictive, the willingness to cooperate is reduced, while when they interpret it as support (or assistance), the willingness to cooperate increases (FREY; STUTZER, 2006). Vollan (2008), in his work with African communities, found that an external support institution does not lead to crowding out, while restrictive external intervention does. These findings are in line with Frey and Stutzer (2006), who argue that environmental care awareness and the motivation to do so can be reduced if third-party intervention (of the government, especially) is perceived as controlling

(or restrictive), whereas it can be inclusive if the intervention is perceived as supportive, motivating participants.

Comparatively, both transaction cost theory and agency theory consider monitoring and enforcement to increase partner effort, while the crowding out literature suggests the opposite (DICKINSON; VILLEVAL, 2008). Houser *et al*. (2008), Frey and Jegen (2001) and Fehr and Falk (2002) reinforce this observation, stating that individuals can reduce their willingness to cooperate when threatened by sanctions / punishments or even by economic incentives and rewards.

2.4 The role of reward and punishment mechanisms

In order to encourage cooperation between individuals, some authors suggest the use of reward mechanisms (for cooperation) and punishment (for noncooperation) as tools to promote cooperation in social dilemmas or situations when immediate self-interest and longer term collective interest conflict (BALLIET; LANGER; MULDER, 2011; CHOI; AHN, 2013).

The reward mechanisms, from the perspective of the game of the public goods, are an artifice used to promote cooperation between the parties, being effective in games of more than one round (WALKER; HALLORAN, 2004) and when the cost of promoting it is less than the gain of the recipient (SEFTON; SHUPP; WALKER, 2007), being recommended the use of this instrument individually (NARLOCH; PASCUAL; DRUCKER, 2012). For the latter authors (2012, p.2014) "by raising the individual pay-offs and decreasing free-riding incentives, individual rewards could have a stabilizing effect on collective action due to motivating people to stick to the social norm". As an example of agency theory, it is suggested that the partner is motivated by his / her financial returns from the interactions, so that the higher the return, the greater the likelihood of the agent adopting the cooperative stance (DICKINSON; VILLEVAL, 2008).

The table below summarizes some of the results related to the reward in the public goods game:

Themes	Observations	Authors	Types of experiment
Interactions / rounds question	- Reward only takes effect in games with successive interactions;	Sefton *et al* (2000); Walker; Halloran, (2004); Balliet; Langer; Mulder, (2011)	Laboratory Experiment
Collective and individual reward and crowding out effect	- The collective reward is ineffective and tends to reduce the motivation for cooperation - The individual reward is effective, and tends to stimulate cooperation;	Gneezy *et al*. (2003); Travers, Clements, Keane, and Milner-Gulland (2011); Narloch; Pascual; Drucker (2012)	Field experiment
Reward, empowerment of local groups and crowding out effect	- Policies developed to reward cooperative behaviors from local stakeholders will be more effective if they allow local groups themselves to be responsible for local decisions, otherwise local stakeholders tend to cease cooperation	Travers *et al.* (2011)	Field experiment
Non-monetary	- The experience of being praised	Kumakawa (2013)	Laboratory

reward x cooperation	(social reward) does not lead to increased cooperation in the next round		Experiment
Unit reward x cooperation	- When the reward rate and its cost are 1: 1, the reward mechanism is not able to maintain cooperation, regardless of the number of rounds	Walker; Halloran (2004); Sefton; Shupp; Walker (2007)	Laboratory Experiment
Positive Rewards x Cooperation	- Positive rewards (1: 5) have a stronger impact on cooperation than unit rewards; - When the impact of reward is significant in cooperation, its use is more frequent	Andreoni; Harbaugh; Vesterlund (2003);Vyrastekova; Soest (2008); Drouvelis (2010)	Laboratory Experiment

Box 2: Synthesis of the studies that address the reward in games of public goods
Source: Prepared based on literature review

Regarding punishment mechanisms, Reuben and Riedl (2009) broaden the discussion about contributions to the public goods, indicating that differences in contributions are due to the forms of punishment imposed, so that when there is no punishment, all converge towards free riding behavior. About that, other authors (Masclet *et al*., 2003) also observed that when the punishment is monetary, the offerings increase more than when the punishment is non-monetary. However, for both possibilities, when the punishment is withdrawn, the contributions decrease in the game of the public goods.

