

# THE CONSTRUCTION OF HEALTH CAUSAL RELATIONS IN THE BELO MONTE DAM CONTEXT

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## Introduction

Global demand for commodities and energy sources has led to a fast expansion of agricultural lands to produce grains and biofuels, construction of large-scale projects such as hydroelectric dams and mining activities. Such expansion waves are not necessarily new in the context of expansion of the Amazonia borders, except that interventions in the Amazon region are driven today by an increasing number of projects built simultaneously (along with the size and geographic range of the projects), and a Pan-amazon coordination pattern never seen before (LITTLE, 2013).

The Growth Acceleration Plans (PAC I and II), within the Brazilian context and IIRSA (Initiative for Infrastructure Integration in South America), in the South-American level, are programs focused on the logistics of transport, energy and communication and have the same design of the modernization model based on megaprojects (CASTRO, 2012). Moreover, it reissues, according to this author, the development model that has guided the expansion of the Amazonia border since the 1970s and caused socio-territorial conflicts involving diverse local actors and intensified the exploitation of natural resources and deforesting.

Hydroelectric dams are examples of large-scale development projects that lead to a sudden inflow of people and capital. They represent an event of great magnitude that affects in the short and long run the trajectory of a region, whose specificities and depth are still not fully understood. The planning process can take many years (23 years in the case of Belo Monte), require multiple adjustments to the original design as a response to political pressures and local and national interests (including, in this case, changes in the location of the dam and reservoir), cause impacts during the many years of construction and continuing consequences to the environment, the population's living conditions in general and health in particular for decades after the project completion (MORAN, 2016).

Literature has plenty of examples showing the changes and socioenvironmental impacts from dams' construction in the most different contexts, and there is a consensus among experts as to repetition of similar situations in diverse contexts, especially concer-

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ning problems resulting from people migration and resettlement (CERNEA, 1988, 2003; SCUDDER, 1997, 2005, FEARNSIDE, 2001, 2006, among others).

However, there are few studies that succeeded in establishing consistent causal relations, especially regarding health impacts, to the extent of showing the causal relations (exact or probabilistic) of the outcome impacts. This is most due to the small number of research and assessment projects that monitored the process longitudinally before, during and after the installation of a hydroelectric dam. In the specific case of health impacts, it is also due to the lack of studies assessing health conditions that go beyond sheer medical aspects; to failures in the official health records on the population impacted by the project and the scarce number of researches on the human and animal health conditions prior to the impacts.

This paper discusses the poor attention given to health-related aspects in social and environmental impact assessments and examines the problems related to the construction of causal relations in the emergence (or reduction) of diseases or injuries, having as examples the relationship between migration and workers' diseases (brought or acquired), cases of syphilis in pregnant women, violence-related deaths (homicides) and traffic accidents in the context of construction of the Belo Monte dam. Going beyond the deterministic view of the causes of diseases, but without neglecting it, we will discuss the challenges of building a complex network of causal relations (based on a conception of multifactorial disease causes) that incorporate the bio-physiological causes with others deriving from human actions or political decisions or omissions, and rank the degree of influence of these causal factors in this specific context.

The present analysis is part of the research project "Health and Environment: a study on the social and epidemiological processes that follow the construction of Belo Melo/PA hydroelectric dam" (Cnpq). For the purposes of this paper, we used the official data available in the Live Birth Information System (SINASC), the Notifiable Diseases Information System (SINAN) and the Mortality Information System (SIM), and on the analysis of interviews with professionals of the Primary Healthcare Units and the epidemiological surveillance service in the city of Altamira.

## **Health issues and their position in social impact assessments (SIA) and environmental impact assessments (EIA) of hydroelectric dams**

Since the constitution of the World Commission on Dams in 1998 and the publication of the first systematic assessment of large world dams in 2000, social impact assessment has been required as part of the licensing process of hydroelectric projects. In addition, the need to incorporate a health impact assessment in all development policies was included as one of the basic principles of the Agenda 21 (UN, 1993) and further emphasized in various other documents and international treaties. However, there has been little agreement on the best way to use EIA as a research instrument to understand the impacts of dams on human communities, which variables should be considered in the assessment (WHO, 2000) and how to use all these data to produce an effective assessment of health conditions.

