

# Mapping and Analysis of Environmental Risks in Dr. Luzardo Ferreira de Melo Street, Jauary- I, Itacoatiara-AM

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**Abstract:** Risk areas or facilities are regions where no recommend to build houses because they are very exposed to natural disasters such as landslides and floods. This region has been growing steadily in the last ten years mainly due to human action itself. Just as big cities suffer from the disorderly growth of the urban space, the cities of the interior also go through this process, which contributes to the less favored classes to build houses on the slopes of streams, springs, thus causing serious problems, both spatial and environmental impacts. Initially, the authors intended to identify the main factors that led to the expansion of the area based on the Dr. Luzardo Ferreira De Melo street, in the Jauary-I neighborhood. There were surveys and bibliographical revisions accompanied by some research techniques such as data, photographic records and information collected from local residents. It was detected several environmental, health and safety problems due to the marginality that was there. Finally, they propose is the recovery and revitalization of the area, opportune a regular occupation.

**Key words:** disorderly growth, risk areas, safety problems, marginalized people, area revitalization

## 1. Introduction

Itacoatiara city is located near the Amazon basin. The rivers that pass through the city are Solimões and Rio Negro Rivers; together they form the Amazon River. In addition, the large rivers that cover the small streams and lagoons cut the city, which also has a large number of tributaries in its regions [1]. The growing problem of residences in irregular areas in riverbeds and in inappropriate places is alarming throughout Brazil [2] and in Itacoatiara is not different according to what was witnessed through visits and research to Dr. Luzardo Ferreira de Melo street, Jauary-I neighborhood, Itacoatiara - AM.

We also realized that the center this problem stay in the need to reside even aware of the risks to health and

physical integrity created in a flood; historically, it became increasingly busy with the expansion of urban centers. Residences that suffer most from flooding would be complete fieldwork and the focus of this research: specially the increase abandoning of many houses by the residents due to the constant flooding of the river. On field, it was possible to identify the mark of the floods in the dwellings, as well as to observe the accumulation of waste and sewage. These field features indicate the environmental risks that this area is subject to and lead us to identify the physical and social damages faced by the community [3]; for example, housing destruction, health damage, disease spread insecurity, marginality and others. The aims of this article was draw up map of environmental risk and present solutions to identified problems; but, specifically to carry out technical visit the local street; analyze the characteristics of the site; classify according to the degree of environmental risk; obtain

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information through direct approach with area residents; and propose solutions to identified problems together the governments officials.

## **2. Materials and Methods**

The research was carried out through a technical visit at the site (see Fig. 1). There were surveys and bibliographical revisions accompanied by some

research techniques such as data, photographic records and information collected from local residents. In this step, the principal reference was the book Mapping of Risks in Slopes and Riverbank was used as a parameter to classify the risks and elaborate a map [5]. According to the characteristics found, the classification of each one was obeyed the criteria for the determination of the degrees of risk as presented into book [5].



**Fig. 1** Technical visit to record images of the local's actual conditions: first and second images show the standard of housing construction; the second also presents the marks of the last flood (2018), and the third shows total absence of street sanitation.

In addition, one analysis of the hydrological processes followed the sequence describe as C1, C2, C3 that respectively mean: Flood and slow flooding of fluvial plains; Flood and Flood with high kinetic energy; Flood and Flood with high kinetic energy and transport of solids. To *urban occupation*: V1 and V2 respectively mean low constructive pattern with predominance of residences made of wood and medium to good construction standard with predominance of masonry residences.

To *distance from dwellings to drainage axis* used P1 and P2 that respectively mean: high hazard or high possibility of direct impact considering the radius of reach of the process; and, low hazard or low possibility of direct impact considering the radius of reach of the process. The risk map also was produced using the evaluation method proposed by the Risk Mapping in River Slopes and Margins Manual of Technological Research Institute [4-5].

This map was elaborated considering three criteria: hydrological processes, vulnerability of the urban occupation and distance of the dwellings to the drainage axis. The first criterion of analysis refers to the identification of the hydrological scenario present in each area to be investigated. In this sense, and by way of guidance, one can consider the typologies of hydrological processes (C1, C2 and C3), which are: Hydrological process 1: flooding and slow flooding of river plains (C1); Hydrological process 2: flood and flood with high kinetic energy (C2); Hydrological process 3: flood and flood with high energy of flow and capacity of transport of solid material (C3).