While the prediction of punishment in contractual arrangements is interpreted as a mechanism of prevention of opportunistic behavior (WILLIANSON, 1985, 1991), in experiments of the game of the public goods, it is observed the prediction of punishment as a mechanism that aims to ensure the efficiency / contribution to the good (FEHR; GAECHTER, 2000; PAGE; PUTTERMAN, 2000; SEFTON, SHUPP; WALKER, 2002), penalizing those who choose not to cooperate although they can enjoy the public good.

In this context, it is observed the reservation of some authors regarding the magnitude of the punishment, recommending that - to be effective - the punishment should be raised in proportion 1: 3 or higher (SEFTON et al., 2007; NIKIFORAKIS; ; CHAUDHURI, 2010): the mere prediction of punishment or punishment with minimal loss to the player would not be effective to cooperation. It should be noted that the use of this resource is recommended to make the application of punishment as a low cost to the punitive and high impact to punished (CARPENTER, 2007; EGAS; RIEDL 2008; NIKIFORAKIS; NORMANN, 2008). The table below summarizes some of the main findings regarding the mechanisms of punishment in games of the public goods.

Themes	**Observations**	**Authors**	**Types of experiment**
Violation of norms X punishment	Punishment is accepted when norms of justice and norms of cooperation are violated, being voluntary or provided for in contract.	Dominique *et al*. (2000); Choi; Ahn, (2013)	Laboratory Experiment
Conditions to punish	The conditions for altruistic punishment must be relatively favorable (low cost for the punitive and high impact for the punished) for the cooperation to be maintained.	Egas; Riedl (2008); Nikiforakis; Normann (2008)	Laboratory Experiment
Return of the punished player	When the punished player returns from the penalty applied, cooperation tends to be	Nikiforakis (2004)	Laboratory Experiment

	extinguished more quickly.		
Free rider behavior and punishment	With the prediction of punishment, the free riding behavior is inhibited.	Fehr; Gaechter (2000), Page; Putterman (2000), Sefton, Shupp; Walker (2002)	Laboratory Experiment
Face-to-face communication X punishment	Comparing the efficiency of face-to-face communication with predicted punishment, it is observed that communication increases contributions more than the possibility of punishment, and considering the cost of punishment, only communication significantly increases the gains of individuals and the group.	Bochet; Page; Putterman (2005)	Laboratory Experiment
Conditional cooperation	Conditional co-workers are often willing to punish free riders, even if there is a cost and does not confer long-term benefits	Falk *et al.* (2005); Gächter; Thöni (2007); Gächter *et al*. (2008)	Laboratory Experiment
Efficiency x punishment	- Both the contributions and the efficiency of the public good are greater in the treatments that allow punishment than in those that do not foresee it; - Without possibility of punishment, *'homogeneity X heterogeneity'* does not matter, since free riding behavior arises and will increase over time	Rockenbach; Milinski (2006); Reuben e Riedl (2009)	Laboratory Experiment
Punishment x number of rounds	In single round games, punishment has no effect.	Walker; Halloran (2004); Gächter *et al*. (2008)	Laboratory Experiment
Magnitude of punishment x cooperation	- When punishment is small (templates 1 to 1) it is not effective in maintaining cooperation; - To ensure group efficiency, punishment must be high.	Sefton *et al.* (2007); Nikiforakis; Normann (2008); Chaudhuri (2010)	Laboratory Experiment
Size of the group x punishment	When full monitoring is allowed, the size of the group tends to increase the contribution considering that there is greater monitoring on the free riders.	Carpenter (2007)	Laboratory Experiment
Cost of punishment	Interest in punishing decreases as the cost of punishment increases, analogously to the law of demand.	Anderson; Putterman (2006)	Laboratory Experiment
Social punishment x antisocial punishment	In the possibility of choosing between punishing free riders or those who contribute much above average, one chooses to punish the free riders	Hermann *et al.* (2008); Ertan *et al*. (2009)	Laboratory Experiment
Punishment x contract writing	Punishment is best applied to contracts that require full cooperation. In contracts that require a minimum level of cooperation, punishment tends to be inefficient.	Dannenberg (2016)	Laboratory Experiment
Non-monetary Punishment	- Non-monetary punishments may increase cooperation for a limited period of time; - These punishments are more effective among people known than with strangers; - Both forms of punishment are more	Masclet *et al.* (2003)	Laboratory Experiment

	efficient for cooperation than not having punishment.		