There have been advances in international agreements on the general principles, among them the precautionary principle, intra- and inter-generational equality, preservation of social and cultural diversity, and the internationalization of costs associated with a planned intervention (TILT, BRAUN and HE, 2009), which would guide social impacts assessments of large development projects. However, the application of these principles in diverse international contexts has been ineffective (FEARNSIDE, 2001; MORET and FERREIRA, 2009) and not often considered by the governments before and during the projects execution. Statement made by Jim Yong Kim, president of the World Bank (THE GUARDIAN, March 09/2015) illustrates the failure of the institution that he represents to

[...] understand, monitor and deliver even on its most basic policies. A review of 59 projects where resettlement was anticipated found that “a disturbingly large number of projects had insufficient data available to allow evaluation, and thus received ‘Don’t Know’ ratings.” The status of people physically displaced was unknown for 61% of the projects and in most of these, there was “little or no information about the replacement housing or what had happened to the relocated people.

In addition, both SIAs and EIAs make little reference to human health, which results in small amounts of resources to the health sector and huge amounts of resources to the sectors whose activities may have serious environmental effects on human health (HASSAN and BIRLEY, 1999; TETTEH, FREMPONG and AWUAH, 2004). In most cases, health-related propositions are more oriented by a strictly medical view and not by a multifactorial view of the health issues in the affected community. Such limited perspective is translated into actions and recommendations for improvement of equipment and access to healthcare services, which, although important to meet the increased population demand, represent only part of the mitigation measures needed. They are measures intended to the medical care of the affected individuals, which, although necessary, do not minimize at all the problems encountered in the range of public or community health. Therefore, health is not considered a key part of the project to be developed and is reduced to a series of last-minute arrangements made to enhance healthcare services to enable them to handle unavoidable health problems (COUTO, 1999).

Such approach has a key implication in the results of impact studies because they consist of different data. The existing healthcare facilities as well as the individuals' clinical data allow identifying the material resources that a community has available to provide medical care to individuals. On the other hand, epidemiological data (valid in the population context) enables to identify the incidence and prevalence of certain expected diseases, what is circulating in the environment and how the population is reacting to the changes. Depending on the degree of sophistication of the health surveillance services and scientific research in the region, it also enables to identify unusual cases and with potential impact on public health.

One of the solutions proposed by the World Health Organization (WHO), regarding the lack of appropriate routine investigations to assess health impacts, is to consider

health in a larger scope in the EIAs. However, not all health-related problems have only physical environmental determinants, but also social determinants – health issues need to be part of SIAs. Thus, assessment of individual and collective health as a function of dam construction has a part linked to environmental impact assessment and other to social impact assessment (WHO, 2000), in addition to its emerging properties: a series of typical features that distinguish them from either of these two procedures but result from the interaction between both. Thus, a first challenge would be: How to avoid health-related aspects to remain hidden or neglected either in theory or in practice in social and environment impact assessments?

According to WHO, in the case of dams, some diseases such as filariasis, malaria and schistosomiasis are often studied and cited in studies, while other health impacts are neglected. Examples include the increased incidence of sexually transmitted diseases, injuries, diseases and deaths associated with the displacement of people involved in these projects, added to the lack of capabilities to detect other arising diseases that are not part of the official health public records, but specifically those contained in the list of mandatorily notifiable diseases.

Along with such negligence in considering health impacts in development projects, a lack of consistent preliminary studies, evaluation and further monitoring of the implementation of large hydroelectric projects are on the base of the difficulties of establishing causal relations in epidemiology and the population health. How to assess changes resulting from the implementation of a dam if studies on the conditions existing before the project implementation are flawed, incomplete or neglected? In the specific case of impact on the population health, how to establish a causal relation if the data for comparison purposes are insufficient and flawed? For example, among other endemic diseases in northern Brazil, dengue is an underreported disease due to the difficulty (or negligence) of the epidemiological surveillance service to conduct an effective survey of the cases that are treated at home (with paracetamol), without any contact with the healthcare units. Underreporting of dengue cases is cited both in the literature (TEIXEIRA et al. 2003; TAUILL, 2002; DUARTE and FRANÇA, 2006; TOLEDO et al. 2006; MONTEIRO et al. 2009; MORAES and DUARTE, 2005; LUCENA et al. 2011, among others) and by interviews with healthcare providers in Altamira. In this regard, as the number of cases do not represent the actual prevalence of this disease in this region, the correlation between the increased or decreased number of dengue cases with the construction of the Belo Monte dam will hardly be proven.

Construction of dams, reservoirs and irrigation systems in tropical areas may cause fast environmental degradation, and the risks to health may increase even before any precautionary action is taken or related dangers are perceived (HUNTER, 1993).

Health impact assessment of the construction of a dam based on an ecological and systemic approach should include the analysis of the characteristics of the regional environment, not only local. That is, in terms of public health, impact studies should assess not only the prevailing diseases but also the medical and healthcare facilities that exist in the affected site, and should also identify through systematic and continuous studies the pathogens that circulate or may circulate in the environment, which do not consider geographic boundaries.

