INTERNATIONAL SOCIETY FOR SOIL MECHANICS AND GEOTECHNICAL ENGINEERING

Community based landslide risk management: collaborative monitoring experience - Vila Nova Esperança

Alessandra Cristina Corsi[1], Fernando Marinho[2], Gabriela M. Medero[3], Jose Humberto Cababellero Acosta[4], Tazio G. L. C. Viadana[2], Pedro C. B. Leal[5], Marcela P. P. Guimarães[1]

[1]Instituto de Pesquisas Tecnológicas do Estado de São Paulo

accorsi@ipt.br

[2]Universidade de São Paulo

[3]Universidade Heriot-Watt

[4]Universidade Nacional da Colômbia

[5]Universidade de São Paulo

[6]Instituto Geológico

Abstract

Currently, in Brazil, approximately 8.2 million people live in risk areas, such as landslides or floods. Risk management by the community is an important tool for risk reduction and is currently being applied in several countries. This paper presents the results of implementing participatory landslide risk management in the Vila Nova Esperança community. This community is located in the cities of São Paulo and Taboão da Serra, São Paulo state, Brazil. The learnings from a pilot project with similar risk conditions developed in a community in Medellin (Colombia) by researchers from the University of Herriot-Watt and Edinburgh (Scotland) and the National University of Colombia (called ¿RESILIENCIA O RESISTENCIA? MITIGACIÓN NEGOCIADA DE LOS RIESGOS DE DESLIZAMIENTO EN ASENTAMIENTOS INFORMALES EN MEDELLÍN) were the basis for the adopted assumptions in Sao Paulo's high risk of landslides community. A follow up project (entitled COPRODUCTION RISK MANAGEMENT STRATEGIES THROUGH INFRASTRUCTURE DEVELOPMENT IN LATIN AMERICAN CITIES) in partnership with the University of São Paulo (USP) among the Institute for Technological Research and the Geological Institute implemented the community based risk management in Brazil. The choice of the community for the pilot project was based on the following: (i) an area of high or very high risk sectors; (ii) a community organization and/or (iii) the presence of Civil Defence Nucleus.. The project facilitated the understanding of the territory by the community residents and the recognition of the risks which they are exposed. With this knowledge, the attribution of individual actions and responsibilities became more avoidable for the residents of the community. Thus, together, both (institutions and community) selected 7 critical points/locations that potentially could be triggering points of a landslide for collaborative monitoring. Residents who were interested and agreed to participate were responsible to take photographs of a certain location and send them via social media (WhatsApp mobile phone app). The residents who follow the monitoring were trained to analyze and understand the changes over time displayed in each photograph. Importantly, climate variation data were used to aid in the understanding of photographs. Based on the knowledge of developed with the community leader and residents, residents have initiated several mitigation actions to reduce the high landslide risk in the particular area near Progresso Street.

1 INTRODUCTION

Many cities are facing serious challenges including ineffective development control systems, informal and often chaotic peri-urban expansion, a proliferation of informal housing and livelihood activities, poor connectivity, and traffic congestion and energy inefficiency. Moreover, unchecked and unplanned urban sprawl and inequality are perennial concerns in both cities and peri-urban areas. Furthermore, over 75 per cent of the world's cities grew more unequal over the last 20 years (UH Habitat 2018).

In developing countries, proximally 881 million urban dwellers were living in shantytowns in 2014. The ineffectiveness of land and housing policies, is one of the majors factors that lead to shantytowns expansion. Additionally, in both developing and developed countries, urban housing, whether for rent or ownership, is becoming increasingly unaffordable. In developed countries, young people are continuing to live with their parents for longer as they cannot afford housing of their own (UH Habitat 2018).

Since, the Hyogo Framework for Action (2005-2015) the process to risk mitigation should start with community engagement. However, community-based approaches existed even before the existence of the state and its formal governance structure. People and communities used to help and take care of each other's disaster needs (Raw 2016).

