

Population heterogeneity and social representations of dams in the Amazon ¹

Alisson Flávio Barbieri²

Gilvan Ramalho Guedes³

Artur de Souza Moret⁴

Neiva de Araújo⁵

Abstract. Large-scale infrastructure projects have caused dramatic disturbances in the Amazon, including social conflicts which have, as one of the root causes, from the lack of understanding of perceptions from heterogeneous population in an impacted area. This paper investigates how discourses and social representations about the project and future construction of the UHE Tabajara, in the municipality of Machadinho, Rondonia, differ across demographic and socioeconomic groups. We assess how the collective representation of the UHE varies by different social actors in the area directly affected by the dam (village of Tabajara), and the urban and rural areas, using the *Technique of Free Association of Words*. The results will allow us to unveil how latent conflicts and perceptions about the impacts of the construction of the UHE Tabajara reflect a heterogeneous population whose individual and household characteristics should be taken into account in compensation and mitigation policies related to the construction of dams in Machadinho in particular, and for other infrastructure projects in the Amazon.

Introduction

Large-scale infrastructure projects have caused dramatic disturbances in the Amazon, including social conflicts and power asymmetry in the discussions involving entrepreneurs, State, and the Civil Society. The misunderstanding of the population perceptions and expectations about the projects and their different meanings in a diverse, heterogeneous population is one of the root causes of the conflicts and of biased and ineffective compensatory and mitigation policies. One of the current development projects in the Amazon is the UHE Tabajara, which will encompass a 400 Km² dam and a hydroelectric plant with a capacity of 450 MW in the municipality of Machadinho, in Rondonia.

In this paper we discuss the potential impacts of UHE on the local environment and on the population in its surroundings and how discourses and social representations about the UHE Tabajara differ across demographic and socioeconomic groups. We also discuss the importance of heterogeneous schemes for more effective intervention and mitigation strategies based on these different views and significations. We assess how the collective representation of the dam construction varies by different social actors. Variation in social representation can be assessed by using the *Technique of Free Association of Words*. The technique allows us to empirically assess the social representations of the dam by population subgroups in three distinct areas: the area directly affected by the dam (village of Tabajara), the urban area of Machadinho, and the oldest rural settlement area in the municipality.

The results allow us to unveil how latent conflicts and perceptions about the impacts of the construction of the UHE Tabajara reflect a heterogeneous population whose individual and

¹ Paper presented at the VII Congress of the Latin American Population Association (ALAP), Foz do Iguaçu, October 2016.

² Associate Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil. Email: barbieri@cedeplar.ufmg.br.

³ Associate Professor Universidade Federal de Minas Gerais (UFMG), Belo Horizonte, Brazil.

⁴ Professor, Universidade Federal de Rondonia (UNIR), Porto Velho, Brazil.

⁵ Assistant Professor, Universidade Federal de Rondonia (UNIR), Cacoal, Brazil.

household characteristics should be taken into account in compensation and mitigation policies related to the construction of dams in Machadinho in particular, and for other infrastructure projects in the Amazon.

Conflicts around Hydroelectric plants and dams in the Amazon

The history of the Amazon (and the State of Rondonia, in particular) reveals the succession of several economic and exploratory cycles related to mining (gold, cassiterite, and diamond), rubber, timber, and cattle ranching. More recently, beginning in the 1980s and having a boom in the 2000s, hydroelectric energy has consolidated as another extractive and economic boom given the still unexplored hydric potential in the Amazon. A remarkable feature in all these sites is their *extractive* nature, since the cycles have not adequately taken into account the welfare and aspirations of the inhabitants and have generated uneven socioeconomic benefits.

Energy planning in Brazil has clearly taken as the main option the *monotechnology* based on high-capacity hydroelectric power plants (UHE) and dams. The main discourse behind this option is the fact that the country dominates the methodology and technology behind UHEs construction and the need of big plants to match increasing demand. This option has also been defended against the construction of small hydroelectric plants (PCHs), which produce enormous socioenvironmental impacts given the characteristics of the Amazon geology (marrocos and Moret, 2009). The centrality of UHEs in Brazil's energy planning, as well as the construction of a number of large UHEs, the overestimation of dams and the small participation of the population of the affected territory during all stages of planning and construction have increased in recent years the social mobilization and socioenvironmental conflicts regarding UHEs (Moret, 2001; Seva, 2005 and 2008; Bemann, 2007; Zhou, 2015; Vainer, 2013).

The project of the UHE Tabajara, in the municipality of Machadinho, in the southern Brazilian Amazon, dates from the 1980s. One of the justifications for this project by the federal energy company (ELETRONORTE) was to provide energy supply for the states of Rondonia and Acre, since they were not linked to the national energy grid (*Sistema Nacional Integrado - SIN*). Energy supply in these states was precarious, with frequent shortages. Thus, the UHEs faced virtually no opposition, given the perceptions and discourses that they would allow better services and infrastructure (hospitals, commerce, services, amenities, etc.) (Nobrega, 2008, p. 65-68). Nowadays the same discourse and perceptions from the 1980s are used to justify, for example, the UHE Tabajara in Machadinho.

On the other hand, some of the studies mentioned above in the territories which will receive UHEs in the Amazon show that UHEs in the Amazon have engendered the emergence of socioenvironmental conflicts since the 1980s, and especially during the 2000s. Some of the reasons that have been reported as causes of these conflicts are the low participation of the local population in the discussion about the UHEs construction, the elimination or reduction of traditional economic activities, migration fluxes into the places and permanence of a share of these migrants after the construction peak, the social changes due to the rising and consolidation of peripheral poor areas, increasing criminality and violence (robbery, murder, drug trafficking, prostitution), income spillover effects due to the low capacity of local municipalities to fully benefit and retain the income generated since the local job force is usually low-skilled, low paid and the highest remunerated services are located in other places (ROSS, 2015). The scale or size of an UHE, such as the one planned in Tabajara, involves impressive amounts of resources and economic interests, which dramatically compares to the size and bargaining power of local municipalities and communities. As an example, Machadinho's Gross Annual Municipal Product is around R\$397 million (IBGE, 2013), while the construction of the UHE alone will cost around 3.3 times more, or US\$350 million (considering as reference US\$1000/kW installed), or around R\$1,250 million (considering the exchange ratio in April 2016: US\$ 1 =R\$3,70).

