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SOCIAL INNOVATION FOR ENHANCING FLOOD RESILIENCE: SÃO LUIZ DO PARAITINGA, BRAZIL

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RESUMO: Este estudo tem como objetivo principal pesquisar se, e como a inovação social pode melhorar a resiliência às inundações. A área de estudo fica localizada em São Luiz do Paraitinga, Brasil, cidade que está exposta a eventos de enchentes. Para este trabalho estão sendo considerados cinco diferentes métodos participativos, mas só três dos métodos já foram aplicados para a coleta de dados. Como resultado da aplicação dos métodos, membros da comunidade foram envolvidos ativamente e, até agora, os dados de dois dos cinco métodos já foram analisados. Potenciais medidas foram identificadas, sendo em sua maioria medidas não estruturais que podem ser conduzidas pelos mesmos membros da comunidade, para redução de risco de desastres (RRD).

ABSTRACT: This study has as main objective to investigate whether and how social innovation could improve flood resilience. The study area is focused on São Luiz do Paraitinga, Brazil, which is a city that is exposed to flood events. For this work, five different participatory methods were considered, but three out of the total have been already applied for collecting data. As a result of the application of the methods, community members were actively engaged, and so far, data from two of the five methods were already analyzed. Potential measures were identified, which are mostly non-structural that can be led by the community members, for disaster risk reduction (DRR).

Keywords: vulnerability, adaptation, social participation, children.

INTRODUCTION

In the Earth System, there are different physical, chemical, biological, and social processes that take place (BOCKHEIM; GENNADIYEV, 2010). Some of them are related to weather-related events like floods, which are becoming more frequent and intense due to climate change and human decisions (MASSON-DELMOTTE et al., 2018). Flood events are in some cases related to disasters that cause social, physical, and economic losses, which have increased with a large spatial and inter-annual variability (INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE - IPPC, 2012). Globally, weather-related events represented 91% of the total major reported events (7,255), and floods represent 43.4% out of the total events (UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION - UNDRR, 2018). In Brazil, where the study area of this research is found, floods and flash floods events affected 33% of the total number of people (126,926,656) from 1991 to 2012. But, in terms of the death toll, flood-related hazards are linked to the largest toll with 54.15% out of the total reported (CENTRO UNIVERSITÁRIO DE ESTUDOS E PESQUISAS SOBRE DESASTRES - CEPED, 2013).

Disasters are the product hazardous events, but also the combination of vulnerabilities, which are socially constructed (MARCHEZINI, 2018; O'KEEFE; WESTGATE; WISNER, 1976; WISNER et al., 2004). Disasters by definition are about humans and societies, and then if people are not affected, they are not considered as disasters (KELMAN, 2019). Then, if humans are the main affected agents, they should become part of the solution too. Thus, social participation is essential for performing measures for disaster risk reduction (DRR) in order to improve resilience to the impacts of hazardous events (HORE et al., 2020), as it is proposed by the Sendai Framework for Disaster Risk Reduction

2015-2030 goal: "prevent and reduce existing disaster risk…"

This research aims to investigate how social participation, which leads to social innovation, could address societal needs by involving different stakeholders through an open process of participation, exchange, and collaboration, including end-users (SORENSEN; TORFING, 2011). In this work, the authors focus on flood hazards in the city of São Luiz do Paraitinga, Brazil. A city that has suffered the impacts of floods along with its history, and where the most recent and severe flood event occurred in 2010 when the river water levels reached up to 12 meters above the mean water level. During this flood event, there were several historical buildings that collapsed or were damaged, and economic and social activities were affected (MARCHEZINI et al., 2017).

MATERIALS AND METHODS

In order to accomplish the main objective of this research, the authors are considering five different interdisciplinary methods: Participatory 3D model (P3DM), participatory mapping, semi-structured interviews, surveys, and workshops with different focus groups (public in general, high school employees, children, and key stakeholders). However, three methods (P3DM, participatory mapping, and semi-structured interviews) were already applied with the different focus groups. The other two methods (survey and stakeholders' workshop) will be conducted and designed after data of the first three methods are analyzed. In parallel to all the methods, a bibliographic research is taking place to enrich the different methods and outputs.

The P3DM, which was the first applied method, was complemented with secondary methods (semi-structured interviews, roundtable conversations, discussion, and presentations). It is a tool that helps to take into account people's participation to characterize their own territory and processes (VALENCIO et al., 2009). It raises local awareness of territories, provides stakeholders with powerful mediums for land-use management, and serves as an effective community-organizing tool (RAMBALDI; CALLOSA-TARR, 2002).

For the P3DM, it was characterized the São Luiz do Paraitinga's urban area by using low-cost materials to represent the relief, which was based on contour lines and considering a scale of 1:500,000. Fixed elements were also made to represent landmarks, buildings, and even vegetation. In addition, unfixed elements were made to represent cars, boats, and mostly different groups of humans, which could help to represent vulnerable groups by taking into account different aspects like gender, age, race, disabilities, religion, and occupation (NORSTRÖM et al., 2020; REY et al., 2019).

