

## **Resilient Infrastructure for Natural Disaster: The Case of Mãe Luiza in Natal, Brazil**

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### **Abstract**

This paper analyzes the population acceptance of Mãe Luiza resilience a stairway infrastructure built to reduce the risk of natural disasters. The paper will present the results supporting a methodology to overcome potential negative reactions of local population. Mãe Luiza community is part of a disorderly urban area constructed over coastal Aeolian dunes located on the Natal Dunes State Park bordering the Atlantic Ocean. The community started growing over 50 years ago, becoming very dense and without following any urban control criteria, accumulating environment, structure and social problems and generating deep changes in the geotechnical behavior of the dune, derived from several factors such as: slopes, permeability, relief, garbage, clogging galleries and improvised drainage. The rainfall triggering the landslide natural disaster in July 2014, achieved records of 340 mm in a period of 36 hours and impacted an area of 10.000 square meters causing a disastrous destruction of 30 houses completely destroyed and 78 partially impacted. In our research we have reconstructed the disaster environment using video and photos documenting the effects of the accident, news reports on the media, technical documents describing the area recovery and also personal interviews with members of the community. The disaster area was renovated with an impressive stairway and sidewalk based on a creative design, attractive aesthetics and functional usage as a gym for fitness activities. The resilient public infrastructure is well kept and became an attraction for the community and visitors. The main objective of our research is to understand the reasons for the success and to develop a methodology that may help the communities to approve resilient infrastructures and adopt behavior transformation towards a more responsible environment attitude. We are collecting and analyzing the results of a public survey which will be presented and discussed in our paper. The respondents to the survey below, will provide their assessment quantifying their answers from 1 to 5 and unstructured comments can be added. The questions were related to: 1) The staircase as a low-cost entertainment and exercise option for the user; 2) The staircase as a space for healthy practices and improving the health of the population; 3) Assessment of the frequency and respect for girls and women; 4) Infrastructure resistance to periods of rain and sun; 5) The staircase as an innovative infrastructure; 6) Evaluation of the city hall from the construction of the staircase; 7) Location and orientation for the correct disposal of garbage; 8) Partnership and integration of the staircase with the community of Mãe Luiza; 9) Maintenance of interest in participating in physical activities in the staircase; 10) Development of more sustainable living habits from the use of the staircase; 11) Engagement of municipality engaging the population in the design and project of the staircase; 12) The attractiveness and effectiveness of the infrastructure; 13) The staircase decreases the risk of future landslides; 14) Current Feeling of safety; 15) Exam of population about to live in another location. The paper will provide the methodology and also recommendations how to engage the citizens in the participation of co-design and co-creation processes.

## 1. Introduction

This research analyzes the community acceptance of the stairway resilience infrastructure held in Mãe Luiza, located in city of Natal, Rio Grande do Norte State, Brazil. The stairway was built to reduce the risk of natural disasters, considering that below the sidewalk there is a stormwater drainage infrastructure. The uniqueness of this research was consider very successful the solution found for encapsulate the stormwater drainage infrastructure: a stairway/sidewalk, to recovery an area affect by a landslide. The most interesting of this solution was the public acceptance of this facility considering it to use of physical exercises, mobility and entertainment.

This research seeks to 1) describe the environment of the collapse of Mãe Luiza; 2) Characterize the intervention that was performed in Mãe Luiza; 3) dissertation about the results of the intervention of the construction of the Mãe Luiza/Areia Preta staircase according to the users' perspective.

The present research seeks to answer the following question: To what extent is the stairway/sidewalk and access ramp to Mãe Luiza community was an efficient response to a climate accident?

## 2. Mãe Luiza Stairway

Mãe Luiza community is part of a disorderly urban area built on the coastal wind dunes located in the Natal Dunes State Park, bordering the Atlantic Ocean. The community began to grow more than 50 years ago, becoming very dense and without urban control criteria, accumulating environmental, structural and social problems and generating profound changes in the geotechnical behavior of the dune, derived from various factors such as slopes, permeability, garbage, clogging galleries and makeshift drainage. The area where Mãe Luiza's stairway is located can be seen in the following figure.

**Figure 1 –Mãe Luiza Stairway**



Source: Google Maps (2019).