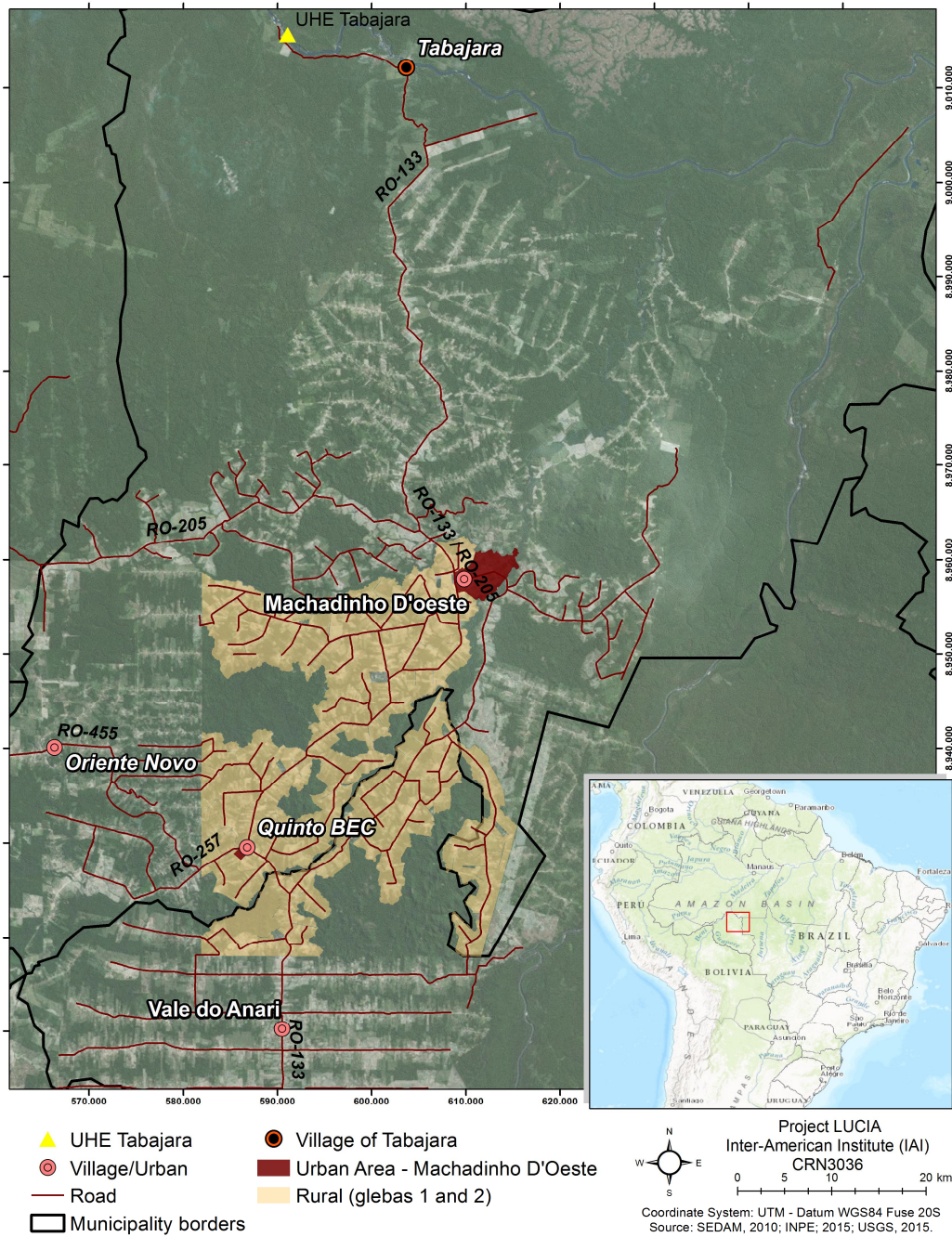
Study area

Machadinho D'Oeste (Figure 1) is a municipality in the State of Rondônia, in the southwestern part of the Brazilian Amazon. It is a former planned Colonization Project, with an area of 8,509 km² and population of 31,135 according to the 2010 Census (and estimated 35,000 in 2016). The Colonization Project was conceived in the Northwest Region Integrated Development Program (Polonoroeste), approved in 1981 and partly financed by the World Bank. The occupation of plots by farm colonists began in 1984 (see further discussion in Monte-Mór, 2004). By July 1985, Machadinho's urban nucleus became a booming little town, with over 1,500 houses, although about 30% of them were unfinished or only used as a second home—an “urban base”—for rural families (Monte-Mór, 2004). This last aspect gives Machadinho an important characteristic: the real hybrid (urban) nature of contemporary frontier settlements in which rural livelihoods are combined with opportunities offered by urban areas in terms of jobs, goods and services (Monte-Mór, 2004; Barbieri et al., 2009; Barbieri et al., 2016). In Machadinho, practically all urban dwellers own and exploit rural parcels, strengthening the land market on both urban and rural fronts (Monte-Mór, 2004).

The UHE Tabajara will be constructed in the village which carries this same name, in the northern part of the municipality and in the river Ji-Parana (also known as Rio Machado). The UHE Tabajara is projected to generate 350 MW of installed power and is currently under the stage of primary licensing, with studies on social and environmental impacts being conducted (IBAMA, 2016). The beginning of the operation is expected for 2021 (ANEEL, 2016).

Figure 1 shows the location of the three study areas in Machadinho which we investigate in this paper: the oldest rural settlement area in the municipality corresponding to *glebas* (land parcels) 1 and 2, the area directly affected by the dam - the village of Tabajara, and the urban area.

Figure 1– Study Area in Machadinho D’Oeste: rural study area, urban area and Village of Tabajara



Data and methods

We use data from 341 field survey interviews conducted in Machadinho in 2015 – 27% in the urban area, 62% in the rural area, and 11% in the Village of Tabajara. Rural data represents a random sample of 211 individuals based on a list of 259 farm households visited in a 2010 fieldwork. Data on urban and Tabajara study sites comes from an intentional sampling in which field interviewers were distributed in different parts of the urban area and Tabajara and

interviewed individuals found in their residences or business. The dataset includes information on social perceptions about the dams, in which an interviewee defines five words or expressions that he or she recalls when told about the UHE Tabajara. We ask the interviewee to rank the words or expressions according to their relevance and, then, explain and justify the meaning for his or her choice. We also collect socioeconomic and demographic information for each interviewee. Our purpose is to identify differences within population in each study area regarding perceptions, socioeconomic and demographic characteristics regarding the UHE.