Box 3: Synthesis of studies addressing punishment
Source: Prepared from the literature review.

In view of the above, to propose the contributions of incentive mechanisms to cooperation in the field of sustainability for a specific group of stakeholders of the Itaipu Power Plant, as well as to evaluate the manifestation of the crowding out effect, it is necessary to observe how such motivations and constraints collective incentives associated with environmental preservation affect individual decisions to contribute to the public good.

3. METHODOLOGICAL PROCEDURES AND CONSTRUCTION OF THE PROPOSAL

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

The research was conducted based on the assessment of documents - Ten-Year Energy Plan (MME, 2015), annual sustainability reports of the Itaipu Power Plant and environmental contract documents between this organization and its stakeholders, in the form of contracts, service permits, covenants and cooperation agreements. The purpose was to contextualize the main initiatives aimed at environmental preservation that require the participation of the community of professional fishermen operating in the reservoir, the time horizon of these relationships, the types of expected results and the participation demanded for the stakeholders. There are 456 professional fishermen, placed in 10 colonies / fishing associations. The following picture shows the distribution along the Itaipu Reservoir.

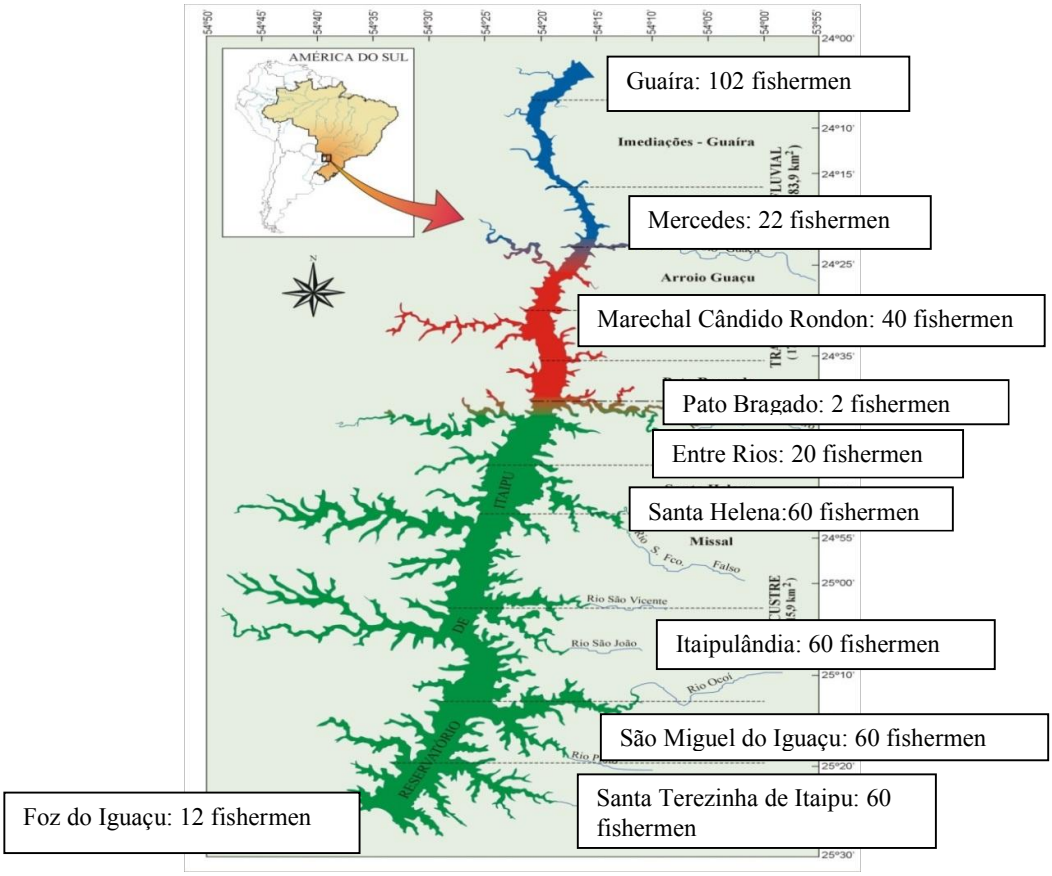

Figure 1: Distribution of professional fishermen along the reservoir
Source: Prepared based on secondary data