As can be seen in the image above, the stairway provides the connection between two streets: Silvio Pedroza, a waterfront avenue in the Areia Preta neighborhood and Guanabara street in the neighborhood of Mãe Luiza. Silvio Pedroza Avenue features luxury properties and Guanabara Street, popular properties.

The following image shows the post-collapse moment of Guanabara Street, which also caused the Silvio Pedroza avenue to be blocked, as shown.

**Figure 2 –Areia Preta Landslide**



Source: Julio Rezende.

The image above shows the speed of the accident and the way how Natal society was not prepared for a natural disaster of such magnitude presented.

The construction of the stairway was developed as a response infrastructure to the climate accident that took place on June 13<sup>th</sup> and 14<sup>th</sup>, 2014, after a 36-hour flooding. This was considered the largest flood ever recorded in Natal, Rio Grande do Norte, Brazil. As a result of the rain, houses in the neighborhood of Mãe Luiza collapsed, killing one resident. During the accident, the public emergency service was activated avoiding more fatalities. The collapse impacted an area of 10,000 square meters, causing 30 houses completely destroyed and 78 partially impacted.

The stairway is a project of architects Luciano Barros, Alexandre Abreu, Lúcio Dantas and Patrícia Luz of the Institute of Architects of Brazil (IAB). In view of its design and usefulness, the stairway has become a popular place for people to exercise and for their interest in entertainment. The stairway can be viewed in the following figure.

**Figure 3 – The stairway use**



Source: Julio Rezende.

The picture above registers a good number of users of Mãe Luiza stairway/sidewalk. The landslide in Mãe Luiza was remarkable because it changed the lives of thousands, taking place during a world event, the 2014 World Cup, exposing how the population and urban infrastructure are under threat from climate issues. This research highlights the importance for cities to be prepared to deal with climate change related phenomena and also the necessity of consider creative solutions based in users' perspectives.

### 3. Environmental recovery through the creation of recreational infrastructure

This research has as its main theoretical reference the revitalization of cities, seeking to examine measures for cities and neighborhoods recovery well-operationalized based.

According to Edmonton(2019), recreation is the experience that results from freely chosen participation in physical, social, intellectual, creative and spiritual pursuits that enhance individual and community wellbeing. Examining the experience of Edmonton (Canada), the recreational activities must consider 5 dimensions: Goal 1: Active Living; Goal 2: Inclusion & Access; Goal 3: Connecting People & Nature; Goal 4: Supportive Environments; Goal 5: Recreation Capacity. Considering this perspective, foster active living through physical recreation collaborates to:

- Recreation participation throughout the life course;
- Physical literacy;
- Play;
- Reduce sedentary behavior.

Considering Edmonton(2019) experience, it is necessary perceive the importance of government recreational planning and how the green infrastructure would be connected with green infrastructure resilience.

It is noted that public leisure and sports facilities are important resources for the revitalization of neighborhoods and cities and instruments for the promotion of the Sustainable Development Goals (SDGs). The following table shows some variables based on how to public leisure and sports equipment can collaborate with the Sustainable Development Goals (SDGs).

**Table 1 - Association of public equipment of leisure and sports with the SDG**

Studied aspects	SDG
Public leisure and sports equipment as a low-cost entertainment and exercise option for the user	Goal 3. Ensure a healthy life and promote well-being for all at all ages
Public leisure and sports facilities as a space for healthy practices and improved population health	Goal 3
Public leisure and sports facilities as a space of safety and respect for girls and women	Goal 5. Achieve gender equality and empower all women and girls
Public leisure and sports equipment with good infrastructure condition	Goal 9. Build resilient infrastructures
Innovative Infrastructure	Goal 9
Public leisure and sports facilities as a result of the good management of prefectures and state governments.	Goal 16 - Strong Institutions
Public leisure and sports equipment that contribute to the correct disposal of waste	Objective 15. Protect, restore and promote sustainable use of terrestrial ecosystems
Good partnership and integration of the staircase with the community of Mãe Luiza	Goal 10. Reduce inequality within and between countries
Interest in participating in stairway physical activities	Goal 3
Contribution to the development of more sustainable lifestyles	Goal 3

As can be seen from Table 1, environmental recovery interventions can bring varied benefits to society, with various associations with the Sustainable Development Goals.