Based on Moscovici's (1961) *Theory of Social Representation* (TSR), we assess how the construction of the dam is important to induce behavioral change when it is absorbed and socially signified and how it manifests. Using the *Technique of Free Association of Words*, we catalog the main words and expressions evoked by individuals based on the inducted term "Tabajara Dam", and then use the package TELP within the R programming language to empirically assess the social representations of the dam by population residence (rural, urban, village of Tabajara). We accomplish this by identifying the most important and stable expressions or words by comparing the frequency and the average of evocations by order of importance.

Evocations were first categorized to represent meaningful and standardized concepts. For instance, expressions such as "violence" and "violent" were considered "violence". Once appropriately treated, standardized evocations were then given an average evocation rank, based on whether they appeared first to last in terms of importance for the interviewee. These two dimensions, frequency and importance rank, are then organized in four quadrants. Each quadrant is defined according to the level of evocation frequency and average evocation rank. Following Abric's *Central System Theory* (Abric, 1994, 2003), we focus our analysis on the core elements of social representations expressed in the first quadrant. We complement this analysis with insights from the elements expressed in the other quadrants. Sa (1996), based on Abric (1994), suggests that each quadrant has its own meaning, which links to the other quadrants. The first quadrant represents the core of social representations, unveiling collective meaning and importance; these are shared and stable values in the group. According to Sa (1996), the central system also represents the collective memory given the history and socioeconomic structure shared by a group. This collective memory defines a homogeneous, lasting, and resistant representation that is resilient to change in group values. The peripheral system comprises two quadrants defining both contradictions and heterogeneities in the collectivity and elements sensitive to variations in the context – thus sensitive to evolution and change (Sa, 1996; Abric, 2003). Finally, the fourth quadrant represents evocated elements more related to individual, isolated perceptions about an object.

Following Sa (1996), we assume that the core of social representations may vary between groups (study areas) due to their level of exposition and anchoring of the inducing term (object); otherwise, if differences refer only to the elements in the peripheral system, groups would signify the object in a similar fashion, with variation manifesting on contextual or individual conditions.

We scrutinize heterogeneity on social representations regarding the Tabajara Hydroelectric Power plant using a qualitative assessment on the meaning of expressions reported by respondents based upon frequency and importance rank of responses. The process of analyzing social representation as suggested by Abric (1994) was implemented in multiple steps: 1) standardization of words or expression evocated, 2) visualization of most frequent words based on word clouds, 3) definition of the cut points for the average evocation rank and frequency, 4) aggregation of evocations, based on assigned cut points, and 5) qualitative meaning of evocated words and expressions in the core system. The first step regarded a classification of words with the same meaning into standard categories, avoiding the loss in heterogeneity. This is a key step to the quality and meaningfulness of the subsequent steps. Thus, following Bonomo et al. (2011), we created a new variable, named polarization, which can preserve the positive or negative meaning of two words collapsed into the same smoothed evocation. The second step basically uses the frequency that the evocations were cited and place

them in a cloud of words with different sizes based solely on the frequency of appearance. Although limited, this is a first approach to understand the collective representation of the Tabajara Hydroelectric Power Plant, and was conducted for the full sample and by subsample of each study area (rural, urban, and village). This analysis was performed using the programming language R, version 3.2.5 with the packages ‘wordcloud’ and ‘RColorBrewer’.

One of the main drawback of the quantitative systematization of the central core system approach is the arbitrariness for choosing the cut points related to the frequency and the average evocation rank. To overcome this issue, we explore visually the spatial position of evocations based on individual values of these two parameters. Within this scatterplot of possible combinations of the two parameters, we used the three main summary measures: the mean, the median, and the mode. Due to the distribution of our evocations based on those parameters we opted for defining the cut points as the mean of frequency and average evocation rank. With the parameters defined, we implemented the quadrant analysis using the recently R developed package “telp”, which replaces the old software EVOC2000. The social representation based on the technique of the free words association was performed for the full sample and for each study site. To complement this analysis, we use the qualitative phrases explaining the meaning of the words in the first quadrant. This is an important part of signification of the central core system. Finally, we evaluate descriptively the results by place of residence and basic socioeconomic characteristics such as age, occupation, sex, and place of birth.

Results

Descriptive sample analysis

Table 1 shows the main differences between interviewees in the three study sites. The urban study area is more representative of a male, younger population predominantly (87%) in non-agricultural or extractivist occupations. It also presents the higher proportion of population born in Machadinho or nearby, which is coherent with the lower mean age of the interviewees. Rural and Tabajara study areas have higher mean age and proportion of interviewees born outside the Machadinho region (above the average for all study areas) and a more balanced proportion of men and women compared to the urban area. Most of the interviewees are occupied in agriculture and extractive activities (mean of 0.33) given the higher weight of the rural population (100% had the main occupation in agriculture or extractivism), while in Tabajara this proportion was 23%.

