ENVIRONMENTAL RISK MANAGEMENT IN MUNICIPALITIES OF THE METROPOLITAN AREA OF CARIRI, CEARÁ, BRAZIL

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1. Introduction

Although Brazilians had believed for a while to be free of natural disasters, due to the non-occurrence of earthquakes and hurricanes in Brazil, this assumption has changed over time. Once since 1990, the frequency of natural disasters has increased, mostly as a result of floods and landslides. Between the years of 1990 and 2010 it is estimated that 90 million people were affected by floods and mudslides in the country (ROCHA, 2013).

Research conducted by the Brazilian Institute of Geography and Statistics in recent years has revealed alarming data regarding natural disasters. According to the study, 48% of the districts in Brazil are not able to prevent neither to act properly upon these catastrophes, and only 15% of municipalities have sanctioned laws regarding land usage linked to flood prevention. Furthermore, only 2.6% of them pursue specific laws concerning inundation. These numbers are below the country needs. The study also indicates that among the years of 2008 and 2013, approximately 40% of the municipalities have undergone at least one natural disaster and most of these districts do not possess the necessary mechanisms to address the situation. Along this period, 2,276 cities faced gradual or sudden floods and/ or landslides. Considering only gradual floods, 1.4 million people were left homeless or displaced.

The picture of natural catastrophes in Brazil shows that most disasters occur as a result of extreme atmospheric events associated with disordered occupations, which consequently leads to environmental degradation and damages to human health. However,

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actions from the government and the society have been held more significantly after the occurrence of tragedies. It's the case of Rio de Janeiro, where government authorities in 1988 brought together community leaders from the “Morro (hill)" and from the “asfalto (asphalt)" after the city have been overwhelmed by rains and landslides. Nowadays, the city constitutes an example due to its actions regarding accident prevention.

The establishment of local alliances among community leaders and government agencies to organize and coordinate actions when facing natural disaster situations is the first recommendation of the United Nations and the National Civil Defense Department in order to allow cities to resist and recover from the effects of those catastrophes.

Despite losing lives and the direct financial debt, natural disasters also cause several problems to public health. Diseases transmitted by biological vectors through contaminated sources of water and food are the ones that mostly affect the victims of such tragedies. Natural disasters can enhance the occurrence of emerging diseases or influence the increase of re-emerging ones.

Factors that may contribute to the occurrence and increasing of new diseases due to such disasters are diverse, highlighting: Interruption and /or contamination of water supplies and sanitary services; disorganization of public health; climate changes favoring the emergence of the vectors and lack of control over food and water quality (ROCHA, 2013).

Upon the occurrence of a natural disaster usually there is damage to sanitation services, not to mention road blocking due to the accumulation of debris. All these factors contribute to aggravate health risks, which are even more accentuated when people are conducted to shelters. Once they are usually not appropriate to receive those affected by such disasters.

In addition to post-disaster health problems, public managers should care about the health of the population located in risk areas. Those people deal with an unhealthy environment in a daily basis, which is often not assisted by basic services such as garbage collection and water supply.

According to the exposed above it is evident that natural disasters in Brazil and environmental health problems in areas of disordered occupations possess strong consequences in large urban centers. Essentially, it's the result of absence of planning and control over city expansions. Once the Metropolitan Region of Cariri, located in the state of Ceara has undergone a sharpen increase in recent years, the subject of this article is remarkably important for the municipalities comprising the region.

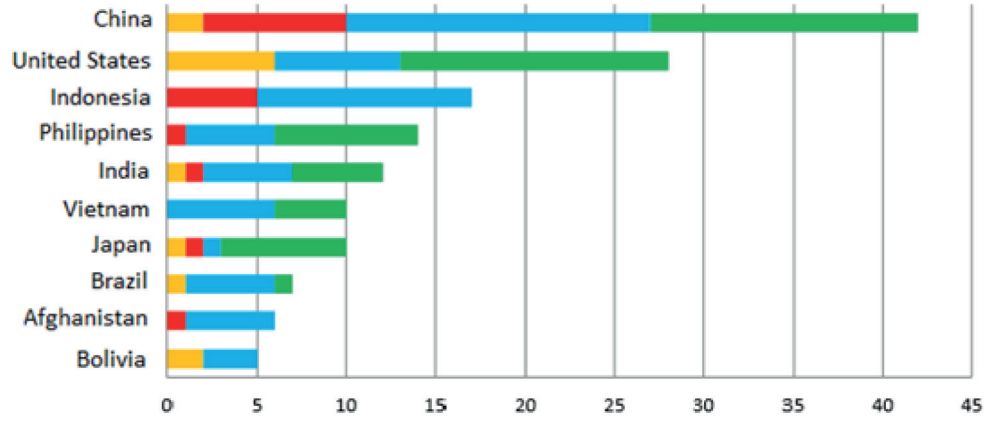
This paper aims to present the situation of disordered occupation in the Metropolitan Region of Cariri; perform a diagnosis on the health of residents living in a risk area; analyze the work performed by the Civil Defense local department; and suggest actions to address the situation, contributing to reduce natural disasters in the region. The current study was developed through a literature review and the authors' practical experience. Aiming to assess the local situation field trips were realized to occupied slope areas, identifying environmental hazards and health related issues.