The participatory mapping was the second method that was applied. This method has been used for a wide range of applications including managing natural resources, planning farming activities, implementing health and educational activities, and resolving territorial disputes. Maps are considered powerful instruments that give visual expression to realities that are perceived, desired, or considered useful (CHAMBERS, 2012). Participatory mapping is also increasingly being used for community-based DRR since it enables people to delineate areas exposed to hazards and vulnerabilities, which enhance communities to propose measures (BENSON; TWIGG; ROSSETTO, 2007).

For the participatory mapping method, the authors focused on children, who were students from the only high school that there is in the city (Monsenhor Ignácio Gióia). Participants were dived into teams, and they were asked to map hazard-prone and vulnerable areas to be able to identify areas at risk. Then, they were asked to discuss measures that they could lead to promoting DRR. After, they presented their ideas and got feedback from stakeholders, who were invited to participate in this activity.

The third method, which was already completed, was related to semi-structured interviews with nine key stakeholders. The interviews were meetings based on guided conversations. Interviews have been already conducted in different works to address researchers related to the impact of natural hazards. For instance, wildfires, and floods impacts, and to search what actions can be taken in order to become more resilient (VAN KESSEL; GIBBS; MACDOUGALL, 2015).

Regarding the fourth (survey) and the fifth (workshop with stakeholders) methods, the authors are planning to apply them later this year since they will be designed them based on the outputs from the methods that already took place. The survey is thought to be an online tool that will mostly help to prioritize what community-based measures people are more interested in, and the workshop will help to

investigate available resources and to design the path that should be followed to develop the measures.

RESULTS AND DISCUSSION

As a result of the different methods that were already applied (P3DM, participatory mapping, and semi-structured interviews) with the different focus groups, the authors managed to identify community-based measures for enhancing flood resilience in São Luiz do Paraitinga, Brazil. However, this document focuses on the outputs of the first (P3DM) and the second (Participatory mapping) method.

In the following **Table *1***, it can be seen the measures proposed by 131 people that participated during the P3DM activities and secondary methods. The measures are classified according to the different focus groups that proposed them. In addition, participants identified floods events as potential hazards that could affect the community, and specifically public in general and children also highlighted landslides.

Public in general	High school employees	Children
○ Evacuation plans ○ Collaborative monitoring ○ Networks empowerment ○ Rescue activities ○ Emotional support and response ○ Logistical planning ○ Land-use management ○ Communication strategies ○ Ecosystems conservation ○ Temporary shelters	○ Evacuation plans ○ Collaborative monitoring ○ Artistic activities ○ Fieldtrips to areas at risk ○ Partnerships for enhancing capacities ○ Vulnerability mapping ○ Open information platforms ○ Children empowerment	○ Evacuation plans ○ Awareness campaigns ○ Donations ○ Networks empowerment ○ Rescue actions ○ Emotional support and response ○ Logistical planning ○ Clean-up activities post disasters ○ Temporary shelters

Table 1 – Measures proposed by the three focus groups that participated during the P3DM activities.

For the participatory mapping, 22 children from the high school Monsenhor Ignácio Gióia participated. Children, in groups, identified and proposed five measures to lessen the impacts of floods and landslides in the city. The proposals were thought to be led by themselves but supported by different stakeholders (**Table *2***).

Team	Measures
1	○ Intercity communication committee
2	○ Territorial planning
3	○ Integral DRR framework
4	○ DRR App
5	○ Social preparedness

Table 2 – Measures that resulted during the participatory mapping session with children.

As can be seen in **Table *1*** and **Table *2***, the proposed measures are mostly non-structural measures since they are actions that use knowledge, practice, or agreement to DRR and impacts, through policies and laws, public awareness-raising, training, and education. Only one measure (temporary shelters) could be considered as a structural action since it was based on a physical construction to reduce the impacts of hazards (UNDRR, 2017). Similar results were found in other researchers that also took place in Brazil, where most of the community-based measures were non-structural, apart from shelters (JACOBI; MOMM-SCHULT; BOHN, 2013; LOSEKANN, 2017; PASSOS; COELHO; DIAS, 2017).

With the methods that were already applied in this research, social engagement was

successfully carried in a comprehensive and inclusive way. For instance, with marginalized and vulnerable groups like children, who are very often voiceless in decision-making processes (PETAL et al., 2020).

CONCLUSIONS

All the focus groups, which were intended to be involved, were already reached out. However, data collection was done only with three out of the five methods that are considered. For the data analysis, the outputs of the first two methods (P3DM and participatory mapping) were already analyzed. The interactive methods have shown that they can be used to promote social participation to talk about sensitive topics like disasters.

Participants were able to identify floods events as potential hazards, which were followed by landslides. Participants were also able to discuss, and propose measures, mainly non-structural, for enhancing DRR. However, it is still pending to investigate, how the proposed measures could be implemented by considering a preventive approach, with the support of public policies, as well as, how participants could get involved in the entire processes.

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