Amazonia is a vast territory, with the most dense and varied ecosystem in the world and for this reason is conducive to the transmission of numerous tropical diseases, with particular risks to the populations exposed to precarious living conditions. Many of these diseases, which are well known and endemic in the region, such as malaria, dengue, tegumentary leishmaniasis, yellow fever, Chagas disease, coexist with other diseases such as leprosy, viral hepatitis, mycosis, which had their prevalence rate increased due to reasons not yet determined. The increased transmission of pathogens known when new lifestyles are introduced in the region, favoring their circulation, the emergence of pathogens not previously detected in the region and those recently recognized in the Amazonia (TAUIL, 2009), in addition to other non-infectious diseases and harms (e.g., injuries and deaths caused by accidents and violence), show the complexity that one should have in mind when starting any impact assessment work.

Such complexity becomes even greater when, alongside a “naturally” pre-existing dynamics, one seeks to establish a causal relation between the construction of a large hydroelectric project (e.g., Belo Monte) and the changed dynamics of pre-existing diseases and the emergence of other diseases in the region. Studies on the impacts of hydroelectric projects in human and animal health describe the emergence of diseases as well as vectors and disease reservoirs during the construction of the dam and after its completion. However, little is known about the environment and health conditions before the construction of the dam, which shows the weakness of the data that will support social and environmental impact assessments and the estimated impacts in that context, making them very limited in range and depth. This context shows that one of the health impacts from the construction of a dam is exactly the lack of preliminary studies: the resulting impact from what was not done!

In the case of zoonosis, Avila Pires criticizes the lack of detailed studies on zoological groups such as natural reservoirs and vectors, added to faunal lists resulting from inventories made at distinct times. According to him, in general, few data on the dynamics of the populations are available and the diseases' distribution maps usually plot only human cases. Furthermore:

[...] the concept of “focus”, the place where the disease-transmitting source, is poorly defined and investigated. In the case of zoonosis, the possibility and occurrence of specific diseases will depend on the ecology and biogeography of natural reservoirs, vectors and pathogens in each case and region. In fact, the human case is an ecological indicator of the nosological situation in a region. To the medical practice, what is of interest are the symptomatic events, acute or chronic, while for epidemiology are the non-symptomatic or sub-clinical individuals or carriers, the hosts, reservoirs and vectors or potential existing in the biogeographic region (AVILA PIRES, 2014). (Author's translation)

With respect to Belo Monte, in October 2009, a panel of specialists composed of researchers from diverse areas conducted a critical review of the environmental impact assessment of this project. Among their comments, they pointed out that the Envi-

ronmental Impact Assessment and Environmental Impact Report (EIA-EIR) did not include in their scope a situational diagnosis of the health of the population affected by the project. According to these experts, “there is a reference to secondary data, but not reliable, once they do not represent reality, which might have been solved if the diagnosis had used as methodology the epidemiological investigation of the area of influence with the community participation” (COUTO E SILVA, 2009, p. 88) (Author’s translation).

One of the panel’s conclusions is that environmental alterations caused by the construction of the Belo Monte dam will have more consequences than those expected and described in the EIR.

According to Gorayeb (2009), the Belo Monte EIR presents comments on problems with vector insects and diseases as if it were simply an obligation to cite them, and the studies ordered and supported by accredited Brazilian institutions were based on quick, short-time surveys and with limited resources. For him, these institutions, using their personnel and physical capabilities, developed the surveys well, beyond expectations, as is the case of the report on Limnology, which points out to strong alterations that will take place in the aquatic environments and helps estimate changes in insect populations and other water animals in destroyed, altered and new environments. In this report, Gorayeb (2009) highlighted the recommendations suggested by the researchers about the hematophagous (bloodsucking) insects: Culicidae (mosquitoes, gnats), Simuliidae (blackflies), *Phlebotomus* (sand flies [*squamiventris*]), and commented that kissing bugs (triatominae), vector of Chagas disease, biting midges (*Culicoides*), vector of abroviruses, and horseflies (Tabanidae) were not studied in the EIA-EIR.

In the case of hematophagous insects, Gorayeb (2009) calls attention to the difficulties in predicting which mosquito species will respond with a plague, hitting the large urban areas under the dam influence. Increased immigrant human population (more vulnerable) and massive migration will act as a retro-feeding source of resources for overpopulations of mosquitoes and lack of control of infected people.