2. The World Scenario of Natural Disasters

Natural disasters are progressively affecting more people around the world, especially those living in inappropriate places subject to physical, economic and social damages.

The Centre for Research on the Epidemiology of Disasters (CRED, 2014) from the Institute of Health and Society (IRSS), states the year of 2013 had a devastating impact on human society, with a total of 330 natural disasters, comprising 108 affected countries and reaching 96.5 million victims. Resulting on the death of more than 21,610 people just in that year and damages estimated at US$ 118.6 billion dollars. Among the ten countries that have suffered the greatest number of natural disasters in 2013 is China ranked in the first place (42 disasters - 27.81%) and the United States (28 disasters - 18.54%). Brazil ranks in the 8th position with seven disasters (4.6%). Figure 1 shows the ranking of the ten most affected countries, comprising 151 natural disasters. The disasters causing more casualties worldwide in 2013 were the Haiyan cyclone in the Philippines (7,354 deaths) and the floods in India (6,054 deaths). Regarding the American Continent, a flood in Argentina stands out with 350,000 people affected and US$ 1.3 billion dollars in financial loss.

Figure 1: Countries listed according to the number of reported events in 2013.



	Bolivia	Afghanistan	Brazil	Japan	Vietnam	India	Philippines	Indonesia	United States	China
Clime	2		1	1		1			6	2
Geophysical		1		1		1	1	5		8
Hydrological	3	5	5	1	6	5	5	12	7	17
Meteorological			1	7	4	5	8		15	15

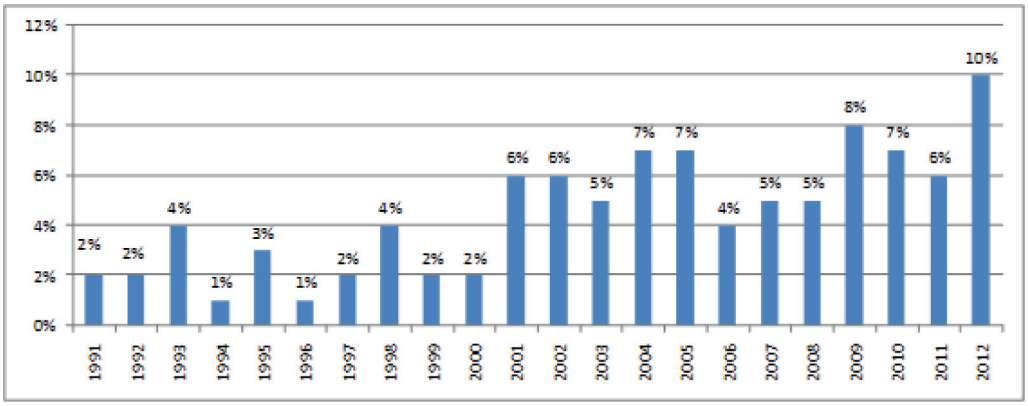
Source: CRED (2014, pp. 15)

Since the year of 2000, the number of disasters taking place in Brazil has increased considerably, particularly in the years of 2009 and 2012 (Figure 2), according to Brazil 2013 apud Santa Catarina Federal University (2013, pp. 34). The EM-DAT (2012) recorded

202 occurrences of major natural disasters in the country between the years of 1990 and 2012, with 12,235 fatalities and a financial loss of approximately US$ 4.6 billion dollars. Landslides in the mountainous region of Rio de Janeiro in 2011 left more than 900 people killed and another 30,000 homeless.

According to Spitzcovsky (2013), Brazil showed in the 90s an increase in all types of natural disasters peculiar of the American Continent with prominence of landslides. Since 1990, roughly 3,300 people have died as a consequence of landslides in the country (OFDA / CRED, 2009). Among 2000 and 2010 sixty natural disasters reached Brazil, leaving 7.5 million Brazilians homeless and suffering with financial, physical and psychological damages (ALVES; LACERDA; LEGAL, 2012).

