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ENVIRONMENTAL STRESS EFFECTS ON HUMAN HEALTH IN BRAZIL: A PANORAMA TO THE FUTURE

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Abstract

Diverse aspects of environmental stress on human health in Brazil were discussed aims to answer questions as: which regions and socioeconomic sectors are most vulnerable to those effects? Which the future of the human health quality in the country? Systematically data on sanitation, demographic indicators and expansion of tropical diseases (TD) in the five geographical areas of the Brazil were analyzed for the period 1980–2012, considering combined factors as destruction of forests, water pollution, population, absence of sanitation and tropical water-related diseases. Data for this review were identified by searches in databases and reports Brazilian government officials and international agencies. Filters were used for select information. The analyses confirm that there is a cause-effect relation between man and environment, being that environmental stress answers to impacts with specific effects on human health, including climate changes and TD epidemics, both associated to socioeconomic conditions.

Keywords: *human health assessment, sanitation, water-related diseases, water supply, environmental vulnerability*.

1. Introduction

An immense part of the world population has no means of basic sanitation, living, working, and playing on insalubrious conditions. Over 95% of sewage in developing countries is discharge without any treatment into receiving bodies of water. The water and sanitation sector in Latin America and the Caribbean are facing a crisis of assurance. Several water-related diseases introduction between 1980s and 1990s, as cholera in 1991, and the high indexes of *schistosomiasis*, *amebiasis*, childhood diarrhea, hepatitis (A and E), and epidemics of malaria, *leishmaniasis*, Chagas and dengue are the symptom of inherent problems, and exposes the weakness and inadequacy of public supply and environmental sanitation. According to Idelovitch & Ringskog (1995), the failure of the public sector to offer reliable service is largely explained by its inability to operate efficiently and adequately the water and sanitation systems, and after almost 20 years the situation is the same or worse.

The relationship human health - environmental stress is one of the most complex ones. Limited sanitation technologies, high illiteracy rates, poor infrastructure, and continuous exploration of natural resources are some factors that have contributed to the increase of the environmental stress on human health. All these factors associated to climate change have contributed to floods and droughts in urban zones, lost of the fertile soils in rural zones, and contamination of rivers and reservoirs. A large share of the Latin America economies depends directly on the agriculture, and so, of clean water to irrigation. Due to sanitation problems, Latin America should be especially vulnerable to climatic changes, and its consequences on drinking water quality.

Improving access to safe drinking water and adequate sanitation, as well as promoting good hygiene, are key components in preventing diverse water-related diseases. A report to 2006 indicated that 2.5 billion people were lacking improved sanitation facilities (WHO/UNICEF, 2008), and almost 25% of population in developing countries was practicing indiscriminate or open defecation (UNICEF/WHO, 2009). Those practices explain the high levels of helminthiases in the world, especially cysticercosis and neurocysticercosis. More than 80% of the world’s 50 million people who are affected by epilepsy live in developing countries, many of which are endemic for *T. solium* infections in humans and pigs (WHO, 2011a), such as Brazil. Between 1990 and 2008, the proportion of the developing world’s population using an improved drinking water source increased from 71% to 84%. Nevertheless, almost 1 billion people have not still access to safe drinking water, and many households do not treat or safely store their household water supplies (WHO, 1997; Warner, 1998; DCTD, 2004; UNICEF/WHO, 2009; Instituto Trata Brasil, 2010).

The constraints for the successful provision of sanitation facilities in developing countries, such as Brazil, are the lacks of funds, trained people, and knowledge about acceptable alternative technologies. Given these constraints, it is not surprising that sanitation service levels in developing countries have remained low. Are the existing human resources being used to their real capacity? Is environmental stress contributing to reduce the water quality that supplies the population of the developing countries? Can be it cause of the many tropical diseases incidence?

A major effort is needed to find and develop alternative sanitation technologies proper to local conditions in developing countries. There is a complex connection between human activities, health and environment stress. The result of this connection is environmental changes followed by emerging of diseases. Understanding how this interaction occurs, and which are theirs consequences, can offer guidance when designing and implementing policies of management, strategies, and measures to discuss current and projected environmental impacts. The purpose of that investigation is shows the interactions between the current condition of sanitation, the environmental stress and human health quality in Brazil, responding questions as: Which regions are most vulnerable to environmental stress effects? Which socioeconomic sectors are the most vulnerable? Which the future of the human health quality in the country?