Table 1- Descriptive statistics for study areas in Machadinho D’Oeste - 2015

| Variable | All sites | | Rural | | Urban | | Tabajara | |
|---|-----------|------------------|-------|------------------|-------|------------------|----------|------------------|
| | N | Mean (st.dev) | N | Mean (st.dev) | N | Mean (st.dev) | N | Mean (st.dev) |
| Sex (0=male, 1=female) | 341 | 0.45 (0.50) | 206 | 0.48 (0.50) | 89 | 0.37 (0.49) | 38 | 0.55 (0.50) |
| Mean Age | 336 | 45.97 (16.92) | 204 | 50.81 (16.16) | 89 | 34.35 (12.66) | 37 | 46.86 (17.75) |
| State of Birth (0=Rondonia, 1=elsewhere) | 341 | 0.72 (0.45) | 206 | 0.84 (0.36) | 89 | 0.49 (0.50) | 38 | 0.61 (0.50) |
| Region of Birth (0=Machadinho region, 1=elsewhere) | 341 | 0.85 (0.35) | 206 | 0.92 (0.27) | 89 | 0.67 (0.47) | 38 | 0.87 (0.34) |
| Occupation (0=agriculture or extractivism, 1=other) | 341 | 0.33 (0.47) | 206 | 0 (0) | 89 | 0.87 (0.33) | 38 | 0.76 (0.43) |

Analysis of Social Representations about the UHE Tabajara

We present the results in the following tables and figures. Table 2 shows the social representations about the UHE Tabajara by quadrants and study area, while Figure 2 illustrates

graphically Table 2, using clouds to represent the higher frequency of evocated expressions for UHE Tabajara according to study area. Figure 3 complements the analysis with the Average Evocation Rank according to study area. Finally, Table 3 provides a qualitative analysis of a sample of meanings associated with the main expressions in the core social representation

The three study areas have highest evocations (frequencies) on *employment*, *robbery (violence)*, *impact of lack of infrastructure*, *reliable energy supply* and *energy brings development*. There are positive perceptions that the UHE will increase *employment* levels and *energy* will bring *development*. As illustrated in Table 4, there is a perception that UHE will solve a structural problem in the local labor market, characterized by rural employment, public jobs or in precarious services: “*The only jobs in the region are in the sawmill and in the City Hall*”; “*There are many unemployed and people needing a job*”; “*Many people wants a job but there is none*” (Table 4). Furthermore, when combined to the peripheral discourse on *reliable supply of energy* in Tabajara and rural areas, the UHE is considered a driver of municipal development since it will solve the problem of lack of reliable, cheaper energy and substitute the current energy generated by small mills moved by diesel which has constrained investments in rural production and industry as well as better life quality: “*Population [suffers from] energy shortage. There is a parcel of the population without energy*”; “*Energy is needed to bring development*”; “*[Energy] Improves livelihoods. I can watch TV, have more water to the cattle because I can use pumps, I can conserve milk*” (Table 4).

The pervasive belief that UHE will bring employment, energy and development to Machadinho contrasts with a negative perception in the three study areas about the actual construction of the UHE as illustrated by the expression *doubts construction*. This is related to the long period and expectative about the construction, which dates from the 1980s, but also to their negative impacts, as discussed previously: “*The bureaucratic part takes a long time. There were many Public Hearings and nothing has been defined*” (Table 4). Furthermore, when combined to the peripheral representations in all study areas suggest that *bad politics and corruption* associated to the UHE may create a negative perception about its uneven benefits and construction: “*Given the political interests, [UHE] will not be built. It is a project to get electing votes*” (Table 4).

Finally, there are important differences on the central elements of social representations when we considering differences in study areas and thus heterogeneous perceptions. Table 2 also shows central elements of social representations which are unique to each study area, as well as elements shared by two study areas. Regarding the first, elements related to *environmental destruction* and *population displacement* appears only in Tabajara, and only in the first peripheral system in urban and rural areas. The great distance from Tabajara to the rural and urban areas, as well as the first is located in the directly impacted area by the dam, reinforce the discourse and concern about the socioenvironmental impacts of UHE: “*The river is my livelihood and is part of the nature, it is source of freedom*”; “*It will not be possible to find another nice place*” (Table 4).

As in many other poorer, mostly rural communities in the Amazon, the precarious infrastructure has been a main concern. Thus, there is a positive perspective in urban areas that UHE will bring *investment in infrastructure*: “*[Investments in the UHE] are good to generate capital to invest in infrastructure*” (Table 4). While there is central perception in rural areas that the UHE will bring important benefits for agriculture, especially by providing *clean* and *cheaper energy* for rural production and improving welfare, there are major concerns about violence and criminality, especially robbery, in rural areas: “*[UHE will] increase robbery, drugs and many other bad things which come together*” (Table 4). An impressive analysis of fieldwork in these areas in 2010 and 2015 depicts recurrent reports of increasing criminality, especially robbery but also murders.

Some expressions in the central system are shared between two study areas, as shown by *reliable supply of energy* discussed above. Tabajara and urban areas share collective discourses regarding UHE *impacts due to the lack of structure* (“*There will be no enough*

school, the hospital will not support because it is already bad, safety will be worse”, Table 4) and that the UHE will generate broader *benefits to the municipality* (“*Development must be in the long run*”, Table 4). Rather than contradictory, these opposing perceptions reveal a cleavage between high potential benefits combined to high potential costs related to the UHE and the lack of a unified discourse about UHE as a socioenvironmental sustainable project. Finally, urban and rural areas share elements regarding negative impacts of the UHE – the *inadequate health system* to receive the new population, especially during the construction peak (“*[Health] is the first concern because there is no adequate structure. Population growth will cause problems*”, Table 4) and lack of security (“*[With UHE construction] there will be 5,000 people in Machadinho. Some are bad, so it needs security structure*”; “*It will come people who will make bad things, I am afraid people will come to steal my house*”, Table 4). On the other hand, these areas share highly positive values regarding the possibility of a cleaner, reliable and cheaper energy supply: “*First God, second, Energy. Energy is everything*” (Table 4).

The peripheral systems show a great heterogeneity of expressions between the study areas. There are no common elements shared by all study areas regarding the first peripheral system (second quadrant) and, in the second peripheral system (third quadrant), just *bad politics and corruption* (as discussed above) are shared by all study areas. This unveils the idiosyncrasies and characteristics unique to each of these three populations. In Tabajara, negative perceptions predominates in the first peripheral system, especially regarding violence and criminality as expressed in *lack of security* and *robbery*, and the inadequate health system in a context of *overpopulation* (second peripheral system). Negative elements also predominate in urban areas: *robbery*, *overpopulation* and *environmental destruction* in the first peripheral system and *social problems* and *impacts on roads and transit* in the second peripheral system, while *benefits to agriculture* appear as an important positive element. Finally, in rural areas there are major perceptions about negative impacts of the UHE in the first peripheral system, regarding the lack of capacity of Machadinho to receive the UHE investment (*impact due to lack of structure* and *overpopulation*) and skepticism about the benefits of the UHE to the municipality, as expressed in the second peripheral system (*energy will benefit outside* and *doubt about benefits*). On the other hand, and showing the divergent, heterogeneous perception about the UHE, rural residents also express the *benefits to commerce*, *benefits to the municipality* and of a *cheaper energy*.