Figure 2: Natural disasters in Brazil occurred between 1991 and 2012.



Source: Brazil 2013 apud Santa Catarina Federal University (2013, pp. 34).

The problems faced by those living in areas prone to droughts, rain shortages, landslides and floods are frequent in the Brazilian scenario. "[...] During the years of 1991 to 2012 51.31% of the recorded disasters were caused by rain shortages and droughts, 20.66% by water rushing streams, and 12.04% were a consequence of floods "(INFORME BRASIL, 2013 apud Santa Catarina Federal University, 2013, pp. 36). This situation aggravates in detriment of human actions, especially the lack of public policies directed towards minimizing harmful effects to the environment.

Although disasters caused by rain shortages and droughts are representative in Brazil, with more prominence in the Northeast Region which includes the state of Ceara, this paper aims to emphasize problems related to urban disasters (landslides and floods) as a result of the joint actions of climatic aspects and the disorderly occupation of both slopes and river banks.

Regarding brusque floods, the state of Ceara presented 46 records between the years 1991 and 2010. The North and Northwest regions of Ceara as well as the Metropolitan Area of Fortaleza showed a higher frequency of sudden floods (UFSC, 2011). Relative to gradual flooding, the municipalities showing the greatest number of records were Viçosa

do Ceara and Crato. The latter belongs to Cariri-MR, the area of interest of this study, and thus it will be discussed in more details later.

3. Environmental Risk Management Actions

The consequences of natural disasters have demonstrated the urgent need to adopt policies on the three government levels and among society groups (NGOs, civil society and universities) as well as global campaigns. An example of global campaign is the International Day for the Reduction of Natural Disasters, decreed by the UN General Assembly and established by the United Nations. The actions comprising this Day aim to raise awareness to the implementation of preventive and mitigation policies capable of promoting resilience to communities at risk.

The adoption of policies for risk reduction is necessary in the three government levels due to the social inequalities in the country which leaves the Brazilian population distinctly vulnerable. The low income population is the most affected, living in risk areas for not being able to afford safer places. Generally, the best areas are occupied by the high society while the inappropriate ones, which require larger investments in order to be suitable for habitation, are left for those with low income.

According to Coutinho and Bandeira (2012), "The Office of the United Nations Disasters Relief Coordinator (UNDRO) made an important contribution to the process of managing risk areas at an international level, and suggested five actions which were taken by several countries such as China (Hong Kong), Australia, USA, Brazil and etc". Risk management actions comprise risk identification, analysis and mapping of risks, prevention policies, planning for emergency situations, public information and training.

The Brazilian Government, through the National Urban Program Department, has conducted risk management actions in several Brazilian cities. Standing out among these programs are the program for urbanization, regularization and integration of precarious settlement areas, the program to support prevention and eradication of risks in precarious settlement areas and more recently the financial support to the development of geotechnical charts of aptitude for urbanization, which aim to guide urban planning managers in the implementation of new settlement areas in order to avoid the emergence of new risk areas and future natural disasters.

As part of higher education institutions, universities have always made their contribution to the society through research and extension activities throughout the country. Recently the Federal University of Pernambuco (UFPE) established the National Laboratory for Risk Reduction of Natural Disasters, which performs supporting activities to the risk vulnerability mapping in areas susceptible to landslides and floods. The Federal University of Santa Catarina (UFSC) established since 2001, The University Center of Studies and Research on Disasters (CEPED), through a technical cooperation set between the Ministry of National Integration, via the National Department of Civil Defense, and the state of Santa Catarina, via the State Department of Civil Defense and UFSC. The UFSC CEPED operates in teaching, research and extension fields related to disaster risk reduction, in order to cooperate in technical development, scientific and cultural

sinistrologia and its dissemination into the society, being a reference to the country and to the world regarding disaster management.

Considering all Brazilian states, some actions are worth mentioning. Actions developed in Pernambuco, through the "Program Viva o Morro", constitute an example to the country. The main objective of this program is to drive an urban structuring process aiming to contribute to disrupt the cycle of inertia and repetition regarding accidents during rainy seasons which involves environmental and material damages and the loss of human lives. Additionally, it aims to establish a virtuous cycle through the adoption of coordinated and progressive solutions to controvert emergency and punctual actions, mobilizing public sectors and residents in a preventive and structured vision for the urbanization of these areas.