2. Materials and Methods

2.1 Analytical procedures

Systematically data on sanitation, Demographic indicators and tropical diseases incidence in Brazil were analyzed and interpreted for the period 1980-2012, comparing the results with data from other developing countries. The terms searched were: “deforestation”, “demographic density”, “environmental health”, “environmental impact”, “health”, “hygiene”, “public policy”, “sanitation”, “sewage”, “tropical diseases”, “water pollution”, “water quality”, and “water-related disease”. Data for this review were identify by searches in databases and reports Brazilian government officials – ANA (National Water Agency); ANVISA (National Agency for Sanitary Vigilance); FIOCRUZ (Oswaldo Cruz Foundation); FUNASA (National Health Foundation); IBGE (Brazilian Institute of Geography and Statistics); MS (Ministry of Health); RIPSA/DATASUS (Interagency Network for Health Information) – and international agencies U.S. EPA (U.S. Environmental Protection Agency); IPCC (Intergovernmental Panel on Climate Change); UNICEF (The United Nations Children's Fund), and WHO (World Health Organization). NGOs official reports and relevant papers were also surveyed through Google Scholar. Filters were used for select information on cholera, *schistosomiasis*, hepatitis A, diarrhea, malaria, *leishmaniasis*, Chagas disease and dengue. All searches were realized in Portuguese and English.

3. Results and Discussion

3.1 Water supply in Brazil

Brazil entered in the twenty-one century with its population structure and tendencies of major population processes strongly altered. The rapid alterations of the population structure are already clear and will have significant consequences to water and sewage services, and so to the human health. In 2000, Brazil’s population of 170 million inhabitants of which 19–22% had not access to adequate water supply and 36% had not adequate sewage disposal facilities (IBGE, 2001, 2002). In 2010 numbers showed a slight improvement in the conditions of sanitation, of 191 million inhabitants about 17% had no access to adequate form of water supply, and between 25–33% had no form of sanitary exhaustion collection (IBGE, 2010a,b). The projections for sanitation services for next ten years are not of improvement and in some cases are of worsening of the services due to the increase in population density in certain regions of the country.

Sanitation services quality is not the same in all regions of the Brazil. The Southeast region has better sanitation services, with 100% of the municipal districts with service of provisioning of water for general net of distribution, which represents 90-93% of the total population or 100% of urban population with water supply (IBGE 2010a,b). The analysis regional showing also that of the total of municipal districts without general net of water supply most of them meet in the North and Northeast regions (Fig 1A), with prominence for the states of Rondônia and Pará (N) and Paraíba and Piauí (NE). An analysis with base in the PNSB 2008 (National Research of Sanitation) with projection for 2010 showed that the North region presented the lowest percentage of water supply covering with 54% of the total population supplied or 74% of the urban population (IBGE, 2002, 2010a,b; Instituto Trata Brasil, 2010).

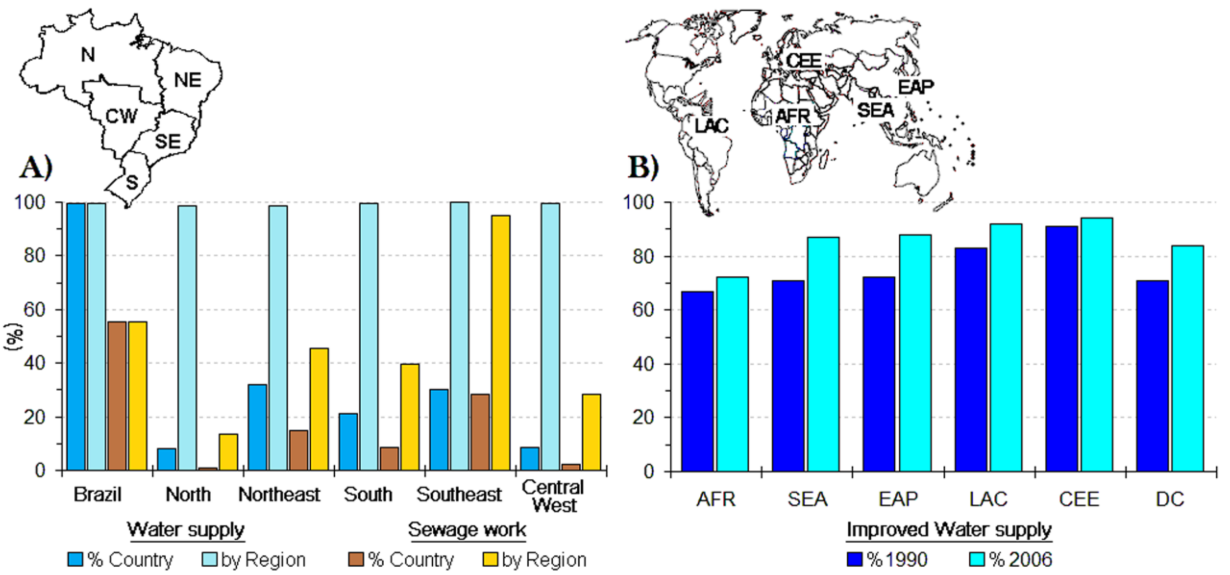

Fig 1: A) percentage of brazilian population supplied by water and sewage in 2010 (Source: IBGE, 2001, 2002, 2010a; ANA, 2005); **B) percentage of world population using improved drinking water source in 1990-2006** (Source: WHO/UNICEF, 2008). Legend: SSA= Sub-Saharan Africa, ME&MA= Middle East & North Africa, SA= South Asia, EAP= East Asia & Pacific, LA&C= Latin American & Caribbean.