Anthropogenic environmental changes are presented as aggravating factors to the problems caused by the insects’ interaction with human communities. The major alterations in the Xingu River Basin resulting from the hydroelectric project may bring unpredictable consequences to the populations of Simuliidae species (...). Other species from regions not occurring in Altamira may come to colonize the breeding habitats that would be created (Gorayeb, 2009, p.79) (Author’s translation).

According to Gorayeb (2009), the ideal with regard to vector insects and the possibility of diseases to spread would be to enhance previous actions of monitoring and control of insect populations, breeding places, sick persons, natural reservoir animals, etc., for a long time.

The basic condition for a profound assessment of the population’s health and the causal correlations between before and after the dam construction involves (or should involve) a detailed and systematic production of data on previously existing conditions.

Various actions should be taken long before the beginning of the project in order to produce a minimum knowledge to allow coping with the aggravation of diseases already existing and the estimated emergence of others. The lack of detailed information on the region to be impacted as well as the lack of transparency in the relationship between the construction consortium and the federal and local government led to management problems regarding responsibilities and obligations (related to the project and other public policies), a situation that had direct consequences on the perception and social acceptability of the project. Political uncertainties with respect to chains of command, attribution of responsibility and management of the actions to be taken ended up being transferred to the municipal government when they should otherwise be included in the project costs, for actions before, during and after the dam construction.

Based on the above context, we will examine the problems related to causal relation in the emergence of diseases, having as examples the cases of syphilis in pregnant women, accidents, violence, as well as the aspects associated with the migration and workers' diseases, in the context of construction of the Belo Monte hydroelectric dam. In some cases, as we will see, it is practically impossible to establish causal relations, only simple correlations, due to the lack of retrospective data; in other cases, we point out what can be done with the data available.

## Migration and health effects

Migration is a process where there is a movement of people from one place to another, either for a short, long or permanent time. It has, historically, a key function in societies structuring and in demographic changes. At the same time, migratory processes, as a globalization component, has contributed to the movement of people, animals and goods and brought important challenges to the public health sector by increasing the risk of dissemination of infectious diseases (WILSON, 1995).

The possibility of migrants spreading infectious diseases to the receiving communities (and vice-versa) is not known due to the lack of a protocol that enables to identify the clinical and epidemiological characteristics and establish comparative parameters for the conditions existing before, during and after the project, which has limited the actions of control of infectious diseases caused by migratory processes (WHO, 2000). In our case study, how to measure the effects of migration on the health of people who came to work at the dam site and the local population?

Considering that in Brazil there is a large mobility of people, especially in the Amazonia, who look for temporary employment and income (therefore, they do not stay long at the location and move again), planning managers often do not consider building permanent infrastructure, which, according to their point of view, will only be temporary. However, this political decision has two impacts:

First, because in the health sector, investments in government infrastructure are made based on the number of persons residing in the municipality. As the population of Altamira (one of the main cities affected) increased nearly 30%, comprised basically of migrant workers, who mostly depend on public healthcare services, implementing some

conditions (e.g., increased hospital facilities) would represent a concrete way to mitigate the impacts. However, the construction of a municipal hospital in Altamira, another one in Vitória do Xingu, and the Workers Village Hospital, as part of the obligations of the construction consortium, are more than two years late, which means that the region has the same hospital infrastructure it had before the implementation of the hydroelectric dam. The consortium, in turn, argues that the delay in building the hospitals is due to external hindrances, which compromised the delivery dates, and that it does not affect negatively the sufficiency of hospital services because there are surplus hospital beds in the region. "As duly justified in previous reports, even with the population increase, the hospitals in Altamira has surplus beds and, therefore, the delay in completing the construction of this hospital has not compromised the health services" (IBAMA, 2015, p. 5). (Author's translation).

Such claim, however, is questionable, because during the construction of the plant several workers went on strike alleging poor working conditions, frequent accidents and risks. According to Conceição (2014) and Acevedo and Oliveira (2012) such conditions have caused stress, workers' and an increased number of work accidents due to poor safety conditions for the workers. Many accident victims were taken to the emergency of the São Rafael Municipal Hospital in Altamira, already unable to meet the demand because of the increased population' size.

Second, because there is a major difference to be considered between the evaluation of the workers' health conditions during their stay at the job, at the hydroelectric plant (thus, data on individual health), and the epidemiological conditions derived from the workers' migratory (itinerary) process. In the case of Belo Monte, there has been negligence in both cases, especially regarding the migrants' itinerary, about which little is known, and which may prevent cross-checks of information on the diverse places or regions where the worker lived before settling in the city, for comparisons and correlations.