Table 2 – Analysis of Social Representations and expressions about the dam and hydroelectric plant Tabajara (UHE Tabajara), according to core quadrants and study area – Machadinho, 2015

2a- all study areas combined

| FIRST QUADRANT | | | SECOND QUADRANT | | |
|-----------------------------|-----------------------|--------------------------------------|-----------------------------------|-----------------------|--------------------------------------|
| Elements of the Core System | Frequency (Mean = 17) | Average Evocation Rank (Mean = 2.43) | Elements of the Peripheral System | Frequency (Mean = 17) | Average Evocation Rank (Mean = 2.43) |
| | F >= Mean | AER < Mean | | F >= Mean | AER >= Mean |
| reliable_supply_energy | 28 | 1,71 | overpopulation | 50 | 2,66 |
| inadequate_health_system | 31 | 1,81 | benefits_commerce | 29 | 2,45 |
| benefits_municipality | 36 | 1,83 | income | 21 | 2,76 |
| energy_development | 62 | 1,90 | impacts_roads_transit | 20 | 2,55 |
| energy_supply | 67 | 1,91 | | | |
| employment | 139 | 1,94 | | | |
| doubts_construction | 39 | 2,13 | | | |
| lack_security | 36 | 2,14 | | | |
| impact_lack_structure | 72 | 2,17 | | | |
| investment_infrastructure | 28 | 2,25 | | | |
| benefits_agriculture | 26 | 2,31 | | | |
| robbery | 73 | 2,32 | | | |
| environmental_destruction | 39 | 2,38 | | | |

| THIRD QUADRANT | | | FOURTH QUADRANT | | |
|-----------------------------------|-----------------------|--------------------------------------|---------------------------|-----------------------|--------------------------------------|
| Elements of the Peripheral System | Frequency (Mean = 17) | Average Evocation Rank (Mean = 2.43) | Elements of the Core | Frequency (Mean = 17) | Average Evocation Rank (Mean = 2.43) |
| | F < Mean | AER < Mean | | F < Mean | AER >= Mean |
| bad_politics_corruption | 7 | 1,43 | doubts_benefits | 9 | 2,44 |
| negative_impacts_commerce | 2 | 1,50 | displacement | 12 | 2,50 |
| benefits_fisheries | 1 | 2,00 | labor_training | 2 | 2,50 |
| benefits_industry | 3 | 2,00 | spillover_effect | 2 | 2,50 |
| cheaper_energy | 10 | 2,00 | investment_schools | 13 | 2,54 |
| clean_energy | 2 | 2,00 | rising_rural_land_prices | 3 | 2,67 |
| deforestation | 1 | 2,00 | rising_living_costs | 12 | 2,83 |
| destruction_leisure_tourism | 2 | 2,00 | benefits_government | 1 | 3,00 |
| energy_benefit_outside | 10 | 2,00 | desocupacao | 1 | 3,00 |
| housing | 1 | 2,00 | destruction_history | 3 | 3,00 |
| impact_public_services | 7 | 2,00 | drugs_prostitution | 7 | 3,00 |
| investment_public_services | 5 | 2,00 | inadequate_education_ | 3 | 3,00 |
| negative_impacts_river | 1 | 2,00 | overconsumption | 1 | 3,00 |
| negative_impacts_fisheries | 1 | 2,00 | expensive_energy | 3 | 3,33 |
| personal_economic_benefits | 2 | 2,00 | flooding | 2 | 3,50 |
| social_problems | 4 | 2,00 | lack_planning_capacity | 1 | 4,00 |
| uneven_compensation | 2 | 2,00 | investment_infrastructure | 1 | 5,00 |
| small_benefits | 11 | 2,18 | jail | 1 | 5,00 |
| diseases | 4 | 2,25 | | | |
| destroy_livelihoods | 6 | 2,33 | | | |

2b – rural area

| FIRST QUADRANT | | | SECOND QUADRANT | | |
|-----------------------------|-----------------------|--------------------------------------|-----------------------------------|-----------------------|--------------------------------------|
| Elements of the Core System | Frequency (Mean = 12) | Average Evocation Rank (Mean = 2.33) | Elements of the Peripheral System | Frequency (Mean = 12) | Average Evocation Rank (Mean = 2.33) |
| | F >= Mean | AER < Mean | | F >= Mean | AER >= Mean |
| reliable_supply_energy | 22 | 1,59 | impact_lack_structure | 47 | 2,38 |
| inadequate_health_system | 18 | 1,61 | overpopulation | 32 | 2,69 |
| energy_development | 35 | 1,80 | environmental_destruction | 20 | 2,50 |
| lack_security | 16 | 1,81 | benefits_commerce | 18 | 2,33 |
| energy_supply | 52 | 1,87 | | | |
| benefits_agriculture | 16 | 2,00 | | | |
| doubts_construction | 26 | 2,12 | | | |
| employment | 80 | 2,15 | | | |
| robbery | 47 | 2,15 | | | |

| THIRD QUADRANT | | | FOURTH QUADRANT | | |
|-----------------------------------|-----------------------|--------------------------------------|----------------------------|-----------------------|--------------------------------------|
| Elements of the Peripheral System | Frequency (Mean = 12) | Average Evocation Rank (Mean = 2.33) | Elements of the Core | Frequency (Mean = 12) | Average Evocation Rank (Mean = 2.33) |
| | F < Mean | AER < Mean | | F < Mean | AER >= Mean |
| impact_public_services | 4 | 1,25 | investment_infrastructure | 7 | 2,43 |
| investment_public_services | 2 | 1,50 | impacts_roads_transit | 10 | 2,50 |
| bad_politics_corruption | 5 | 1,60 | rising_living_costs | 9 | 2,56 |
| small_benefits | 5 | 1,60 | rising_rural_land_prices | 3 | 2,67 |
| benefits_municipality | 11 | 1,91 | investment_schools | 6 | 2,83 |
| benefits_industry | 2 | 2,00 | benefits_government | 1 | 3,00 |
| cheaper_energy | 8 | 2,00 | desocupacao | 1 | 3,00 |
| clean_energy | 2 | 2,00 | displacement | 5 | 3,00 |
| destroy_livelihoods | 4 | 2,00 | drugs_prostitution | 3 | 3,00 |
| destruction_leisure_tourism | 2 | 2,00 | inadequate_education_syste | 3 | 3,00 |
| energy_benefit_outside | 9 | 2,00 | overconsumption | 1 | 3,00 |
| housing | 1 | 2,00 | income | 9 | 3,11 |
| negative_impacts_commerce | 1 | 2,00 | expensive_energy | 3 | 3,33 |
| negative_impacts_fisheries | 1 | 2,00 | flooding | 2 | 3,50 |
| social_problems | 2 | 2,00 | jail | 1 | 5,00 |
| spillover_effect | 1 | 2,00 | | | |
| doubts_benefits | 7 | 2,14 | | | |
| diseases | 4 | 2,25 | | | |