The results from the 2010 demographic census showed that about four times more people live in urban than in rural areas. However, this estimate changes when analyzing the results from the point of view of regional scale. In the Southeast region, the most industrialized region of the country, the ratio of urban and rural population is 13:1, while in the Northeast that is in proportion 3:1. The measure of water required by urban and rural installations varies with local conditions. Urban supplies are obtained from public water supply, while in rural areas the supply is obtained from improved drinking water sources (Fig 1B), e.g., piped water into dwelling, plot or yard, public tap, protected springs and wells, and rainwater collection. It is common in isolated sections of rural areas to find inhabitants drinking water directly from lakes, ponds, streams and water-impounding reservoirs, as has occurred in the arid zone of Pernambuco and Bahia states, both at Northeast region (CPRH, 1998; Aprile & Bouvy, 2008). Many are the difficulties to supply the populations with water of quality. In urban periphery of the Rio de Janeiro and Vitória metropolises, both in the Southeast of the country, the topographical conditions do not allow for proper water and sanitation facilities. In rural areas in the Amazon, water has to be carried long distances, and contaminations occur during transportation depending on the containers and mode of transport. Despite the improvement observed in these last years, it is still significant the share of the population living in units without minimal conditions of salubrity. In both Amazon and arid zone of the Northeast, compact rural villages are served by wells. In scattered rural settlements, wells are mainly used, but the access to water sources is not always easy (author unpublished date). As regards water quality, it is not possible to quantify with precision the percentage of rural population making use water from wells.

3.2 Wastewater problem in Brazil

Many human activities associated to land and water use have contributed to increase the levels of organic compounds in aquatic systems. The industrial and sanitary wastewater with organic compounds is discharged usually into a natural drainage channel, when required often-suitable treatment. Thus, the fresh water can become polluted. The total population in Brazil in 2010, 67% had sewage disposal facilities by public sewerage or septic system. During the same period, it was considered that in Brazil about 16 million m^3 per day of sanitary sewage was produced, but only half of this volume was processed (IBGE, 2010a,b). Brazil's Southeast is very populous and industrialized, contributing with great part of the sewage volume produced in the country (68%), but although the region has the largest volume of sewage collected (above 95%), it processes less of the half of that volume (Fig 1A). The national mean of sewage treatment is below 30%, and in the states of the North and Northeast that percentage is still smaller: Sergipe (9.3%); Amazonas (4.8%); Pará (4.2%); Rondônia (3.8%); Piauí (2.2%) and Maranhão (1.4%) (IBGE, 2010a). All Amazonian states show low levels of sewage treatment, reflecting in a low quality of the public health. Consequently, the most part of the sewage producing in the municipal districts are discarding in water-bodies without any treatment (Siqueira & Aprile, 2013), resulting in pollution and contamination of the aquatic ecosystems.

In industrialized countries, the standard solution for the sanitary disposal of human excreta is waterborne sewage. Users and responsible agencies have come to view the flush toilet as the essential part of an adequate solution to the problem of excreta disposal. However, this method was designed to maximize user convenience and not health benefits. This may be an important goal in developed countries but unhappily has a lower priority in developing countries. The wastewater treatment deficit in Brazil is higher than 90%, and huge efforts to decrease it can barely cope with the net population increase in the areas without sanitation. The high population concentration in urban centers becomes costly treatment of wastewater, requiring greater dilution of pollutant loads. It is estimated that 80% of water supplies are wasted by disposal along with the sewers (Von Sperling, 1998; Instituto Trata Brasil, 2010). Sewerage systems for excreta disposal in rural areas are rare and traditional latrines are the most common disposal system adopted. A large number of cities have problems correlated with inadequate disposal of liquid and solid wastes. That represents a permanent dangers of contamination for both surface and groundwater sources. Water demand for industrial, agricultural, and domestic uses has increased substantially, therefore, depleting the water resources and forcing cities to look for alternative solutions, such as recycling and reuse of industrial wastewater, as occurs in São Paulo City (author unpublished date), and irrigation with wastewater and water desalinization. The water supply reduction and increases of the demand are typical indicators of impacts resulting from the human activity on the aquatic resources in developing countries. In the less-developed areas where water supply and sanitation services are not adequate, many problems stay (e.g., scarcity of water resources, lack of new techniques for extraction and distribution of water, absence of routine maintenance of systems, and lack of adequate water treatment facilities for rural communities.