The causal relations between the migration processes and the effects on health depend on reliable data about the workers' health conditions in their place of origin, during the journey (including parallel itineraries) and during settlement and adaptation to the new locality. These data will influence the workers' individual health profile and the epidemiological profile derived from interactions with the locals.

According to reports provided by the *Norte Energia* consortium and published by IBAMA about the monitoring of the Basic Environmental Project - BEP (IBAMA, 2015), there is little information about the migrants, in general limited to their origin, percentage of migrant workers and some aspects relating to the socioeconomic conditions in the region of origin. Neither pre-employment medical testing nor a more complete health protocol are required. The hiring process is very quick, because as the company claims:

[...] hiring new workers is necessary to replace about one thousand workers who, in general, every day terminate their ninety-day temporary contract and leave their jobs to visit the family and because of a high turnover rate that, on average, in the first semester of 2014 reached about 7% with a peak of 10.65% in February this year.



Conceição (2014, p. 74) shows that, based on data from the Ministry of Labor and Employment, constant hiring of new workers are related to constant layoffs by the contractor: from January to July 2013, of a total of 12,289 workers hired, 52% were dismissed in the same period<sup>1</sup>. Such high turnover rate was denounced by social movements in the region and is one of the aspects associated with several workers strikes – two in 2011, four in 2012 and three in 2013 (CONCEIÇÃO, 2014).

From the public health point of view, such constant hiring and firing process, along with the lack of consistent information on the workers' health profile, produce a gap when building health data and indicators to be used to monitor the project continuously and systematically and to correlate morbidity conditions before and after the dam installation. In the case of malaria control, for example, a primary action of the construction consortium should be to carry out laboratory testing for this disease in all individuals hired and, if positive, evaluate the stay of these workers in the area and concomitantly implement appropriate treatment actions.

In such context of lack of consistent data on the worker's health (before coming to Altamira and during his stay), it will be difficult to build reliable causal relations of the impacts of migration on the incidence and prevalence rate of diseases in the region.

### Syphilis in pregnant women

Similar to the difficulties pointed out in the correlation between workers migration and diseases dissemination, we give another example of this problem found in Altamira.

During a meeting of the Health Board of the Plan of Sustainable Development of the Xingu River, there was a debate on the increased number of cases of syphilis in pregnant women in the city of Altamira (as shown in Graph 1). What are the causes of such increase? The agent responsible for health issues of the Norte Energia consortium argued that the increase represented the collapse of the Prenatal Healthcare Program, and the Altamira Secretary for Health, in turn, replied that the problem was caused by the increased number of workers (men) in the city because of the construction of the Belo Monte dam. There are here two analytical (interdependent) problems: the first is related to how to demonstrate the causal relation between the workers inflow to the city of Altamira and the increased number of cases. Were they many positive men who infected several women? Were they few positive men who contaminated several partners? Do these cases have a relation with the increased prostitution in the city? How to relate the cases occurred in Altamira with the increase of notified cases in various other regions in Brazil between 2005 and 2013 (from 1,865 cases in 2005 to 21,382 in 2013, according to data from the Ministry of Health)? Was the increased capacity to detect cases via the notification system that made visible what was underdiagnosed before? With regard to this last question, we could find through interviews with professionals of the Epidemiological Surveillance system in Altamira that this city began to notify syphilis in pregnant women in 2010. This makes the research even more complex and corroborates the argument of this paper, through which the lack of data and/or the precariousness of existing data

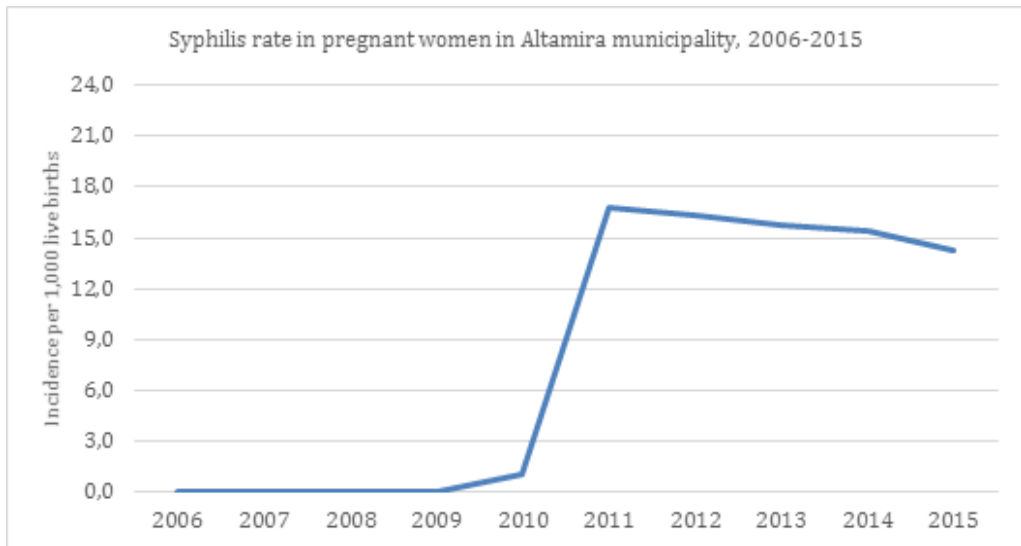
on the population health prior to the beginning of construction of Belo Monte prevents constructing reliable causal relations.