The second for risk analysis refers to the vulnerability of the urban occupation present in each risk area. The vulnerability assessment comprises the analysis of the constructive standard considering basically two constructive types: High vulnerability of accidents (V1): low constructive standard where houses built with wood predominate, remains of material with low capacity to resist the impact of hydrological processes; Low accident vulnerability

(V2): medium to good constructive standard where dwellings built in masonry predominate with good capacity to withstand the impacts of hydrological processes. The third criterion for risk analysis refers to the distance of the dwellings to the drainage axis: High hazard (P1): High possibility of direct impact considering the radius of reach of the process, and Low hazard (P2): Low possibility of direct impact considering the radius of reach of the process.

Finally, after the analysis of all the criteria, the data were crossed through the Tables 1 and 2 to verify the types of risks that exist in each sector in the study area. The risks were defined in this analysis into four levels, being: Very High Risk (MA), High Risk (A), Medium Risk (M) and Low Risk (B) [5], as descript on the Table 3. It results from the crossing of the criteria for: hydrological processes (C1, C2 and C3), urban occupation (V1 and V2) and distance from the dwellings to the drainage axis.

Therefore, Tables 1, 2 and 3 were used as instruments of analysis, associated with photos, technical visits and interviews with local residents.

### 3. Situations Identified in Dr. Luzardo Ferreira de Melo Street

Analyzing the criteria hydrological processes, urban occupation and distance from the dwellings to the drainage axis, the followings situations found were:

- 1) Regarding the local hydrological scenario, it is classified as: C1.
- 2) Vulnerability is classified as: V1.
- 3) Regarding Dangerousness, it is classified as: P1.

And, to define the degree of risk, the 3 risk analysis criteria and parameters were considered (Table 2).

**Table 1 Preliminary risk degree according to arrangement between hydrological scenarios and housing vulnerability (Source: TRI, 2007).**

	C1	C2	C3
V1	M	A	MA
V2	B	M	A

**Table 2** Classification of the risk degree (Source: TRI, 2007).

Degree of Probability	Classification	Description
<b>R1</b>	Low	Predisposing geological conditions (terrain type, slope, etc.) and the level of intervention in the area are of low potential for the development of landslide processes. There is no evidence of development of slope stabilization processes, the condition is less critical.
<b>R2</b>	Medium	Predisposing geological conditions (terrain type, slope, etc.) and the level of intervention in the area are of medium potential for the development of landslide processes. There are some evidences of instability but they are incipient.
<b>R3</b>	High	Predisposing geological conditions (terrain type, slope, etc.) and the level of intervention in the area are of high potential for the development of landslide processes. There is some evidence of instability. Maintaining the existing conditions, destructive events can occur during episodes of intense and concentrated rainfall.
<b>R4</b>	Very high	The predisposing geological conditions (terrain type, slope, etc.) and the level of intervention in the area are very high potential for the development of landslide processes. There is some evidence of significant and large number of instability. Maintaining existing conditions, destructive events are very likely to occur during episodes of heavy and concentrated rainfall.

**Table 3** Definition of the Risk levels: Very High Risk (MA), High Risk (A), Medium Risk (M) and Low Risk (B) (Source: TRI, 2007).

	P1	P2
C1xV1	M	B
C1xV2	B	B
C2xV1	A	M
C2xV2	M	B
C3xV1	MA	A
C3xV2	A	M

Among the 4 existing risk levels: Very high risk (R4), High risk (R3), Medium risk (R2) and Low risk (R1). The Dr. Luzardo Ferreira de Melo Street was classified as: R2, like we can see to the Figs. 1 and 2 and Table 3.

Through the interviews we were informed, by the residents, that they are in this hard situation because they moved to the capital, which before living in small towns, and were unable to choose a safe place to live. Thus, it is resulting into a disorderly occupation of people who came from the interior and built their residence where they got since this are going worse situation each day. They allege difficulties with the infrastructure in general, which gets worse during the period of floods caused by the rise of the river, causing physical and socioeconomic disturbances to all who live in the locality. Residential constructions are marked by rustic features and their main raw material is wood as shown in Fig. 2, which increases their vulnerability to natural phenomena.