3.3 Environmental stress – Sanitation – Health

Another important aspect of the environment and human health quality is environmental stress generated by unplanned and indiscriminate use of natural resources. Brazil already has indications of recognized environmental stress by the climate change from deforestation and expansion of agriculture, especially in Amazon (Faminow, 1998; Fearnside, 2001, 2002). Amazonian had two major droughts in the last ten years (2005 and 2010), which affected the life quality of more 1 million inhabitants of the floodplain. Droughts are becoming more frequent and intense, interfering in national socioeconomic structure. The environmental stress makes the environment vulnerable to disturbances of great magnitude (Turner *et al*., 2003; Metzger & Schröter, 2006) exposing it to many endemic diseases.

In general, the inhabitants more poor are forced to live in risky zone areas (slums, invasions, villas, and shacks) without any sanitation or security. It is estimated that in 2010, Brazil possessed about 6300 slums, concentrated especially in the Southeast region (IBGE, 2010b). In São Paulo City more than half million people living in risk zone areas (slums in hills) with possibility of tumbling or sliding (see Fig 2) (Destak, 2012; Radioagência NP, 2012). Many times, inhabitants of rural areas have migrated to urban areas due to floods or droughts in their regions. If climate changes worsen, more and more people must move to big cities increasing of sanitation problems. The impact of climate change can influence populations in larger Latin American cities (e.g., Caracas, La Habana, Mexico City and São Paulo), which may be especially vulnerable because they lack the resources to adapt to heat waves (McMichael & Githeko, 2001). Populations are becoming more vulnerable to disasters in developing countries, and the intense rains that plague large urban centers aggravate floods in the same time that exposing water-related diseases (Kovats, 2000;

McMichael & Kovats, 2000). This phenomenon has occurred frequently in larger Latin American cities as São Paulo and Rio de Janeiro (Southeast), Porto Alegre (South), and Recife (Northeast) (Destak, 2012; Radioagência NP, 2012; Unicamp, 2012), which are examples of unplanned urban growth in Brazil.

The adaptation to environmental stress must include reuse of treated wastewater to diverse activities as irrigation, composting, aquaculture, cooling of industrial plants, dust suppression, toilet flushing, general washing of paved areas, fire fighting and recreation facilities (Asano, 1991; Asano & Mills, 1990; Shelef, 1991; Mathew *et al*., 2000). However, studies show that the reuse of water involves investments in treatment and transportation, and when the reuse is poorly done contributes to environmental pollution and health risks by pathogenic infections (Pound & Crites, 1973; Asano, 1991; Asano & Mills, 1990; Bouhoum & Amahmid, 2000).

The adverse health effects related to low quality of water are frequent in developing countries. The pollution and contamination of the water supplies by human and animal excreta may generate water-borne or dirty-water diseases, which include *amebiasis*, *giardiasis*, Paratyphoid fever (*salmonellosis*), cholera, *shigellosis*, hepatitis (A and E) and other forms of diarrhea (WHO, 1990; Makule, 2000; DCTD, 2004; UNICEF/WHO, 2009; Instituto Trata Brasil, 2010), all very common in poor rural areas of the country (Fig 3). The sanitation absence in the poor communities that living around water bodies results in several water-based diseases, which include *ascariasis* (soil-transmitted helminthiases) and *schistosomiasis*, both very common in hot areas of the Northeast of Brazil and considered neglected tropical diseases (WHO, 1990; DCTD, 2004; UNICEF/WHO, 2009; Instituto Trata Brasil, 2010).