Community can play an important role in management risk and risk reduction. Around the world, there are a significant number of this importance, mainly in : El Salvador, Cameroon, Philippines, Indonesia, Fiji and Samoa, Bangladesh, middle Himalayas, Eastern Caribbean, India, Colombia and Brazil.

There is widespread evidence that poor households often group together as part of informal community arrangements in order to reduce risk exposure and provide informal (typically incomplete) mutual insurance among group members. Such behaviors merit reinforcement, especially given the apparent relative importance of household- or individual-specific, idiosyncratic risk, which makes local risk management feasible, even desirable. (Bhattamishra and Barrett 2010).

The objective of this paper is to show the results of implementing participatory landslide risk management in Vila Nova Esperança community.

The community is located in the cities of São Paulo and Taboão da Serra, São Paulo state, Brazil (Figure 1). The learnings from a pilot project with similar risk conditions developed in a community in Medellin (Colombia) by researchers from the University of Herriot-Watt and Edinburgh (Scotland) and the National University of Colombia (called ¿RESILIENCIA O RESISTENCIA? MITIGACIÓN NEGOCIADA DE LOS RIESGOS DE DESLIZAMIENTO EN ASENTAMIENTOS INFORMALES EN MEDELLÍN) were the basis of the adopted assumptions in Sao Paulo's high risk of landslides community (Smith et al. 2018). A follow up project (entitled COPRODUCTION RISK MANAGEMENT STRATEGIES THROUGH INFRASTRUCTURE DEVELOPMENT IN LATIN AMERICAN CITIES) in partnership with the University of São Paulo (USP) among the Institute for Technological Research and the Geological Institute implemented the community based risk management in Brazil.
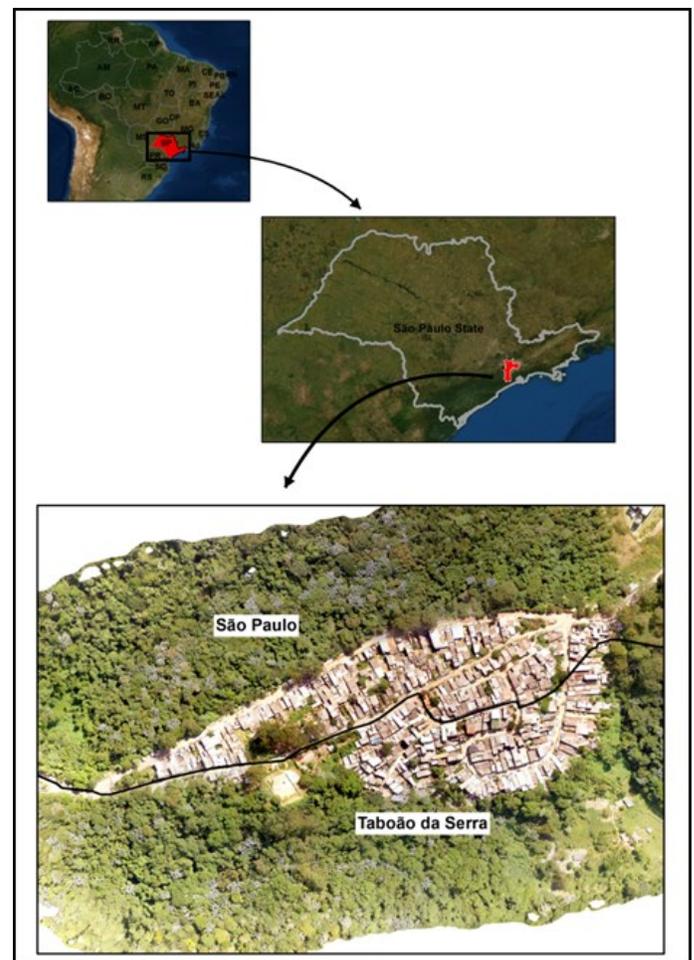

Figure 1. Vila Nova Esperança location.

The implementation of community monitoring, used from the perspective of knowledge generation and social learning, is an important tool to assist in risk management.