As the region is characterized by being a floodplain area due to periodic flooding, its foundation in the ground is made by stilt-shaped buildings, with houses erected 1.5 m to 2.5 m above ground level, with the purpose of mitigate material losses.

In general, from the information obtained it was possible to verify that public policies are lacking to attend the population that lives in this area. There is then a high concentration of the population in the risk area under study. The preventive systems and awareness are failures too. They end up further aggravating the situation of the residents, who suffer each year from the rise of rivers, living in constant danger.

#### 4. Some Structural and Non-structural Measures

Dr. Luzardo De Melo Street has always suffered from flooding problems, as according to reports of residents, the disorderly installation of residences on Lake Jauary causes disruption every year with the rising waters of the Amazon River that invades homes causing material, physical and social losses. From interviews conducted it was found that there are no structural proposals, the only assistance provided by the Government to residents of the locality is the construction of bridges that allow the entry and exit of



residents of their homes during the flood. According to residents, there has never been any mobilization by the

government to improve the state of the area.



**Fig. 2** Technical visit to record images of the local's actual conditions: first and second images show the standard of housing construction; the first shows the poor degree and the instability buildings (at side), and the second also presents the marks of the last flood (2018).

The weakness or lack of public policy on housing, the speculation of the real estate market and the division of classes where those who have better purchasing power get better territorial spaces and those less favored become excluded because they cannot afford it; thus, they end up speeding up the process of occupying risky areas, and these areas are often

neglected for their low commercial value and become the home of many economically disadvantaged people.

This reality is experienced by the residents of Dr. Luzardo Ferreira de Melo Street, located on Lake Jauary, where they live every year with the rising waters of the Amazon River that invades homes causing material, physical and social losses.

For some years the Government of the State of Amazonas has been building popular houses in Itacoatiara - AM, distributed by lot to families selected by the Secretariat of Social Assistance, but these houses are aimed at serving the general population, provided that it meets the established criteria, it does not resemble, for example, the Manaus Igarapés Social and Environmental Program — PROSAMIM, which works specifically with families living in wetlands.

## 5. Conclusions

Through the analysis of environmental risk scenarios in Dr. Luzardo Ferreira de Melo Street, we can observe the existence of several conditioning factors that demonstrate the fragility of the area and its residents. Both men and the environment have undergone severe changes, often negative, in every study it was observed that the economic situation is considered the main determining factor for people to settle in risk areas, acting as environmental shapers.

However, on the other hand, the competent authorities were interviewed and they informed that the local government built houses in the appropriate place and donated to residents of Jauary I. Unfortunately, official reports show that not a few took possession of

the house and after some months (or years sometimes) sold and returned to live in precarious conditions; in the same place they left. Thus, it is clear that the problem has a broader social nature than that detected up to this point. It is possible for an association of environmental and socio-economic research to provide more detailed results.

## References

- [1] Jocélio Araújo dos Santos, Analysis of Environmental Risks Related to Floods and Landslides in the Favela São José, João Pessoa -PB, 2007, p. 9.
- [2] Mirna Feitoza Pereira, Márcio Alexandre dos Santos Silva and Taissa Dias Barros, *Palafitas of Manaus: Relations Between Nature and Culture in the City Space*, 2011, p. 40.
- [3] *Revista Geonorte: Special Edition*, 2012, Vol. 1, No. 4, pp. 318-330.
- [4] Roberto Lobato Corrêa, *The Urban Space* (3rd ed.), Attica Publisher, Principles Series, 1995, p. 174.
- [5] Case study of housing in an environmental risk situation associated to the fluvial dynamics of the river Paraíba do Sul between the Municipalities of Três Rios and Paraíba do Sul/Rj, 2010, accessed on 03/12/2015, available online at: <http://cidades.ibge.gov.br/xtras/perfil.php?codmun=130190>.
- [6] Brazil, Ministry of Cities, Institute of Technological Research, Mapping of Risks in Slopes and Riverbank/ Celso Santos Carvalho, Eduardo Soares de Macedo and Agostinho Tadashi Ogura, 2007, p. 176.