Following the research, eight personal interviews were carried out with managers involved in this sustainability program, guided by a semi-structured script of qualitative issues (GODOY, 2006) - whose content included the validation of the researcher's findings from the examination of secondary documents, as well as the explanation regarding the fishermen of the region of the west of Paraná identified as relevant to the power plant, the particularities of each project developed and the risks of the eventual non-cooperation. The issues also explored topics related to relationship management, their determinants and constraints.

3.1 Selection of players and definition of games

The criteria for identification and selection of potential players in this proposal was based on identification - among those groups belonging to the local society - that frequently interact with the dam. They are stakeholders with frequent interface relationships, mainly with the area of environment and environmental management. It was also considered:

- that the fishing community possessed - direct or indirect - contact with any contractual regiment. This point is an attribute of cooperation: when the participants themselves agree to a work order and punishment system, it is often not necessary to use it and the benefits of cooperation can be substantially improved (OSTROM, 2010);
- that fishermen represent a stakeholder group mentioned in official documents of the Brazilian electric sector (MME, 2015) and 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). As an exception, we mention 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 the foundations for the classification of stakeholders, the criteria of relationship of dependence (LANGTRY, 1994) and of legitimacy in the relationship (CORNELL; SHAPIRO, 1987; CARROL, 1989) of professional fishermen in relation to power plant could be observed;
- These are mostly low-income groups, whose decisions that benefit them in the short term may overlap with long-term cooperation decisions, although the detriment of sustainability and contractual rules. On the other hand, the imposition of external incentive mechanisms can undermine the motivation of this class to preserve the public good in question;

The following figure characterizes the stakeholders identified from the data collection.

Stakeholder	Description	Relevance of stakeholders to Itaipu	Problems of eventual non-cooperation
Fishermen	They are people who descend, predominantly, from traditional riverside communities and live from fishing in the reservoir.	- As they survive from a resource of the reservoir, they are fundamental for the preservation of the same; - Cooperate in research and monitoring activities that ITAIPU develops in the reservoir; - Cooperate in cleaning campaigns of the reservoir, acting as environmental agents that help to raise awareness of local communities; - Develop, in partnership with Itaipu, activities focused on aquaculture to complement income; - Develop joint actions, in which Itaipu assists in the transfer of technology for the processing and aggregation of value to fish;	- The discontinuity in providing information, compromising the monitoring of fishing resources and socioeconomic data in the long term. - The risk of lawsuits against the dam, alleging material damages resulting from the construction of the Reservoir; - Pollution of the reservoir due to the accumulation of dumped garbage; - Contamination of the reservoir.

Box 4: Characterization of the fishing community
Source: Prepared from the literature review.

From the characterization of these groups, we identified which sustainability projects had interaction and then proposed the game of the public good that best represents the dilemma faced by groups, especially regarding the public good. Regarding the type of game, it is proposed to detail the gains resulting from the cooperation:

Group	Joint projects in the field of sustainability	Public goods	Proposed game
Fishermen	- Monitoring of the Yield and Socioeconomics of Fishing in the Reservoir; - Mobilization to clean the reservoir; - Mobilization for the removal of garbage from the reservoir; - Transfer of technology for fish processing	- Fish and their potential as a commercial and subsistence input for fishermen; - The donation in the game represents a *proxi* of the cooperation, indicating how much the fishermen are willing to maintain the public good, although to the detriment of the individual benefit of the moment (retention of the amount)	**Voluntary contribution (public good game):** Fishermen - in a game of 7 rounds in order to reproduce a contractual instrument - will receive a monetary amount, which they should choose to donate to the care in the preservation of the reservoir or take for their own benefit. The amount of six individuals per group will be used. The number of individuals is in accordance with that selected by the field experiments literature [Cardenas (2000) worked with groups of 7 participants; Cavalcanti *et al*. (2010) worked with 6 individuals]. It will be proposed to perform experiments with variation in the use of reward (with no reward; collective reward; individualized reward) and punishment (without punishment; low punishment; high punishment) mechanisms, as well as the evaluation of the manifestation of the crowding out effect in the groups, in order to verify which incentive best fits the interactions between Itaipu and the fishing community, and which measures should be taken.