Our research in Altamira will be completed in 2017, when we expect to answer these questions, by checking the records and conducting interviews to understand the sexual behavior of the affected population.

If such causal relation is confirmed, the second analytical problem is related to the responsibility for the increased number of cases. Who is responsible? The consortium, which should have implemented the conditions stipulated in the EIA-EIR or the public health sector of the municipality who should have ensured health education and prevention to the population? Or even the partners involved in the cases, based on the free choice of sexual behavior?

Anyway, while the causes remain unknown, the public services seek to remedy the problem with treatment and health education programs, which likely will remain until the number of cases decrease and not as a continuous program put into practice for all generations of the population in the city.

**Graph 1.**  
**Syphilis incidence in pregnant women per city of residence – Altamira/PA**



Source: SINAN, 2015.

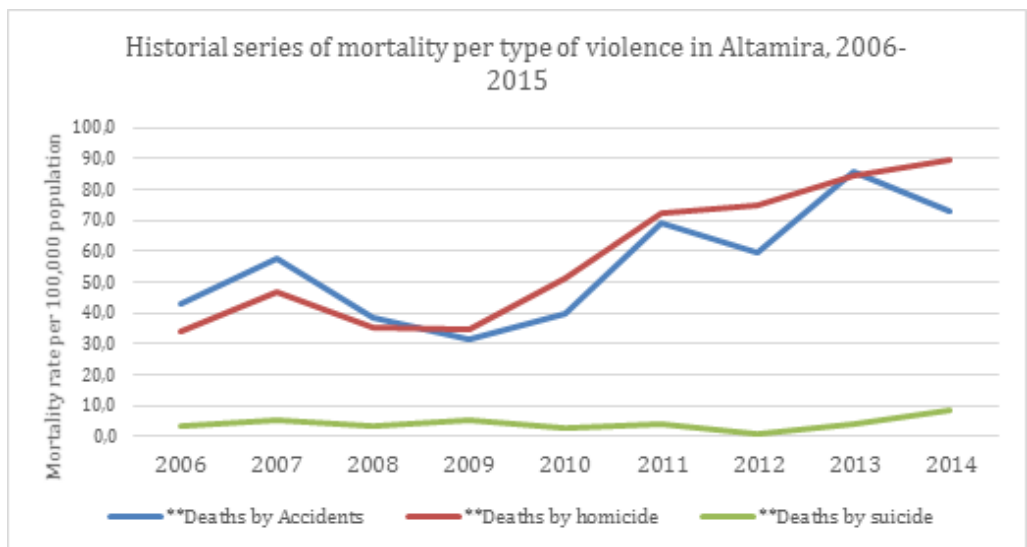
Note: According to CONASS' technical note – Rate of syphilis in pregnant women is measured by the number of cases of pregnant women with syphilis correlating it with the number of live births in the same period.

## Mortality per type of violence (Homicide, Suicide and Accidents)

Widely denounced by the local and national media, violence in the city of Altamira grew dramatically, as shown in Graph 2, particularly during 2011-2014, among men aged 15-34 years (SINAN, 2015).

The increased violence in the city coincides with the beginning of the dam construction and the workers arrival. However, as violence has grown in various regions of the country, where there is no infrastructure project at issue, establishing a causal relation (Belo Monte = violence increase) depends on the answers to the following questions: in the case of homicides, who are the aggressors and the victims, what is their origin and what motives led to such increase in violence? Are the agents who incite violence in Altamira the persons who migrated to the city or are the locals who became more violent and are reacting to social and economic changes occurred in the city?

**Graph 2. Deaths by violence – accidents, homicides and suicides – in the city of Altamira**



Source: SINAN and SIM, 2015

From the social point of view, the ongoing changes in the city of Altamira have already generated various problems to be studied and monitored in the long term regarding its repercussions on the health of the affected populations, and, particularly, on violence increase. For example, after receiving dozens of complaints from riverside inhabitants, the Public Prosecutor's Office in Altamira, along with other institutions, carried out an inspection in early July 2015, and found systematic violation of the rights secured in the Constitution, laws and plant's licenses, with destruction of traditional communities and the impossibility of the affected people to rebuild their lives after their removal.