### 4. Methodology

For the development of the research were interviewed 52 users of the stairway. These interviews were conducted at different times in the morning and evening. The following aspects were evaluated:

1. The stairway as a low cost entertainment and exercise option for the user;
2. The stairway as a space for healthy practices and improvement of population health;
3. Safety for girls and women;

4. Stairway infrastructure (resistance to rain and sun);
5. Innovative infrastructure;
6. City Hall evaluation;
7. Orientation for the correct disposal of waste;
8. Partnership and integration of the stairway with the community of Mãe Luiza;
9. Interest in participating in physical activities on the stairway;
10. Contribution to the development of more sustainable lifestyle habits.

The research made uses photos documenting the effects of the environmental accident, media reports, technical papers, describing the recovery of the area, and personal interviews with community members. In addition, it is considered that field research was very important in finding out how community building impacted the community. Some results are presented below.

## 5. Results

Some of the aspects evaluated are associated with some Sustainable Development Goals. It can be said that the stairway contributes to sustainable development in the city of Natal. Such statement involves to say that there is collaboration for various types of stairway users. It was possible to notice different users of the stairway:

- People who come from other places to exercise,
- residents using stairway access to work or school,
- residents seeking for leisure,
- tourists,
- People looking for entertainment.

It is interesting to note that the stairway serves to resident, people from other neighborhoods and even the tourists. There are also various types of use: mobility, tourism, leisure and sports.

### a) The stairway as a low-cost entertainment and exercise option for the user

All respondents agreed that the stairway is a low cost entertainment and exercise option for the user. The stairway is integrated with the Areia Preta, where the community of Mãe Luiza attends, while the main leisure and entertainment space. The following figure records some boys from the community using the staircase ramp.

**Figure 4 - Stairway ramp use by community boys**



Source: Julio Rezende

The infrastructure of entertainment and physical activity is also complemented by the sidewalk of Via Costeira, other beaches in the locality, such as Praia dos Artistas and Forte, as well some squares.

### b) The stairway as a space for healthy practices and improvement of population health

It is interesting to note that the stairway is associated with a time when the interest of the society of Natal to participate in physical activities grows. All respondents agreed that the stairway is an area for healthy practices and improvement of population health.



**Figura 5 – Pessoas em práticas de exercícios físicos na escadaria**



Fonte: Julio Rezende

The desire to be healthy is perceived. Note this change of mindset. It is noticeable the creation of a fitness / exercise culture in the city of Natal. Many sportmen who practice exercises come with a personal trainer companion.

c) Safety for girls and women

56% consider that there is safety for girls and women. It is considered important for security the installation of the police guardhouse and the operation of an electronic security system.

d) City Hall Evaluation

Eighty-seven percent would appreciate that the city hall did a good work on building the stairway. However, according to one of the users, the city should provide more public services for the population, because until this date there has been no compensation of the collapsed houses. It is not known to the population that the work was financed with federal resources.

In view of the successful experience of urban art-based interventions elsewhere in Natal, initiatives in this area also will be developed in this area.

e) Guidance for correct waste disposal

Only 42% of respondents considered that there is good guidance for the correct disposal of waste. Two dumpsters can be seen in front of the staircase.

f) Partnership and integration of the stairway with the community of Mãe Luiza

96% consider that the stairway provides a good integration with the community of Mãe Luiza. However, some people interviewed stressed that there is no investment in cultural and entertainment activities for the community.

g) Interest in participating in stairway physical activities

96% said that They maintained their interest about develop physical activities on the stairway. Professionals were suggested to help people with physical activities. Physical education teachers should help their students not to exceed the physical limits, because there are often physical injuries due to the lack of guidance from a professional.

h) Contribution to the development of more sustainable lifestyles

92% consider that the stairway contributes to the development of more sustainable lifestyle habits. Sustainability is associated with: 1- Contact with nature (youth uses the stairway to go to the beach); 2- Accessibility (a track to Mãe Luiza neighborhood); 3 - Mobility, allowing access to public transportation.