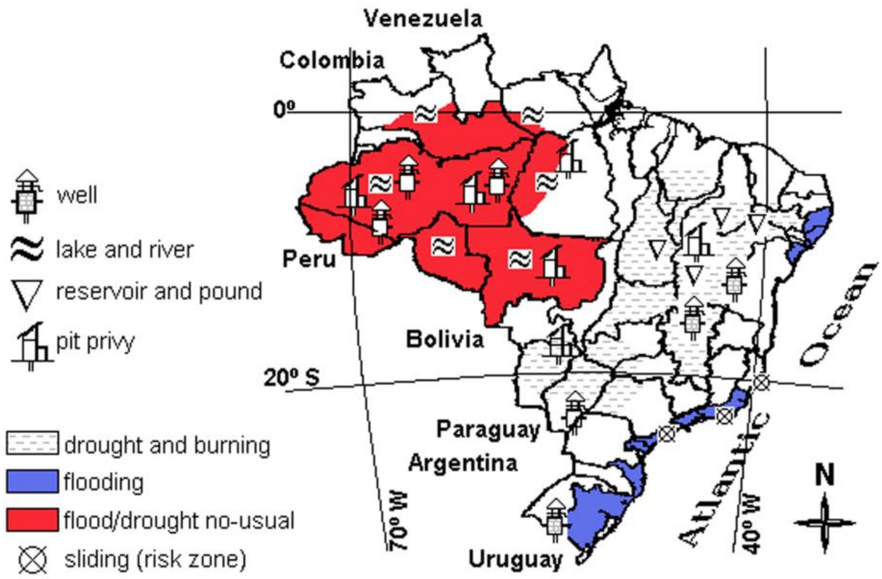

Fig 2: Map of vulnerability in Brazil. Human activities associated to environmental stress, and areas with water supply without treatment.

Data of the World Health Organization revealed that each year 2.5 billion cases of diarrhea occur in the world with children under-five years of age by pathogens as *E. coli*, *Shigella* and *Salmonella*, viruses and protozoa (Shier *et al*., 1996; UNICEF/WHO, 2009; Instituto Trata Brasil, 2010), and estimates suggest that overall incidence has remained relatively stable in the last two decades (Boschi Pint *et al*., 2009). Mortality has declined over the past two decades from an estimated 5 million deaths per year (1990s) among children under-five to 1.5 million deaths per year in 2009 (DCTD, 2004; UNICEF/WHO, 2009). More than half of the cases are in Africa and South Asia, although the incidence in the Latin America and the Caribbean is not worthless. In Brazil, the children under-five mortality rate in 2008 was 22 per 1000 live births or 67,000 under-five deaths (UNICEF/WHO, 2009; WHO, 2009a). It is estimated that 88% of diarrhea deaths worldwide are attributable to unsafe drinking water, inadequate sanitation and poor hygiene (Black *et al*., 2003). The diarrhea represents 80% of the diseases related to the inadequate sanitation in Brazil (Instituto Trata Brasil, 2010).

In many traditional communities of the North (Amazon) and Central-West regions there are not water facilities and adequate toilet. People fetch untreated water from rivers and lakes and keep it in their homes for use. In these regions the level of childhood diarrhea is higher than mean to the country. A cheap and efficient solution for that problem is dry toilet construction, which the volume and weight of pathogenic is reduced by dehydration and decomposition process (Calvert, 1997; Jönsson, 1997; Winblad, 2000; Aprile & Siqueira, 2011), and has been suggested with success to communities in Central and Occidental Amazonian (Aprile & Siqueira, 2011).

Brazil is already vulnerable to several sensitive diseases such as cholera, *schistosomiasis*, hepatitis, malaria, *leishmaniasis*, *trypanosomiasis* or Chagas disease, and dengue (see hotspots in Fig 3). The cholera introduction occurred in Brazil in 1991 by the Amazon, and was spreading through the North region, after the course of the rivers toward the Northeast and Southeast regions. In 1991, 2100 cases were registered, increasing to 60,300 cases in 1993. In the early 2000s the number of cases recorded was just over 700 (FUNASA, 2002). The world estimates to *schistosomiasis* are of the studies developed by the WHO Division of Control of Tropical Diseases (CTD) that estimated a decreasing from 200 million of cases in 1990 to 160 million the cases among 2009-2010, with 32 million of people treated actually in world (WHO, 1990, 2011a). Lately, the number of cases treated of *schistosomiasis* in Americas had a progressive decline from 91,000 in 2006 to 30,000 in 2009 (WHO, 2011a). There are indications of the presence of *schistosomiasis* in 19 Brazilian states, in a continuous strip along the coast, from Rio Grande do Norte State to Bahia State, in the Northeast, reaching then the interior of the states of Espírito Santo and Minas Gerais in the Southeast region (FUNASA, 2002) (Fig 3). There is not specific data on the cases of *schistosomiasis* in Brazil, however according to WHO Department of Control of Neglected Tropical Diseases, the good news is that in 2020 Brazil can eliminated *S. mansoni* infections (WHO, 2012). Naturally that for that to happen is necessary an efficient and extensive program of sanitation in whole country. The Fig 3 presents an outdated map of Chagas disease in Brazil. The active vectorial transmission in Brazil is nowadays focused on the Amazon region. The area highlighted by the map is the area where there are more people who became infected by *T. cruzi* years ago, and this group of people eventually has suffered the consequences of the "environmental stress" as they expand their agricultural and livestock activities toward the forest.