The importance of community monitoring is to systematically obtain information from natural slopes or slopes of cut and fill by means of photos taken weekly to monitor and identify features of movement indicative of possible ruptures. In addition to identifying the path of rainwater and the release of wastewater and sewage that directly assists in the proposal of mitigation works.

2 MONITORING METHOD

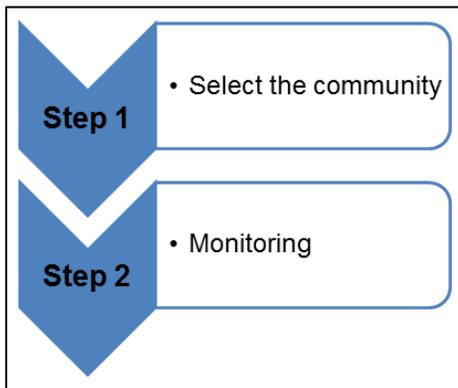The monitoring method adopted for this study was based on the following steps shown in Figure 2.

Figure 2. Steps of the method.

2.1 First Step – Community selection

The community was selected based on three key parameters: (i) an area of high or very high landslide risk sectors; (ii) a community organization and/or (iii) the presence of Civil Defence Nucleus. Since, Vila Nova Esperança, which is in the division of the municipalities of São Paulo and Taboão da Serra met all the necessary parameters it was chosen for this study. Before the implementations of the monitoring program, the community leader, Ms. Maria de Lourdes, better known as Lia was contacted and approved the study.

Landslide risk map were made by IPT in 2006 and 2010 (Figure 3). In Vila Nova Esperança high and very high sectors were mapped (Figure 3).
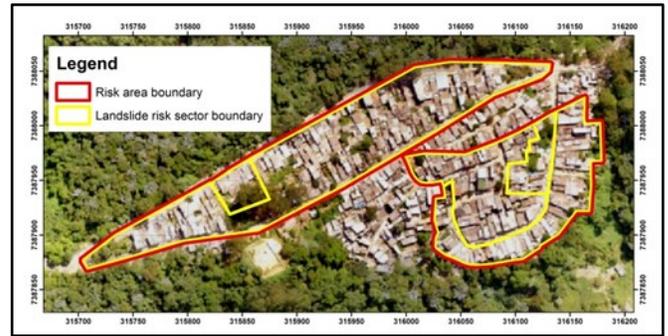
Figure 3. Landslide risk map.

2.2 Second Step – Monitoring

There are different types of monitoring that are related to the objectives, the process to be monitored, the scale, scope and methodology employed.

For this study, the community monitoring was adopted in order to empower local residents to observe their territory. Even though the scope of this type of monitoring is small, it provides knowledge of the processes that operate in the territory and becomes a mechanism to identify changes in it.

Depending on the scale of work and the resources used in the monitoring, it is possible through comparative procedures to observe changes in the slope like trees, poles, walls position; breaking in the terrain or in dwellings, release of water served and sewage on the slopes among other features indicative of terrain movement.

In this project, community monitoring was based on modern technologies of free use and widely known and used by community residents.

To allow the interactions with broad range of local residents, the community monitoring was conducted by the resident's mobile phone and free softwares. Moreover, the community monitoring followed a simple protocol, wich involved four steps:

- Select the points;
- Systematically photographing with the use of the mobile phone;
- Send the photos weekly via Whatsup;
- Analyze the photos and identify the changes in the territory.

2.2.1 Select the points

The points for monitoring were selected together with the Community and according to the

high and very high landslide risks mapped to the Vila Nova Esperança (Figure 4).

It was select 7 monitoring points and 5 volunteer residents/families that live close to these points. The residents were trained to obtain the weekly photos for monitoring. Afterwards, they were trained to analyze the photos and identify the changes in the points and identify the signs prior to a rupture.