In terms of activities developed in a city level, it stands out the work performed by the Geo-Rio Institute in Rio de Janeiro, and the Civil Defense of Recife (CODECIR), with their more effective management actions. The Civil Defense Department from these cities has worked through structural actions with engineering constructions and non-structural ones via social activities in communities.

One of the non-structural actions recently developed in the city of Rio de Janeiro comes from the Rio Alert System, by which community notices are issued on weather conditions, i.e. on the intensity of rain expected. When heavy rain, with potential to cause isolated landslides is forecasted, warnings are issued to the population (via the press and website Alert Rio - www.sistemaalerta-rio.com.br). The Community Alert System for Heavy Rains is another option operating in the city, by which residents receive rainfall warnings through SMS messages. There is also information through sirens installed in the most critical locations. It goes on when heavy rain is expected for the next few hours with potential to cause widespread landslides, indicating a stage of high alert in the area.

3.1 Irregular Occupations x Environmental Risks in the Cariri-MR

In recent years the Cariri-MR, located in the Northeast of Brazil, has shown a high process of economic and social growth, bringing an increasing concern to urban planners regarding its consequences. Along with the Metropolitan Region of Fortaleza, the Cariri-MR promoted the economy growth of Ceara in the last decade. In 2010, these regions accounted for 74.71% of the gross domestic product (GDP) of Ceara, which is equivalent to R$ 58.17 billion (IPECE, 2012).

According to IBGE, the economic structure from the Cariri-MR in 2002 was concentrated 75.69% in the service sector, 19.2% in the industrial sector and 5.10% in farming. When compared to data from 2010, it can be seen that the biggest change was on the portion of the agricultural sector, which decreased to 2.84%.The IPECE (2012, pp. 19) complements citing "the municipalities of Cariri-MR presenting the greatest impact on the economy of Ceara were Juazeiro (R$ 1.9 billion) and Crato (R$ 846.4 million)."

Regarding population increase in the Cariri-MR in 1991, 424,590 inhabitants were accounted, while the population census realized in 2010 recorded 571,111 inhabitants in the region. From 1991 to 2000 the population increased in 18% and among 2000 and

2010, 14% (IBGE, 2010). The three cities showing the highest population growth over the last 10 years were Juazeiro, Crato and Barbalha. This fact is a result of migratory flux caused by several reasons such as the establishment of a university campus from the Federal University of Ceara in the region, which was recently converted into the Federal University of Cariri, and construction works in the region sponsored by federal and state governments (Project for integration of the Sao Francisco River and the Transnordestina Railway).

Between 2010 and 2014, the municipalities of Nova Olinda, Juazeiro, Crato and Barbalha, belonging to the Cariri-MR showed higher growth rates. Government is unable to follow the population increase in the Cariri-MR, which can be confirmed by the numerous problems presented in such cities, for instance inadequate occupation of slope areas and problems with urban mobility, public health and security.

In the city of Juazeiro do Norte, the urban system has undergone major changes, mainly due to the influence of industrialization, expansion of real estate market, as well as public and economic policies which boost the urbanization process without however, consider the need for maintenance of environmental sustainability and life quality of the population at social risk. These facts lead to socio-economic and environmental inequalities, responsible for development of spontaneous occupation areas.

According to IBGE (2010) approximately 30% of the population of Juazeiro do Norte, the main town in the Cariri Region, is among the line of indigence and poverty and 20% is below the indigence line. The number of cases of mosquito-borne diseases, especially dengue fever is quite high. In relation to basic sanitation, although 90% of residents have access to water supply services, 53% have no access to sanitary sewage system. The data reveal the precarious conditions of sanitation infrastructure, housing and low level of education and income of a significant portion of the region population. Pointing to the absence of public policies to address disparities involving socioeconomic and health issues.

Magalhães; Peulvast; Bétar (2010, pp.01) state that:

> The cities of Crato and Barbalha grow rapidly towards the scarps of the plateau, resulting in diverse environmental problems such as deforestation, uncontrolled usage of water resources, occupation of slope areas, water and soil pollution, waste exposure and health risks.

According to Brazil (2010, pp. 59) "[...] housing constructions on river banks lead to silting and grounding of the region water sources". Another aspect to be considered is that the cities do not possess specific public departments responsible for the housing sector. Only registering families, which not own a house, to request federal funds and include them in popular housing programs.

The consequences of irregular occupations are plentiful. The Seminario neighborhood for example, located in Crato, irregularly occupied by roughly 150 families has exposed their residents to numerous environmental problems in the recent years,

including lack of satisfactory sanitation, risk of erosion processes and landslides, as well as risk of environmental health (Figure 3). It should be noted that this area is classified as a special area, forming the "Parque da Encosta do Seminario", characterized by the unique environmental aspects that should be protected and valued. However, the absence of urban control on the city contributed to the occupation of the area.