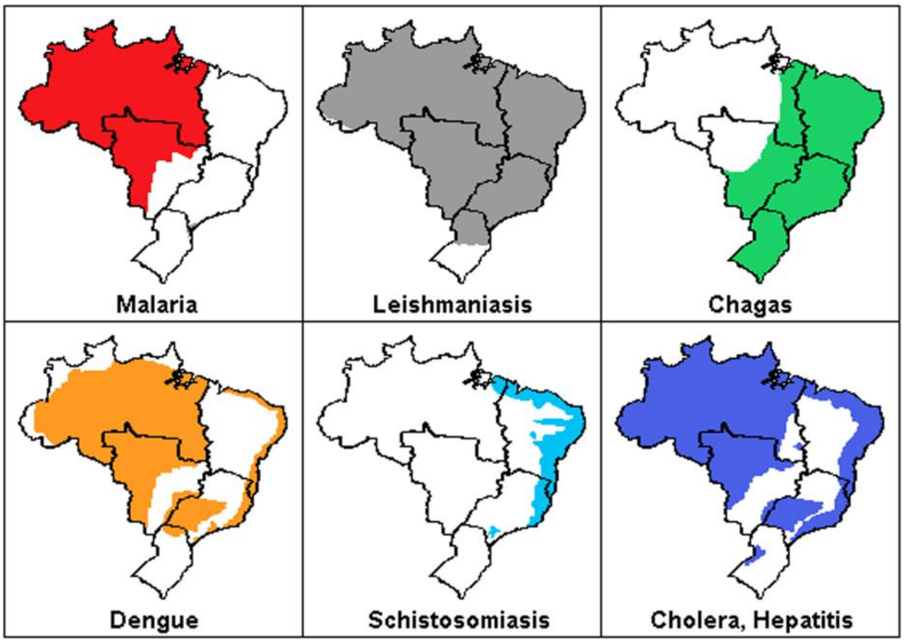

Fig 3: Hotspots of tropical diseases transmission in Brazil associated to sanitation problems (Source: WHO, 1990, 2009b, 2010, 2011a,b; Githeko *et al*., 2000; FUNASA, 2002; DCTD, 2004).

Hepatitis A (HAV) is other disease directly associated to environmental health vulnerability. Brazil had over 138,000 confirmed cases of hepatitis A from 1999 to 2011, according to laboratory criteria, and with an annual mean of 7000 cases and 31 deaths in 2011. According to the Ministry of Health report for 2011, the highest number of cases was founded in the age group of 5-9 years, with an incidence rate of 14.8 per 100,000 inhabitants. In children under-five years of age the incidence rate was between 7 to girls and 8 to male. Most cases of HAV per 100,000 inhabitants, by region of residence, are located in the Amazon, with a maximum rate of 31 cases in 2004 and 16 cases in 2011. Central-West region had the second highest incidence of hepatitis A in the last decade, with an incidence rate of 28 cases in 2005 and 5 cases in 2011. The incidence rate of HAV in the North, Northeast and Central-West always remained above the incidence rate in Brazil, which reached its highest rate in 2005 to 10 cases per 100,000 inhabitants (ANVISA, 2000; FUNASA, 2002; DATASUS, 2011; WHO, 2012; MS, 2013). The last investigation shows a progressive decline in the incidence rate of HAV morbidity in all regions of Brazil, trend observed before (De Paula, 2007) for the period 1980–2002.

Vector-borne diseases are other import group of diseases in tropical areas transmitted by vectors-insects or other animals. Millions of people suffer from these infections that include malaria, *leishmaniasis*, Chagas disease, dengue, *lymphatic filariasis* and *onchocerciasis*. The greatest difficulty in reviews of malaria cases is that the estimates vary greatly from one author to another, especially when the review is conducted regionally or locally. In 1990 the WHO/CTD estimated 267 million people infected, with 107 million clinical cases per year, and a mortality rate between 1–2 million per year to 103 affected countries (WHO, 1990). Between 2009 and 2011 WHO reports showed there to be a reduction in the number of cases of mortality worldwide (WHO, 2009b, 2010, 2011b), possibly in response to the malaria eradication program in progress. A systematic analysis about cases of malaria worldwide between 1980 and 2010 was presented by Murray and colleagues (Murray *et al*., 2012). In Brazil, malaria is concentrated especially in North (Amazon) and Central-West regions (Fig 3). The latest results on the annual Parasite Incidence of Malaria (PIM) for 2010 revealed that Amazon continues to be responsible for the higher incidence of malaria in the country, in descending order in the states of Acre, Roraima and Rondônia (FUNASA, 2002; DATASUS, 2011) The control of the Chagas disease vector has contributed much to reducing transmission of the disease in Latin America and Caribbean, and has helped save millions from chronic impairments. It is estimated that in 2004 the coverage of treatment for lymphatic filariasis in the Americas was about 2,280,000 people treated and in 2009 about 3,360,000 (WHO, 2011a,b).