Figure 4 shows the points of monitoring and a brief description of them were in Table 1.
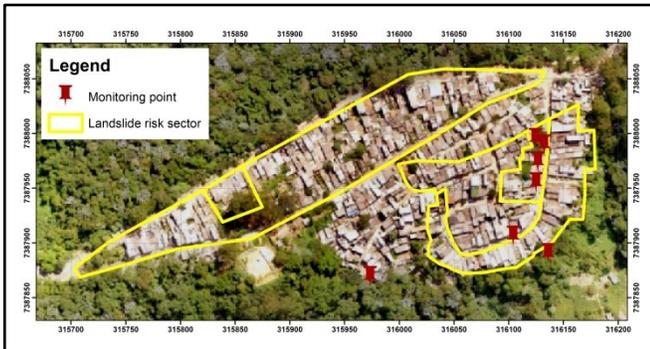

Figure 4. Monitoring points in Vila Nova Esperança.

Table 1. Monitoring Points, what to observe and the frequency of monitoring.

Point	What to monitoring?	Frequency
1	Trees and walls sloping, cracks in the ground and houses	Once a week and during and after the rains
2	Wastewater and sewage. Garbage and rubble	Once a week and during and after the rains
3	Movement features: walls and posts sloping, cracks in the ground	Once a week and during and after the rains
4	Movement features: walls and posts sloping, cracks in the ground. Wastewater and sewage.	Once a week and during and after the rains
5	Movement features: walls and posts sloping, cracks in the ground. Disposed water and sewage. Observed earth detachment	Once a week and during and after the rains
6	Movement features: walls and posts sloping, cracks in the ground. Disposed water and sewage. Observed earth detachment	Once a week and during and after the rains
7	Movement on the slopes and small slides Rainwater on the hydraulic ladder	Once a week and during and after the rains

2.2.2 Photographing systematically

After selecting the points, the volunteers for the monitoring were selected, the volunteers used to live near of the point.Tthe interest shown during the perception interviews and other important factors having a mobile phone and knowing how to use WhatsApp.

The volunteers who agreed to participate in the monitoring were trained to take the photograph. The monitoring objectives and its importance for risk management were also explained.

The photographs should be taken weekly and in case of rain more frequently. If possible, the photos should be sent immediately after they were taken so that the day and time could be recorded.

2.2.3 Send the pictures

The residents were trained to send the photographs by WhatsApp. Weekly they should send the photos to one specific researcher of the project. These were checked by the project researcher and stored in the specific folders of each monitoring point.

From the first moment, a process was established by with volunteers organized in WhatsApp groups, taking and sending the photographs.

The photographs were received and analyzed by looking at the following points:

- Chronological comparison of images;
- Evaluation of mass movements;
- Identification of the most critical points from the point of view of the threat.

2.2.4 Analyze the pictures

The method used to analyze the photographs was qualitative. Each week the photos were compared in order to verify if there were any changes in the monitored object. The changes that should be observed were sloping trees and walls, cracks and steps on the slope.

3 RESULTS AND DISCUSSION

The co-operative monitoring began in mid-October. We started the monitoring with four residents. However, other residents from other areas of Vila Nova Esperança showed interest in participating in the monitoring in areas that they believed to be critical.

Table 2 shows the start and the end of monitoring for each point.

Table 2. Start and end of the monitoring.

Point	Start	End
1	10/11/18	10/19/18
2	11/09/18	03/08/19
3	10/11/18	02/06/19
4	10/27/18	12/15/18
5	02/04/19	03/12/19
6	10/19/18	03/08/19
7	10/04/18	-

3.1.1 Point 1

The point is in a very high risk area, since the dwellings were built on the landfill slope, the resident, due to his social vulnerability, was not able to continue the monitoring.

Figure 5 shows the photographs of the monitoring. The visual comparison between them allows us to conclude that the crack in the wall of the neighboring property did not evolve from one week to another.

Figure 5. Crak in the wall border.

3.1.2 Point 2

The monitoring point of the lane allows an analysis of the garbage and construction waste disposal in the lane. The construction waste hinders the function of rainwater drainage system. (Figure 6).