The Seminario neighborhood is the largest and most populous in the city. The environmental degradation and improper occupation in its surroundings constitute concerning factors. Once it endangers the lives of many local residents, especially those near areas affected by erosion. The largest of those areas was most known as " Buraco do Vulcão" (the volcano hole), a huge gully, whose opening was approximately 10 m wide, 6 m deep and 600 m long.

Figure 3: Disorderly occupation of a slope area in the Cariri-MR.

Source: Bandeira; Mariano; Feitosa (2013).

The soil of Seminario neighborhood is naturally susceptible to erosion. Sandy sediments carried by erosion are often carted to the channel that runs through the city (Channel Rio Granjeiro). The channel is then silt up as a result of sediment transport, reducing its water storage capacity. Added to the contributions of wastewater coming

from residencies, hospitals and factories, as well as concentrated rainfalls and the soil impermeabilization on the surroundings, it increases flood probability.

This fact was noticed in January 2011, when a 162 mm rain precipitating for four hours, raised the water level on the Channel Rio Granjeiro and flood the City of Crato. It caused several damages on the city central area as well as the channel destruction. In addition to the flooding in Crato, other cities in the Cariri Metropolitan Area also suffer with flooding during heavy rains, for instance the cities of Juazeiro do Norte, Barbalha and Missao Velha. Regarding to health risks, item 3.2 specifically address the subject with results from a study conducted at the Seminario neighborhood.

Currently Seminario neighborhood is the subject of a project for an urban restructuration, run through a partnership between the State and the City Government, and with financial aid provided by the World Bank (CEARA, 2010). The implementation of the Environmental and Urban Reform Project of Seminario neighborhood has already relocated 135 families to a safer place.

The place left by the families underwent urbanization process, and was performed works of slope stabilization and drainage, implementation of basic sanitation infrastructure, constructing 15,000 meters of domestic sewage with 2,311 connections, as well as wastewater treatment plant.

Another example of risk area in Crato due to slope erosion is the community called "Pequizeiro" located in the neighborhood of "Pinto Madeira". The area is occupied by low-income population with a total area of approximately 20,000 m2, where various factors aggravate the environmental risk.

Standing out among the problems is garbage release on slopes, inadequate cutting of slopes, sand sediment removal, and wastewater discharged directly into the ground. The absence of micro drainage systems also increases the risk degree in the area. The soil type (sandy- silty) also contributes to the site erosion because it disaggregates easily with the action of water.

3.2 Environmental Health in Risk Areas

In areas with flooding and landslide risks there is also the problem of environmental health risks

> Environmental health is the field of study concerning public health which deals with life forms, substances and conditions surrounding the human being which may influence their health and welfare. In other words, it comprises all aspects of human health, including life quality determined by physical, chemical, biological, social and psychological factors in the environment (BRAZIL, 1999 apud RIBEIRO, 2004, pp. 71).

In order to identify changes in the environment with potential to interfere with human health due to some natural disaster, it is necessary to adopt an Environmental Health Surveillance Policy. According to Neto (2002 apud BARCELLOS; QUITÉRIO

2006, pp 177) "The Environmental Health Surveillance Policy aims, [...] to identify measures for prevention and control of environmental risk factors related to diseases or other health problems."

Regarding surveillance and prevention of natural disasters, the Environmental Health Surveillance Policy emphasizes the risk and health effects resulting from events related to floods, droughts, landslides and vegetation fires. The resident population of inappropriate areas (risk areas), devoid of basic sanitation are always exposed to stench, rodents, insects and garbage which accumulates everywhere, not to mention the exposure to sewage often discharged into water streams. Exposing the population to water-borne diseases and even soil ones, and increasing the risk of groundwater contamination.

Citizens with access to an adequate water distribution system are less prone to waterborne diseases such as diarrhea and schistosomiasis, which reduce their life quality.

Waterborne diseases are mainly caused by pathogenic microorganisms originated from an enteric source, animal or human, and are primarily transmitted by the fecal-oral route, i.e. they are excreted in the feces of infected individuals and ingested through sources of food and water contaminated with these faeces (GRABOW 1996 apud AMARAL et al. 2003). This fact is commonly seen in areas with irregular occupations as verified in the slopes of Seminario neighborhood in Crato, Ceara.