There are people who use for exercise; people who use for mobility, to go to work, to go to school, because Silvio Pedroza Avenue is a place for buses lines. The following image records the bus stop.

**Figure 6 – Bus stop in front of the stairway**



Source: Julio Rezende.

The image above is a bus stop at the bottom of the stairway. Many of the public transport users who use the stop are residents of Mãe Luiza and use the stairway to get to the bus stop, or from there to gain access to the local community.

**i) Evaluation of staircase infrastructure**

65% consider that stairway infrastructure is resistant to rain and sun. Note that some benches have already broken, as can be seen in the following figure.

**Figure 7 – Broken bench**



Fonte: Julio Rezende

Sometimes the lamppost lights stop to work with the rains. Following are some elements of infrastructure degradation, as an ordered graffiti.

**Figure 8 - Graffiti in the staircase**



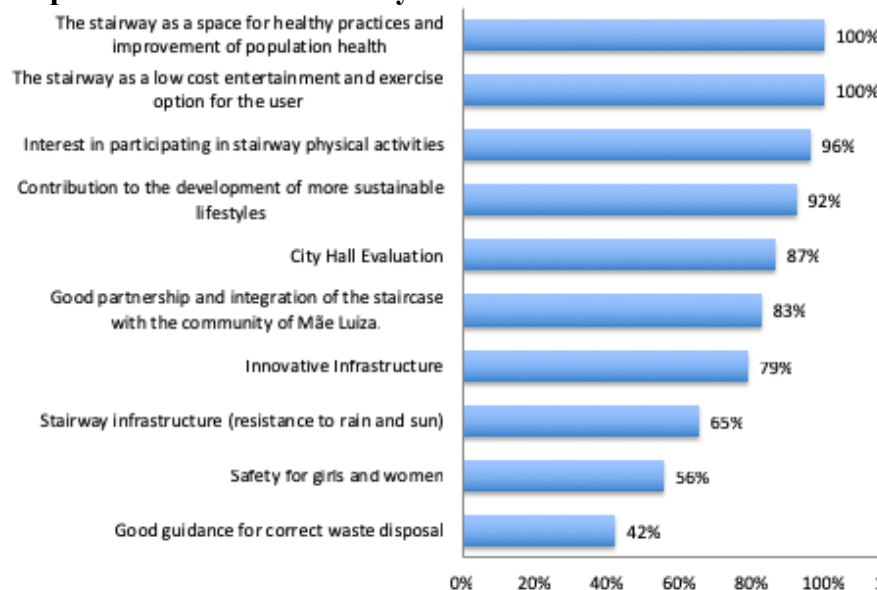
Source: Julio Rezende.

There are needs for infrastructure repairs and maintenance. In July 2019, the city of Natal announced that the stairway was being repaired and Urban Art interventions had been carried out.

Participants' demands for infrastructure improvement regarding investment in physical structures were presented: Bathroom was the main demand. Many need to use a bathroom. They emphasize that a changing room with shower would also be important.

79% consider the stairway infrastructure to be innovative because of its design and use. The following chart consolidates the opinions of the stairway users.

**Chart 1 – User's opinions about the stairway**



Source: Research data.

Observing all the presented elements in the Chart above, would be possible to affirm an overall good evaluation about the stairway of Mãe Luiza. Meantime, the guideline for waste corrected disposal not was well-evaluated, as also the safety for girls and women. Despite this last aspect, not was identified some injuries to women, only reported a fight between boy and a girlfriend, would be avoid with a more frequency of the police. The use of more resistant materials would also collaborate to a more sustainable infrastructure.

### Final considerations

None of the stairway users are former residents from the collapsed area, as their dwellings have not been rebuilt. Many of the people who have lost their homes today live in other neighborhoods. A positive result also collaborated for overcome potential negative reactions of the local population.

Not was possible identify with Natal city hall, the existence of a community recreation planning for the municipality as also an environmental policy considering environmental accidents as more based in flooding. It is possible affirm, that this is an important element to be considered in public policies, mainly based that environmental disaster will become more frequent as a result of climate change.

The research allowed a pleasant contact with the people who attend the stairway. It was noted families of tourists frequenting the stairway, making it noticed that the stairway has become a tourist place, considering its innovative feature and its usefulness.

### References

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