2c- urban area

| FIRST QUADRANT | | | SECOND QUADRANT | | |
|-----------------------------|----------------------|---------------------------------------|-----------------------------------|----------------------|---------------------------------------|
| Elements of the Core System | Frequency (Mean = 8) | Average Evocation Rank (Mean = 2.55) | Elements of the Peripheral System | Frequency (Mean = 8) | Average Evocation Rank (Mean = 2.55) |
| | F >= Mean | AER < Mean | | F >= Mean | AER >= Mean |
| inadequate_health_system | 8 | 1,50 | robbery | 21 | 2,67 |
| employment | 44 | 1,64 | overpopulation | 16 | 2,69 |
| benefits_municipality | 21 | 1,76 | income | 10 | 2,70 |
| impact_lack_structure | 20 | 1,80 | benefits_agriculture | 9 | 3,00 |
| energy_development | 20 | 2,10 | environmental_destruction | 9 | 2,67 |
| investment_infrastructure | 20 | 2,15 | | | |
| doubts_construction | 8 | 2,38 | | | |
| energy_supply | 10 | 2,50 | | | |
| lack_security | 13 | 2,54 | | | |

| THIRD QUADRANT | | | FOURTH QUADRANT | | |
|-----------------------------------|----------------------|---------------------------------------|---------------------------|----------------------|---------------------------------------|
| Elements of the Peripheral System | Frequency (Mean = 8) | Average Evocation Rank (Mean = 2.55) | Elements of the Core | Frequency (Mean = 8) | Average Evocation Rank (Mean = 2.55) |
| | F < Mean | AER < Mean | | F < Mean | AER >= Mean |
| bad_politics_corruption | 1 | 1,00 | benefits_commerce | 6 | 2,67 |
| investment_public_services | 1 | 1,00 | small_benefits | 5 | 3,00 |
| negative_impacts_commerce | 1 | 1,00 | spillover_effect | 1 | 3,00 |
| cheaper_energy | 2 | 2,00 | rising_living_costs | 3 | 3,67 |
| deforestation | 1 | 2,00 | drugs_prostitution | 1 | 4,00 |
| energy_benefit_outside | 1 | 2,00 | lack_planning_capacity | 1 | 4,00 |
| personal_economic_benefits | 2 | 2,00 | displacement | 2 | 4,50 |
| social_problems | 2 | 2,00 | reliable_supply_energy | 2 | 4,50 |
| impacts_roads_transit | 5 | 2,40 | investment_infrastructure | 1 | 5,00 |
| investment_schools | 5 | 2,40 | | | |
| impact_public_services | 2 | 2,50 | | | |
| labor_training | 2 | 2,50 | | | |

2d – village of Tabajara

| FIRST QUADRANT | | | SECOND QUADRANT | | |
|-----------------------------|----------------------|---------------------------------------|-----------------------------------|----------------------|---------------------------------------|
| Elements of the Core System | Frequency (Mean = 3) | Average Evocation Rank (Mean = 2.12) | Elements of the Peripheral System | Frequency (Mean = 3) | Average Evocation Rank (Mean = 2.12) |
| | F >= Mean | AER < Mean | | F >= Mean | AER >= Mean |
| reliable_supply_energy | 3 | 1,00 | lack_security | 6 | 2,33 |
| displacement | 5 | 1,20 | inadequate_health_system | 5 | 3,00 |
| impact_lack_structure | 5 | 1,60 | robbery | 5 | 2,40 |
| doubts_construction | 5 | 1,80 | benefits_commerce | 3 | 3,00 |
| employment | 11 | 1,82 | impacts_roads_transit | 3 | 2,67 |
| energy_development | 6 | 1,83 | | | |
| environmental_destruction | 8 | 1,88 | | | |
| benefits_municipality | 4 | 2,00 | | | |

| THIRD QUADRANT | | | FOURTH QUADRANT | | |
|-----------------------------------|----------------------|---------------------------------------|---------------------------|----------------------|---------------------------------------|
| Elements of the Peripheral System | Frequency (Mean = 3) | Average Evocation Rank (Mean = 2.12) | Elements of the Core | Frequency (Mean = 3) | Average Evocation Rank (Mean = 2.12) |
| | F < Mean | AER < Mean | | F < Mean | AER >= Mean |
| bad_politics_corruption | 1 | 1,00 | destruction_history | 2 | 2,50 |
| benefits_agriculture | 1 | 1,00 | destroy_livelihoods | 2 | 3,00 |
| energy_supply | 2 | 1,00 | investment_infrastructure | 1 | 3,00 |
| small_benefits | 1 | 1,00 | doubts_benefits | 2 | 3,50 |
| income | 2 | 1,50 | drugs_prostitution | 2 | 3,50 |
| benefits_fisheries | 1 | 2,00 | impact_public_services | 1 | 4,00 |
| investment_schools | 2 | 2,00 | | | |
| negative_impacts_river | 1 | 2,00 | | | |
| overpopulation | 2 | 2,00 | | | |
| uneven_compensation | 2 | 2,00 | | | |