A health diagnosis was performed in October 2012 with residents of risk areas in the Seminario neighborhood, especially those living near intense erosion sites. For the purpose of this study the physical aspects of the environment were observed and structured interviews were held with inhabitants of 20 residencies. During the field trips it was observed that apart from the illegal occupation, the area hosts disposal of garbage and debris. The site close to the gully presents a heartbreaking scenario showing abandonment regarding public services, lack of infrastructure and fragile houses located on the slope edge. The residents stayed, for many years, subject to risks due to air, water and soil pollution, such conditions were exacerbated by the their own inadequate actions as the lack of treatment on the ingested water.

Interviews on health aspects were realized through the completion of a survey previously formulated and including information about the physical environment, as well as symptoms of diseases and complications. Regarding the aspects of physical environment, it was collected information about garbage disposal, sewage system, water supply and drinking water treatment.

Regarding diseases and complications, it was listed the most frequent ones in this environmental scenario such as lack of appetite, abdominal pain, skin patches and yellowish skin. Residents were also asked about past diseases. The most common symptoms reported were headaches and loss of appetite which were recorded in more than 50% of interviewees. Moreover, 45% reported to feel tiredness, dizziness, and abdominal pain.

It is important to point out that population should avoid contact with contaminated water coming from floods, which expose them to diseases such as leptospirosis, hepatitis A, typhoid fever, dengue fever as well as acute diarrheal disorders. Residents of risk areas are more vulnerable to the problem.

Regarding water supply, all respondents were said to have running water. However, the interview revealed that 45% do not perform any treatment in their drinking water, i.e. they neither boil nor filter the water before consuming it.

In relation to garbage disposal, all residents reported discharging it on the erosion site. Along the field trips it was noticed a large volume of garbage in the area, making the location highly insalubrious, leading to incidence of insects and rodents. Some residents have burned garbage exacerbating the air pollution, which as a consequence may cause respiratory diseases in children and other residents of the area.

According to the Water and Sewage Company of Ceara - CAGECE, Seminario neighborhood did not possess a sewage system (Ceara, 2010). Therefore, for this reason the effluents have been released directly into the gully by residents from disorderly occupations and by those from surrounding communities. According to Saraiva (2013, pp. 19) "[...] the city of Crato, CE features a large hydro potential however, it lacks a sewage treatment plant which is a deficiency of municipal managers." One of the best preventive health actions is a healthy environment with sewage system and garbage collection. It brings savings for health care services, reduces the waiting time for medical assistance and cases of infectious and parasitic diseases.

Although, the project held at Seminario neighborhood is predicting the implementation of water and sewage systems, it's necessary to promote other actions to improve the population health. Actions, such as guidelines related to hygiene and other factors involving environmental health risks. These guidelines are important once many inappropriate practices are incorporated as cultural habits on the population routines, which may be transported to other areas and consequently turn them into new risk sites. This may happen to the 135 families relocated from Seminario neighborhood.

3.3. Civil Defense Actions in Cariri-MR

According to Brazil (2007, pp. 09), "Civil Defense is the set of actions including measures of prevention, relief, assistance and reconstruction, designed to avoid or minimize disasters and preserve physical and moral integrity of the population as well as restore the social normality ".

The National Policy on Protection and Civil Defense (PNPDEC), approved by the law No. 12,608 / 2012, states that management of risks and disasters should focus on actions of prevention, mitigation, operational readiness, response, recovery and any other actions, to ensure a sustainable development. The law obligates municipalities to execute diverse activities, including implement and coordinate the PNPDEC at a local level, incorporate protective and civil defense actions into the municipal planning, as well as identify and map disaster risk areas.

Although the nine municipalities constituting the Cariri-MR have each established a local Civil Defense Coordination, they haven't done much regarding urban natural disasters, and their actions are mostly directed to drought problems.

Another important group supporting local civil defense actions is the Civil Defense Core. The Civil Defense Core is a form of social mobilization consisting of community

volunteers which aims to raise awareness to the community on their reality and therefore its risks. It encourages local environment preservation in order to reduce the number of disasters. Moreover, it aims to discuss with the community solutions for damage mitigation in case of an emergency, prioritize preventive actions, instruct local communities to situations of accidents and disasters, develop educational campaigns and seek for government and civil partnerships. Despite the group importance to the Civil Defense System, none of the municipalities comprising the Metropolitan Region of Cariri have established a Civil Defense Core (NUDEC).

Deriving from the social group NUDEC, the Youth-NUDEC, is composed by young residents from risk areas. The youth- NUDEC creation encourages young people to understand the concepts of human rights, respect, community engagement, solidarity, and social responsibility. Among the 115 municipalities located in Ceara presenting risk areas, only the city of Caucaia has a Youth - NUDEC group, established in 2012 (CEARA, 2012).