Chagas disease is other important vector-borne diseases in Brazil, with an estimated mean number of cases between 1990 and 2010 of 12 to 14 million (WHO, 1990, 2011a; DCTD, 2004). Of the more than 120 known species of Chagas disease, 48 were identified in Brazil, and 30 species have been captured in the home environment. The states with the highest rates of infection are Espírito Santo and Minas Gerais in the Southeast region, and Rio Grande do Sul in South of Brazil. The Amazon region has low levels of incidence of the disease (WHO, 1990; FUNASA, 2002) (Fig 3).

Dengue ranks today as the most important vector-borne viral disease in the world, with nearly 3 billion people at risk in over 100 countries. In the late 1990s, dengue was responsible by 50–100 millions of cases per year, including 24,000 deaths in the poorest areas of Asia and Americas (WHO, 1997). The number of dengue deaths reported in the Americas 2000–2010 ranged from 80 to 1150 cases (WHO, 2011a). The first documented outbreak in Brazil occurred in 1981–1982 in Roraima (North region). After, epidemics occurred in 1986 in Rio de Janeiro and some capitals of the Northeast region (WHO, 2012). In Brazil, the total number of dengue cases continuous alarming, in main metropolises. The results of the annual incidence rate of dengue per 100,000 inhabitants by state for the year 2010 revealed a high incidence of dengue in the North states, especially in Acre with 4742 cases, Roraima with 1638 cases and Rondônia with 1308 cases (DATASUS, 2011). Unlike malaria, which is preferentially concentrated in the North region, cases of dengue are spread throughout the country, with high incidence rates in the Northeast and Central-West regions (Fig 3). In the Southeast region the highlight was the state of Minas Gerais with 1063 cases in 2010 (DATASUS, 2011). The frequency and pathogenic potential of dengue epidemic are directly associated with the increase of three factors: population density, environmental impact, especially in tropical forests, and unsanitary conditions of the poor population.

Brazil's environmental health vulnerability is result of diverse natural and human factors combined: El Niño Southern Oscillation (ENSO), destruction of forests, unplanned urbanization, and pollution and contamination of the aquatic ecosystems (wastewater). It has observed that the vector-borne diseases incidence varied with the climate changes and tropical forest destruction (Fig 4). Two hypotheses were established to explain that trend: 1) rivers are used as communication ways in Amazonian, and with the drought the human-hosts do not spread maintaining the disease located (FIOCRUZ, 2012), and 2) with the reduction of the forest area there is an increase of the regional drought (climate changes), reducing the number of vector-insects transmitters. The effects of natural events as ENSO can affect the incidence and distribution of the infectious diseases such as malaria (Moreno, 2006), since a dry year may induce malaria epidemics in humid regions but cause malaria decreases in arid regions (Fagan, 1999). Historical data show widespread diseases and social disruption in response to the quasi-periodic ENSO cycle (Fagan, 1999). In 1997–1998, 2005 and 2010, ENSO contributed to severe drought in Amazon with expansive forest fire (AID, 1998; INPE, 2012), and as result the malaria cases had decreased (OPS, 1998; ANVISA, 2000; Confalonieri & Costa-Dias, 2000; DATASUS, 2011). The most plausible explanation for this phenomenon was the decreases of the air humidity.