According to the prosecutor,

the destruction of the riverside lifestyle and the compulsory transformation of native people, who always made a living from the river and land, into unemployed and underemployed dwellers in the Altamira

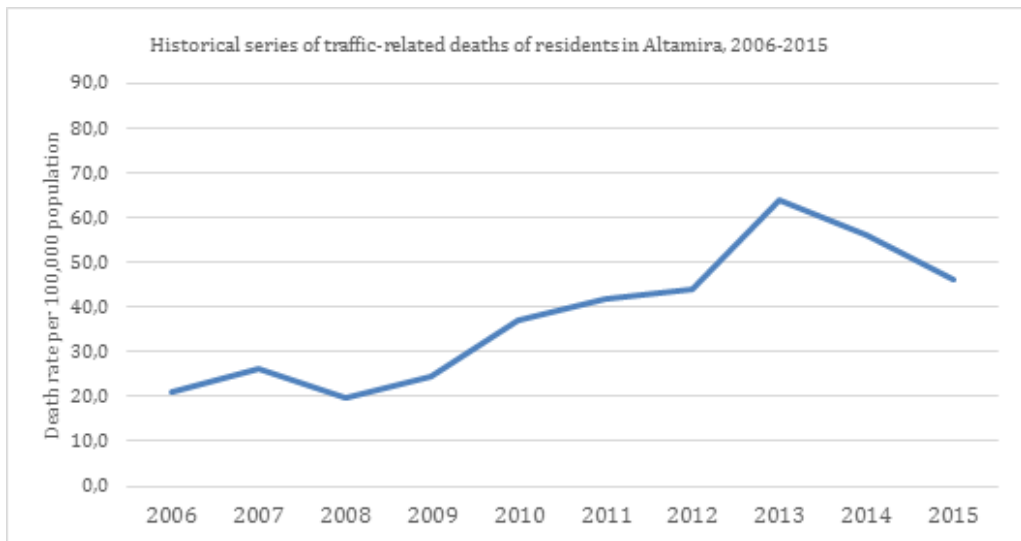
outskirts is the definitive evidence that the rules of the licensing process for the dam, the largest civil work promoted by the federal government, have not been fulfilled. (Author's translation)

What this process can deliver in terms of increase (or not) in violence is an aspect that we will try to follow up in our long-term research in the region (MPF, 2015).

Similar to the increased violence rate by homicide, there was a greater number of traffic accidents in this city, as data from the Information System on Mortality - SIM (2014) shows in Graph 3.

Both death occurrences by violence – homicides and accidents – in a preliminary analysis can be accounted to the increased number of people who came to work at the Belo Monte dam, and this has been a correlation largely widespread by the academic circles and the media. In fact, there is a possible correlation due to the population growth in the city. However, when other variables are considered, the complexity in establishing causal relations increases.

**Graph 3. Traffic-related death rate in the city of Altamira**



Source : Information System on Mortality – SIM

With regard to the deaths caused by traffic accidents, for example, through interviews with the civil and military police, firefighters and employees of the Traffic Department (DETRAN), we found that between 2008 and 2010, in two operations called “Red Light” carried out in the city of Altamira, the Federal Police dismantled a gang formed by officials of the Traffic Department and owners of driving schools, who facilitated issuance of driver’s licenses against payment of kickbacks. Sale of answer keys and copies of the tests to applicants of driver’s license and other frauds related to traffic surveillance and

irregular vehicles inspection by extortion or payment of bribes from drivers were found. What is the impact of these frauds on the increase of traffic accidents in the city? How to associate them with the migrants' growth on data of traffic-related deaths?

Our research aims to investigate, in one hand, the causal relations of the population growth and the Belo Monte construction and, on the other hand, the interests involved in the decision-making process and/or omission by the local public policy agents. In other words, our aim is to determine the impacts from the Belo Monte dam construction in the context of public policies weaknesses in order to contribute to the strategic planning of future development projects in Brazil and how to promote an integrated management of the public and private stakeholders involved in high impact infrastructure project with the responsibilities of policy managers in the area of influence of these projects.

## **Final considerations**

Despite little attention is given to the health-related aspects in social and environmental impact assessments of major infrastructure works, we sought to show in this paper how such dimension allows problematizing a series of indicators just because it is a direct recipient of various socioenvironmental impacts.