3.4. Environmental Education and Training Actions as Risk Prevention Measures on the Cariri- MR

Among the actions cited by UNDRO on management of risk areas are disaster prevention measures, which may be done through construction works, non-structural actions, public information and training. Except for construction works, the remaining actions are inserted in the context of environmental education, which can be held for instance through lectures and training courses.

According to Brazil (2004, pp. 142), the Tbilisi Conference considers environmental education to be:

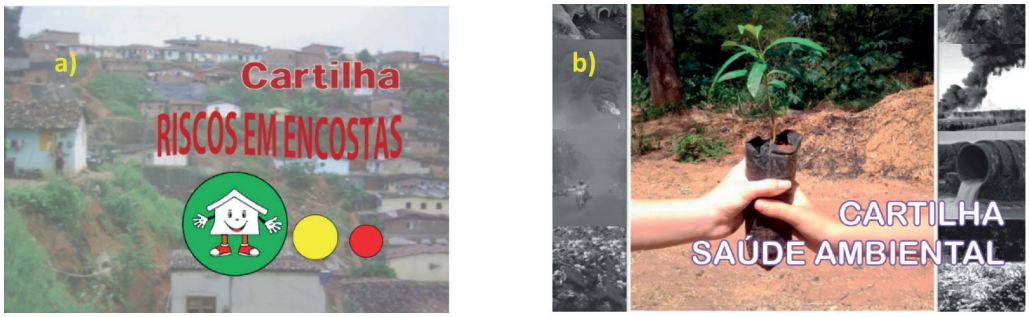
> A permanent process in which individuals and community become aware of their environment and acquire knowledge, values, skills, experience and determination which enables them to act individually and collectively to solve present and future environmental problems.

Lafayette (2006) states there is a need for greater efficiency in public awareness, once lawmakers are poorly sensitive towards environmental problems. Camapum de Carvalho; Lelis (2010, pp. 16) reported "Solution for problems such as erosion, flooding and slope stability lies in environmental education, a non-structural measure."Abílio; Florentine; Ruffo (2010, p. 01) remark "The environmental education can provide a new perception for the relation between mankind and nature, as well as reinforce the need to act as citizens in finding solutions to local problems ".

The dissemination of information through booklets is a prominent way to promote environmental education. Booklets are didactic materials, easily understood, which contains basic information about a particular topic. The disseminated information generates behavior change conditions related to the environment in order to minimize damages to public health and the environment.

The booklets were developed in two different editions, Risks on Slopes (Figure 4a) and Environmental Health (Figure 4b), as part of the outreach program "Management Actions on Risk Areas in Precarious Settlements located in the Metropolitan Region of Cariri". The program was approved by the MEC/ PROEXT 2013 public notice and executed by the Federal University of Cariri. A thousand copies of each booklet edition were produced and distributed to public school libraries located in the municipalities of Crato, Juazeiro and Barbalha.

Figure 4: Illustration of the booklets covers



Source: Personal Archive

The booklets were elaborated in order to facilitate readers' understanding through an easy language and featuring illustrations directed to the target audience (teens and adults living in risk areas). Furthermore, its editions are independent from each other, compact and easily transported to study or work places. The content aims to make information about, risk factors on slopes and environmental health factors, accessible to everyone.

In order to assist in disaster risk reduction, policies, and planning contributing to built a risk reduction culture by establishing alliances between government agencies, the private sector and civil society organizations, was performed in the year of 2015, one short-courses of NUDEC-youth groups creation, in the city of Crato. Two others are expected to take place this year 2016, in Juazeiro do Norte and Barbalha. For such are invited Young students from local schools and risk area residents from the municipalities. These activities will be developed through the Outreach Program previously mentioned.

The NUDEC-Youth short courses it cover the following topics: landslides, floods, overflow risks, alerts, how to monitor rainfall, first aid and resuscitation procedures, environmental health (garbage, diseases, and sanitary conditions), necessary actions to prevent diseases and emergency procedures in case of floods and landslides.

During the short courses participants be trained to perceive risk aspects in their community and to engage directly into actions that will support new habits, and behavioral changes considering the local context. Therefore, the NUDEC-Youth is an important joint strategy between Civil Defense and community. It's worth mentioning that participants receive the course material as well as T-shirts.