Box 5: Sustainability project to which the interest group has interface and proposal of economic games
Source: Prepared from data collection

Checking the willingness to cooperate in actions aimed at sustainability, as well as the role of punishment and reward mechanisms, is relevant for the organization to obtain subsidies for the establishment and maintenance of lasting relationships with these stakeholders. For this, the possibility of communication among the stakeholders (especially direct communication, face-to-face), the long-term horizon of relationships and the reputation of the power plant may represent factors that support the motivation of stakeholders, which in turn increases chances of cooperation between the parties (OSTROM, 2010).

4. FINAL CONSIDERATIONS

The present work sought to present a proposal for an association between two areas of research still poorly integrated, the contributions of behavioral economics and crowding out theory for the analysis of sustainability actions that require cooperation between a hydroelectric power plant and the fishing community that acts in its reservoir. It can be added that most research, from the application of economic experiments, focuses on two aspects:

- Analyzing the decisions aimed at cooperation on 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);
- Analyzing the decisions directed to the cooperation from field experiments with rural communities (CARDENAS, 2000; CARDENAS, OSTROM, 2004; CARPENTER *et al*., 2004; HENRICH *et al*., 2005; VOLLAN, 2008; NARLOCH; PASCUAL; DRUCKER , 2012), in order to understand the dynamics of cooperation of these groups, as well as the factors that interfere in

this dynamic. In this case, research usually involves combining methods (qualitative and experimental) using certain control variables and - sometimes - considering the specific context in which such communities are inserted, in terms of social norms, resource constraints, forms of subsistence. For the development of this proposal, it is recommended the use of behavioral economic experiments, the game of the public goods (CARDENAS, CARPENTER, 2006), in order to measure the propensity to cooperate in social dilemmas. The present proposal is inserted in this field, summarized in the following figure;

Punishment and evaluation of crowding out effect		
Without Punishment	With Low punishment	With High Punishment
Reward and evaluation of the crowding out effect		
No reward	Collective Reward	Individualized Reward

Figure 2: Experiment proposal
Source: Prepared by the author based on specialized literature

It is recognized that economic field experiments lose some of the internal validity and potential of replicability when compared to laboratory experiments (ROE, JUST, 2009), however, to approach the reality of local organizations, as well as to identify the heterogeneity of stakeholders with which this hydropower interacts represents a relevant point to be considered when making decisions about cooperation (CHAKRAVARTY; FONSECA, 2014).

Also, regarding the proposal to use behavioral economic experiments, it is justified because of the nature of the information to be obtained, which would hardly be obtained through the execution of 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 evaluate issues related to the decision-making of agents and groups, especially on issues related to preferences, risks, willingness to cooperate. Due to this methodological option, it is necessary to watch out for the strict compliance with the protocol of manipulation of variables and the operationalization of the experiment, involving procedures in the recruitment phases of potential participants, explanations and stimuli prior to the game, game conduction and even after the experiment (KREPS, 1990, HENRICH *et al*., 2006; CARDENAS, 2000; CARDENAS, CARPENTER, 2006).

The present proposal aims to contribute to the improvement of the research regarding the willingness to cooperate with the stakeholders of hydroelectric power plants, representing this theme as a research opportunity still under development. From a practical perspective, this study assists in obtaining relevant information about the applicability and efficiency of punishment and reward mechanisms in cooperation between the power plant and its local stakeholders, either to support future negotiations and agreements, or in situations of bargaining when these groups present their demands. It is also hoped to improve the management of contractual arrangements based on cooperation between companies and local stakeholders in projects aimed at sustainability; reduce any transaction costs, especially in long-term relationships; complement the content of contracts, drafting the obligations / duties of those involved, penalties applicable and incentives for contractual compliance; and minimize the possibilities of conflicts and disagreements between the partners.

The conduction of similar studies in other mills with recent impacts on local communities, such as the Belo Monte mill (OLIVEIRA *et al*., 2016), and with other players can also aid in the validation of the proposal. The limitations of this research include the relatively low number of respondents and the consequent need for continuity for validation and confirmation of the public assets of each game.

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