In the case of the Belo Monte dam, the health-related compensatory actions were limited to the installation of medical-sanitarian facilities, such as, for example, the construction of healthcare units and hospitals (although not completed yet) and primary sanitation service (this also with problems of completion due to non-defined responsibility for the house sewer connection with the main sewer line). There was no definition of health indicators to monitor the project continuously and systematically nor a monitoring system of the project actions and activities, as reiterated by the panel of experts.

Anticipation and mitigation of the risks to health are possible based on studies on health and environment conditions prior to and after hydroelectric dams' construction, which allow creating conditions for the establishment of temporal causal relations and convert data and information into scientific knowledge. As already pointed out, previous studies are few, faulty and incomplete, and the lack of consistent preliminary assessment studies and further monitoring of large hydroelectric dams are on the base of the difficulties of building causal relations in epidemiology and health of the population.

Political decisions and omissions during the plant installation and implementation, data uncertainty and the consequent difficulties in establishing causal relations produce undefined responsibilities in the decision-making process relating to the mitigating measures and, ultimately, in the effective regional development.

For the electricity sector, power generation is a key condition for the economic development of the country. There is no disagreement over this premise; what is claimed as a strategy to reduce population health risks in future development projects is a detailed production of data and preliminary socioenvironmental studies on the affected region and an inter-sectorial articulation, with definition of responsibilities, development of strategies to improve the services, programs and infrastructure in the area of influence of the projects.

## Note

i Noting that low-level jobs has a higher percentage of termination, such as of bricklayers' mate, which reached 53%; bricklayers and carpenters, reaching 70.7% and 60.4%, respectively; excavator operators reached 72% (CONCEIÇÃO, 2014).

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# THE CONSTRUCTION OF HEALTH CAUSAL RELATIONS IN THE BELO MONTE DAM CONTEXT

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**Abstract:** The assessment of the impacts and risks to health is possible through studies on health (and environmental conditions) before and after the installation of dams. This condition allows the construction of causal relations in timescale and the transformation of data and information on scientific knowledge and public policy. In this article, it is analyzed the issues regarding the attribution of causality in the emergency (or decrease) of the diseases or injuries, taking as examples the relationship between migration and workers' diseases (brought or acquired), cases of syphilis in pregnant women, deaths due to violence (such as homicide) and traffic accidents in the context of the construction of the Belo Monte hydroelectric dam. It is analyzed the challenges for the construction of a complex network of causal relations, that incorporate the bio-physiological causes with other causes derived from human actions and political decisions (or omissions), in this specific context.

**Keywords:** Hydroelectric dams; health; diseases; socio-environmental impacts; Belo Monte.

**Resumo:** Avaliação de impactos e riscos à saúde é possível apartir de estudos sobre as condições de saúde (e do ambiente) anteriores e posteriores à instalação de barragens. Essa condição possibilita a construção de relações de causalidade em escala temporal e a transformação de dados e informações em conhecimento científico e políticas públicas. Nesse artigo, analisa-se os problemas relativos à atribuição de causalidade na emergência (ou redução) de doenças ou lesões, tendo como exemplos a relação entre migração e doenças de trabalhadores (trazidas ou adquiridas), os casos de sífilis em gestantes, mortes devido à violência (do tipo homicídio) e aos acidentes de trânsito, no contexto da construção da usina hidrelétrica de Belo Monte. Apontam-se os desafios para a construção de uma complexa rede de relações causais que incorpore as causas biofisiológicas, com outras causas derivadas das ações humanas e das decisões (ou omissões) políticas nesse contexto específico.

**Palavras-chave:** hidrelétricas; saúde; doenças; impactos socioambientais; Belo Monte

**Resumen:** La evaluación de los impactos y riesgos para la salud es posible a través de los estudios sobre las condiciones de salud (y del medio ambiente) antes y después de la instalación de represas. Esta condición permite la construcción de relaciones de causalidad en escala de tiempo y la transformación de los datos y informaciones en conocimiento científico y políticas públicas. En este artículo, se analizan los problemas relativos a la atribución de la causalidad en caso de la emergencia (o reducción) de enfermedades o lesiones, tomando como ejemplo la relación entre migración y enfermedades de trabajadores (traídas o adquiridas), los casos de sífilis en mujeres embarazadas, muertes debido a violencia (como asesinato) y los accidentes de tráfico, en el contexto de la construcción de la central hidroeléctrica de Belo Monte. Se analizan los desafíos para la construcción de una compleja red de relaciones causales.

**Palabras clave:** Plantas hidroeléctricas; salud; enfermedades; impactos socioambientales; Belo Monte.

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