Figure 6. Garbage and construction waste disposal in the lane.

3.1.3 Point 3

Placing plastic canvas on a cutting slope after a rupture is a constant action in Brazil and cannot be different in Vila Nova Esperança. So at this point we can infer that a landslide has already occurred in the past (Figure 7).

Figure 7. Plastic canvas in an old landslide.

3.1.4 Point 4

Another important observation point is the slope behind the house. The vegetation did not allow identifying a broken pipe throwing sewer in the cut slope which culminated in the slope rupture.

Figure 8. Cut slope behind the house.

3.1.5 Point 5

This point was located at the top of the cut slope. During the monitoring time any changes or indications of movement was observed (Figure 9).

Figure 9. Slope view.

3.1.6 Point 6

This point was intended to monitor the release of disposal water and sewage in the top of the slope. Note that the garbage was cleaned (Figure 10).

Figure 10. Garbage in the top of the slope.

3.1.7 Point 7

This point is located at the area of expansion of the community inside the forest. In the photos sent it is possible to notice that within one month a new house was built where a Kombi was (Figure 11).

Figure 11. New house built in one month.

Through their participation in this process, community researchers demonstrated that residents in popular neighborhoods, with adequate technical instruction, are able to participate in a system detailed monitoring of landslide.

Community researchers took part in the experience to improve the community and because they understood the importance of the process.

During this experience, lessons were learned about the limitations with this type of community participation, and about possible ways in which they can be optimized.

4 CONCLUSION

The monitoring of the risk areas of the Vila Nova Esperança community carried out by the residents is extremely important, especially to increase their perception of the landslide risks and risk management.

The systematic analysis of the photos lead to the empowerment of the community front of the Public Authority, since they have domain of the risk issues to which they are exposed. It provides subsidies for the discussion of the interventions solutions that can be carried out by the community itself as well as those that should be proposed by the Public Authority.

Monitoring has proven relevant, since the community is engaged and concerned with the risk issue of.

The project facilitated the understanding of the territory by the community residents and the recognition of the risks, which they are exposed to. With this knowledge, possible actions as well as given responsibilities of each individual become more evident to the residents. Thus, together, both (institutions and community) selected 7 critical points/locations that potentially could be triggering points of a landslide for

collaborative monitoring. Residents who took an interest and agreed to participate were responsible to take photographs of a certain location and send them via WhatsApp mobile phone app. After, those who follow up with monitoring were trained to analyze and interpret as changes over time displayed in each photograph. Based on the knowledge jointly developed with the community leader and residents, they have initiated various mitigation actions to reduce the high landslide risk in the particular area near Progresso Street.

5 REFERENCES

Bhattamishra, R. and Barrett, C. B. (2010) *"Community-Based Risk Management Arrangements: A Review"*. World Development, 38 (7): 923-932.

Raw, R. (2016) *"Community-Based Risk Reduction"*. Oxford Research Encyclopedia, Natural Hazard Science. Online Publication. Doi: 10.1093/acrefore/9780199389407.013-47.

Instituto de Pesquisas Tecnológicas-IPT (2007) "Reavaliação do mapeamento de áreas de risco no municipio de Taboão da Serra (SP)". Relatório Técnico nº 94273-205.

Instituto de Pesquisas Tecnológicas-IPT (2010) "Análise e mapeamento de riscos asociados a escorregamentos em áreas de encostas e a solapamentos de margens de córregos em favelas do municipio de São Paulo – Subprefeitura Butantã". Relatório Técnico nº 119708-205.

Smith, H., Coupe, F., Medero, G. M., Acosta, J. H. C., Garcia-Ferrari, S., Montoya, C., Velásquez, C., Castro, W. Ce., Rivera, H. (2018) '¿Resiliencia o Resistencia? Mitigación negociada de los riesgos de deslizamiento en asentamientos informales en Mdedellín". Informe de Sínteses.

United Nations Human Settlements Programme- UH Habitat (2018) *"Working for a Better Urban Future: anual Progress Report"*.