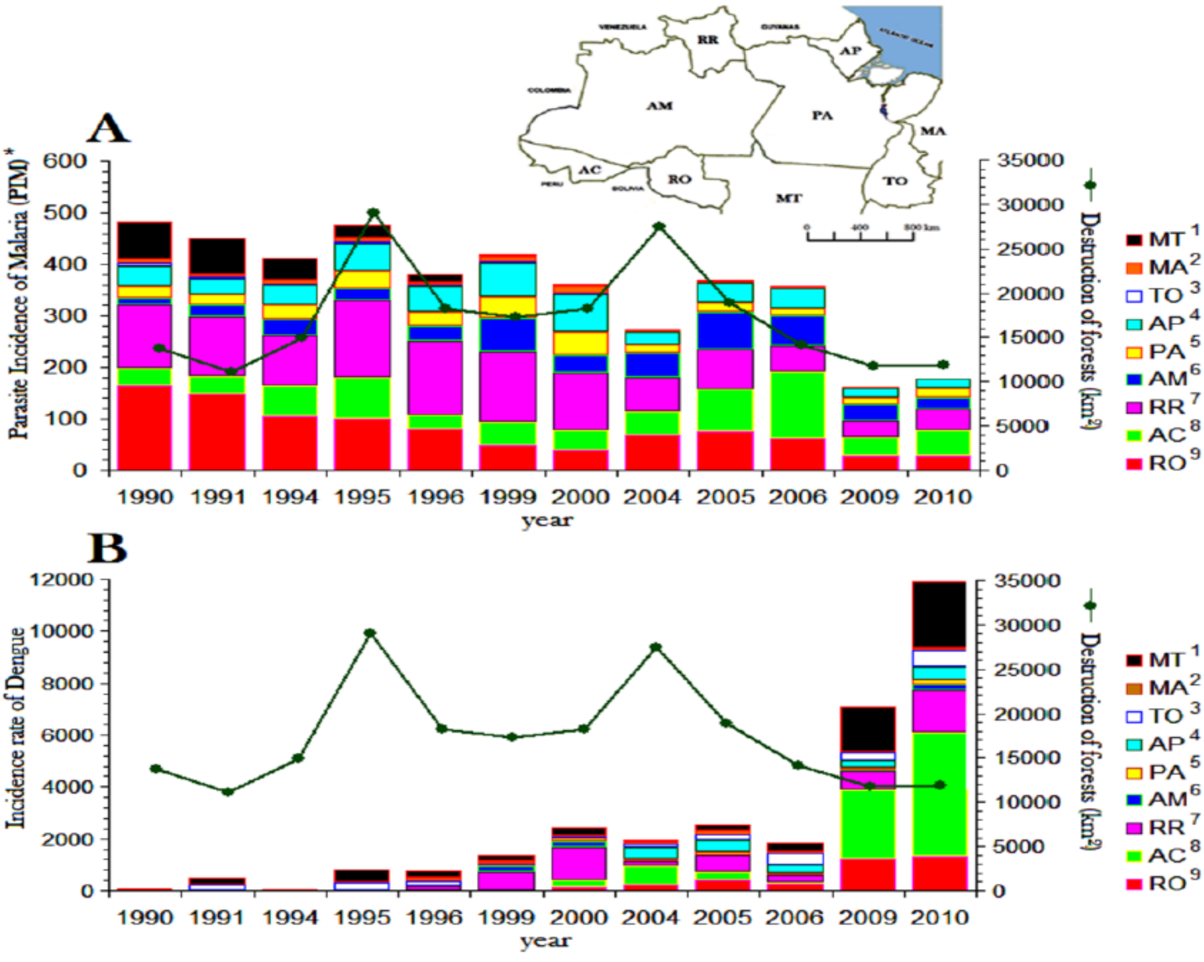

Fig 4: Relationship between A) Malaria and B) Dengue incidence and the area of destruction of Amazon forest between 1990 and 2010 (Source: WHO, 1990; FUNASA, 2002; DATASUS, 2011; INPE 2012; MS 2013). * PIM and Incidence rate in number of cases per 100,000 inhabitants. Amazon concentrates 99.8% of malaria cases in the country, and low correlations between the incidence of cases and area of forest destruction were observed, with Pearson's correlations: $r(MT)^1 = -0.2650$; $r(MA)^2 = 0.1709$; $r(TO)^3 = -0.0079$; $r(AP)^4 = 0.2993$; $r(PA)^5 = 0.2756$; $r(AM)^6 = 0.1962$; $r(RR)^7 = 0.3544$; $r(AC)^8 = 0.1421$; and $r(RO)^9 = -0.0281$.

Water quality in the world is deteriorating due to pollution from human activities. High concentrations of organic matter, phosphorus and nitrogen from domestic sewage are conductive to production of cyanobacteria, which often contain toxic and tumor-promoting microcystins. In Pernambuco State (Northeast Brazil) it was founded in 1990s several reservoirs with algae of the gender Microcystins, especially in reservoirs used to Metropolitan Region of Recife water supply. In the same region, the author founded high levels of schistosomiasis between children that swimming in the same reservoir with infected snails living (author unpublished date).

4. Conclusion and Future Perspectives

Reducing the number of cases of infection by water-related diseases, due to improved services for water supply and collection and treatment of wastewater, in all Brazilian households, would enable to save US$500 million only in hospitalization expenses in public hospitals to over the years. The prevention is still the best mechanism to keep the integrity and health of a population. The universal sanitation reduces much mortality from water-related diseases, which would represent a gain in health and reducing social inequalities. In Brazil, public health campaigns developed had ever significant success in reducing disease. However, the vast social inequality in the country contributes to stay still large centers of poverty, with low infrastructure, and sanitation and health inadequate, keeping mortality rates higher, especially in children, as occurs with the neglected tropical diseases and soil-transmitted helminthiases.

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