Figure 2 – Evocated expressions for UHE Tabajara according to study area



2a- all study areas combined



2b – rural area

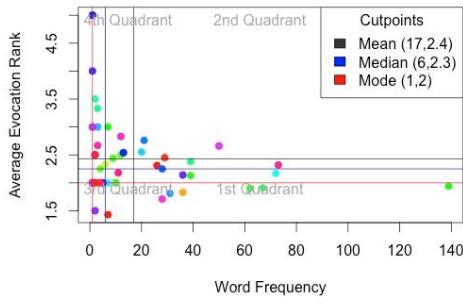


2c- urban area

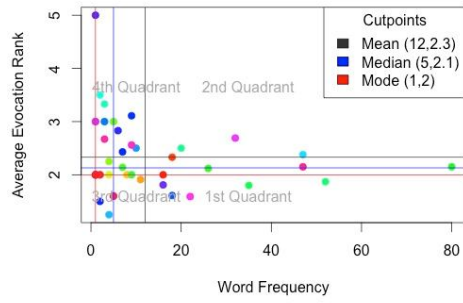


2d – village of Tabajara

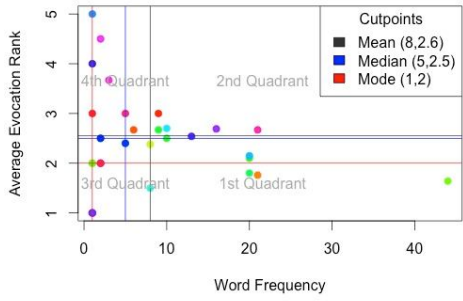
Figure 3 – Average Evocation Rank according to study area



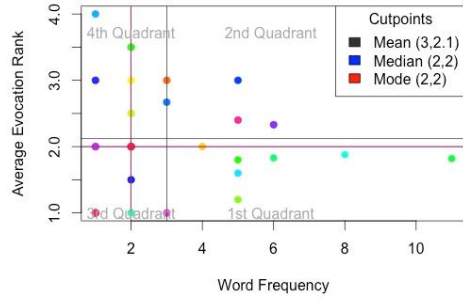
2a- all study areas combined



2b – rural area



2c- urban area



2d – village of Tabajara

Table 3 – Qualitative analysis of a sample of meanings associated with the main expressions in the core social representation

| Expression | Study Area | Discourse |
|------------------------------|--|---|
| employment | Tabajara | "There are no jobs in Tabajara, UHE will offer many opportunities". |
| | | "The only jobs in the region are in the sawmill and in the City Hall". |
| | Rural | "Having a job is essential for everybody. Thus they can have money to buy food". |
| | | "There are many unemployed and people needing a job". |
| | Urban | "For those who like working, there will be jobs". |
| Urban | "Many people wants a job but there is none. The UHE is na opportunity for them". | |
| energy brings development | Tabajara | "It will improve employment and income for the people". |
| | | "The [UHE] construction will generate employment and energy". |
| | Rural | "It will be good to people, energy by motor [diesel] is expensive(...) generated by the nature is cheap". |
| | | "Energy is needed to bring development". |
| | Urban | "Energy can generate employment for the families". |
| Urban | "We need better energy grid, this is fair and necessary". | |
| doubts about construction | Tabajara | "Every year they talk about the construction, but they don't make it". |
| | | "It takes a lot of time and the population is expecting that [UHE] will be built". |
| | Rural | "Given the political interests, [UHE] will not be built. It is a project to get electing votes". |
| | | "[It will not be built] because of political struggle (...)government and society discriminate the countrymen". |
| | Urban | "The bureaucratic part takes a long time. There were many Public Hearings and nothing has been defined". |
| reliable supply of energy | Tabajara | "Population [suffers from] energy shortage. There is a parcel of the population without energy". |
| | | "It will improve life quality". |
| | Rural | "Electricity is very weak, shortages are frequent, sometimes more than once a day". |
| | | "Improves livelihoods. I can watch TV, have more water to the cattle because I can use pumps, I can conserve milk". |
| | Urban | "I do not support the [UHE] because I think the region will become worse". |
| Urban | "We do not have infrastructure". | |
| Impact of lack of structure | Tabajara | "There will be no enough school, the hospital will not support because it is already bad, safety will be worse". |
| | | |
| | Urban | "Employment to local workers and money for those who want to leave". |
| | | "Pave the roads, movement, stores, hospital, school". |
| | Urban | "Development must be in the long run". |
| Urban | "It will generate employment, new businesses will come". | |
| benefits the municipality | Urban | "It means building a better hospital and increasing the number of physicians". |
| | | "[It will need] access to health services and medicine". |
| | Rural | "[Health] is the first concern because there is no adequate structure. Population growth will cause problems". |
| | | "The health situation is precarious and it is unable to assist new people". |
| | Urban | "[With UHE construction] there will be 5,000 people in Machadinho. Some are bad, so it needs security structure". |
| Rural | "I am affraid that bad people will come from outside". | |
| lack of security | Urban | "It will come people who will make bad things, I am afraid people will come to steal my house". |
| | | |
| | Rural | "If energy comes, there will more industries". |
| | | "First God, second, Energy. Energy is everything". |
| | Urban | "Energy is important for the family and for the work". |
| Urban | | |
| energy supply | Urban | "It will not be possible to find another nice place". |
| | Urban | "[We will become] displaced and homeless". |
| displacement | Tabajara | "The river is my livelihood and is part of the nature, it is source of freedom". |
| | Tabajara | "It will destroy leisure and fisheries in 2 de Novembro". |
| environmental destruction | Tabajara | |
| benefits agriculture | Rural | "It will valorize the land". |
| robbery | Rural | "Three things go together. Many people arriving with lack of structure will generate criminality". |
| | | "[UHE will] increase robbery, drugs and many other bad things which come together". |
| Investment in infrastructure | Urban | "[Investments in the UHE] are good to generate capital to invest in infrastructure". |
| | | "With many people arriving, infrastructure will have to improve to receive this people". |

Conclusions

We showed in this paper how the typical social representations and discourses towards the construction of a hydroelectric plan and dam in the municipality of Machadinho can have important differences when we consider population subgroups according to place of residence: the direct impact area (the Village of Tabajara), old-consolidated rural areas and the municipality's urban area. We also showed descriptively the main sample differences between these study areas according to selected socioeconomic and demographic characteristics.