According to Lucena; Albuquerque (2010, pp. 66) "[...] promotion of socio-educational practices, especially with young people, represent a possibility to create democratic spaces capable of stimulating the participation of all those part of the community." Hence, according to the authors, there will be a breakthrough on the intention to raise the number of citizens committed to environmental protection and disaster reduction.

The Federal University of Cariri (UFCA) also offered in the year of 2015 a training course in risk area management, regarding floods and landslides, to municipal managers and technicians. Participants receive information on the occupation process of the Cariri - MR, landslide and slope erosion processes, floods and overflows, risk area management models and mapping methods for risk areas. During the course completion participants receive class material and event T-shirts.

Population does not reflect on the risk scenario they are inserted in, when Civil Defense operates only in the post-disaster period. The Civil Defense Departments from the municipalities comprising Cariri-MR should initiate permanent actions, mainly non-structural ones involving socio-educational practices favoring local risk management.

4. Final Comments

The understanding of urban problems is highly important to plan management strategies. Comprehending location and size of risk areas is the first step in the decision making process. This paper clarifies that risk management actions in Cariri Metropolitan Region are still incipient.

Past experience in risk area management from other cities shows social bonds developed in risk areas are among the main reasons making residents remain in such locations regardless of all dangers. Therefore, community engagement in Civil Defense actions constitutes a mean to raise awareness and mobilize people to the development of activities enabling the perception of previously unknown risks and cultural stimulation to change habits in the environment live.

The search for a quality urban development must be the goal of any municipality. In order to be achieved faster, it's highly important interaction between municipal and state departments as well as research and higher education institutions located in the region. Finally, problem perception is the first step to behavior change acceptance. Knowledge transfer to technical staff and community members is essential for the risk area management process. One believes that direct communication with community allows creation of new values and behavior changes towards the existing risks at a local level. Furthermore, it encourages development of new perceptions on everyday reality.

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ENVIRONMENTAL RISK MANAGEMENT IN MUNICIPALITIES OF THE METROPOLITAN AREA OF CARIRI, CEARÁ, BRAZIL

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***Abstract*:** The landslides areas and flooding risks are present in several cities in the world, annually causing several casualties and health problems to communities. The main objective of this paper is to present the situation of disorderly occupation in the Metropolitan Region of Cariri, the state of Ceara, located in the Northeast of Brazil and propose actions of the risk management in order to contribute to the minimization of natural disasters. Through activities in the occupied slopes and contact with civil defense the main problems existing in some municipalities of the region were identified. Through this study it was concluded that the disaster management is incipient in Cariri. In this sense the work also presented contributions to public managers as to problems related to natural disasters, generating subsidy for the preservation of the environment and to improve the population's quality of life.

***Keywords*:** risk management, landslides, civil defense.

***Resumo*:** As áreas de riscos de deslizamentos de encostas e de inundações estão presentes nas várias cidades do mundo, provocando anualmente diversas mortes e problemas de saúde às comunidades. O objetivo principal deste trabalho é apresentar a situação da ocupação desordenada na Região Metropolitana do Cariri, interior do Ceará, e propor ações de gerenciamento de áreas de risco, a fim de contribuir com a minimização dos desastres naturais. Por meio de atividades realizadas nas encostas ocupadas e do contato com as defesas civis, identificaram-se os principais problemas existentes em alguns municípios da Região. Com esse estudo conclui-se que as ações de gerenciamento dos desastres ainda são incipientes no Cariri. Nesse sentido o trabalho apresenta também contribuições para os gestores públicos no enfrentamento dos problemas vinculados aos desastres naturais, gerando subsídio para a preservação do meio ambiente e para a melhoria da qualidade de vida da população.

***Palavras-chave*:** gerenciamento de riscos, deslizamentos, defesa civil.

Resumen: Las áreas de riesgo de deslizamientos de tierra por declives e inundaciones están presentes en varias ciudades del mundo, provocando anualmente víctimas fatales y problemas sanitarios. El objetivo de este trabajo es presentar la situación de ocupación desordenada en la Región Metropolitana de Cariri, interior del estado de Ceará, y proponer acciones de gestión, contribuyendo a la reducción de los desastres naturales. A través de actividades realizadas en las laderas ocupadas y el contacto con defensa civil, se identificaron problemas existentes en municipios de la Región. Este trabajo concluye que las acciones de gestión de desastres son aún incipientes en la Región. El trabajo también presenta contribuciones para gestores públicos de como hacer frente a los problemas relacionados con desastres naturales, generación de subsidios para preservación del medio ambiente y mejora de la calidad vida de la población.

Palabras Clave: gestión de riesgos, deslizamientos, defensa civil.