In a region deprived of infrastructure, employment and adequate levels of public services and economic opportunities, the huge scale (compared to Machadinho's economy) of an event such as the UHE Tabajara trigger hopes and positive perceptions related to the potential increase in employment opportunities as well as the benefits of a cheaper, reliable energy supply for the economy, rural production and household and individual welfare. In this regard, and independent of the study area, interviewees in the three study areas showed belief that UHE will bring employment, energy and development to Machadinho.

These contradictions are, per se, inherent to the difficulties to reconcile discourses on economic and social development and environmental quality. This perception is not only linked to the conflict between degradation and depletion of natural capital and ecosystems and the aesthetic values related to them; as shown by the skeptical views about the UHE. As shown by the expression *doubts construction*, it also derives from the skepticism about the construction linked to perceptions about vested political interests and corruption involving the UHE. Population, thus, casts doubts about the actual construction and the uneven appropriation of the benefits of the UHE.

These positive benefits are contradictory with the strong perception about negative aspects linked to the construction of the UHE in all the study area in Machadinho regarding impacts of increasing robbery (violence) and the lack of infrastructure. On the other hand, there are evidences that population tend to value (as core, collective representations) negative impacts only related to their immediate space of production and reproduction. In this sense, i) only the population living in the directly impacted area – Tabajara – consider the *environmental destruction* and population *displacement* as core expressions, as well as the lack of infrastructure; ii) inadequate health system and increasing violence in rural areas; iii) inadequate health system, increasing violence and lack of infrastructure in urban areas. These distinct population perceptions are also in terms of positive values, such as i) broader benefits to the municipality, in Tabajara, ii) reliable energy and improvement in agriculture in rural areas, iii) reliable energy, investment in infrastructure and broader benefits to the municipality, in urban areas.

The fragmented perceptions about overall (municipal and regional) positive and negative impacts, and the nature of these impacts in the long run, are also barriers to the social construction of a socioenvironmental sustainability perspective regarding the UHE.

References

- Abric (1994). L'Organisation interne des représentations sociales: système central et système périphérique. In C. Guimelli (rd.), Structures et Transformations des Représentations Sociales. Neuchâtel: Delachaux et Niestlé.
- Abric, J. C. (2003). L'analyse structurale des représentations sociales. In S. Moscovici, & F. Buschini (Orgs.), Les méthodes des sciences humaines (pp. 375-392). França: Puf Fondamental.
- SÁ, Celso Pereira de. Núcleo central das representações sociais. Petrópolis: Vozes, 1996.
- Serge MOSCOVICI. Representações sociais: inves- tigações em psicologia social. Rio de Janeiro, Vo- zes, 2003. 404 páginas (trad. Pedrinho A. Guares- chi, a partir do original em língua inglesa Social representations: explorations in social psychology [Gerard Duveen (ed.), Nova York, Polity Press/Blackwell Publishers, 2000]).

- ANEEL – Agência Nacional de Energia Elétrica. Disponível em: <<http://www2.aneel.gov.br/aplicacoes/capacidadebrasil/capacidadebrasil.cfm>>. Acessado em 22 abr.2016.
- Barbieri, A.F. Guedes, G, Santos, R.O., Fonseca, D. (2016). Deforestation from below: evolving land use systems under demographic heterogeneity Paper presented at the Population of America Conference (PAA), Washington D.C., 2016.
- Barbieri, A.F., Monte-Mór, R.L. and Bilsborrow, R.E. 2009. Towns in the jungle: exploring linkages between rural-urban mobility, urbanization and development in the Amazon. In *Urban Population and Environment Dynamics in the Developing World: Case Studies and Lessons Learned*, ed. De Sherbinin et al., 247–279. Paris: CICRED.
- Bermann, Célio (2007). As novas energias do Brasil. Rio de Janeiro: FASE.
- IBAMA – Instituto Brasileiro de Meio Ambiente (2016).. Disponível em: <ibama.gov.br/licenciamento>. Acessado em 22 abr.2016.
- Marrocos Neto; Moret, A. (2008). Contribuição técnica, econômica e ambiental das PCH no sistema elétrico isolado de Rondônia. Espaço Energia, v. 9, p. 25-33
- Monte-Mór, R. L. (2004). Modernities in the Jungle: Extended Urbanization in the Brazilian Amazon, unpublished Ph.D. dissertation, University of California, Los Angeles (UCLA), Los Angeles.
- Moret, A. (2001). Conflitos em torno da Geração de Eletricidade no Estado de Rondônia. In: BURSZTYN, Marcel. (Org.). A Dificil Sustentabilidade: Política Energética e Conflitos Ambientais. 01ed.Rio de Janeiro: Garamond
- Nóbrega, Renata (2012). Dissertação DE Mestrado. Disponível em: <http://www.ifch.unicamp.br/profseva/RenataSNobrega_MestradoIFCH_Unicamp_abril08.pdf>. Acessado em 06 ago 2012.
- Ross, Michael L. (2015) A Maldição do Petróleo: como a riqueza petrolífera molda o desenvolvimento das nações. Ed. Sanskrito. Porto Alegre.
- Sevá Filho, Oswaldo (2005). *Tenotã-Mõ*. Alertas sobre as consequências dos projetos hidrelétricos no rio Xingu. São Paulo: International Rivers Network/Comissão Pró Índio.
- Sevá Filho, Oswaldo (2008). Oswaldo. *Estranhas catedrais. Notas sobre o capital hidrelétrico, a natureza e a sociedade*. Cienc. Cult. [online], vol.60, n.3, pp. 44-50. ISSN 2317-6660.
- Vainer, Carlos Bernardo (2013). *Recursos Hidráulicos: questões sociais e ambientais*. Disponível em: < <http://www.scielo.br/pdf/ea/v21n59/a09v2159.pdf>>. Acessado em: 08 jul.2013.
- Zhour, Andréa; Oliveira, Raquel (2015). Desenvolvimento, conflitos sociais e violência no Brasil rural: o caso das usinas hidrelétricas. *Ambiente & Sociedade, São Paulo*, v. 10, n. 2, p. 119-135, 2007. Disponível em: <<http://www.scielo.br/pdf/asoc/v10n2/a08v10n2.pdf>>. Acesso em: 13 maio.