



Two Brazilian experts involved in climate vulnerability and risk mapping showed participants how such exercises have been carried out in large cities in the country, and why they are so important. Practitioners from Africa, Asia and Latin America discussed whether risk mapping has been carried out in their cities, whether there has been a climate focus and the challenges that need to be overcome for mapping to be more effective.

CLIMATE VULNERABILITY AND RISK ASSESSMENTS AT THE CITY LEVEL

SUMMARY

Discussion 2 of the online learning exchange focused on how to identify and map climate related risks and threats to a city; the premise being that it is necessary to understand the local reality in order to best prepare for how to cope with extreme events and climate change. Dr. Martha Barata, who was involved in the climate risk mapping carried out in the State of Rio de Janeiro, and Dr. Andrea Young, who was involved in a more detailed exercise in the city of São Paulo, shared their perspectives, giving details of the methods used and the importance of such exercises. Based upon their own experiences, Learning Alliance participants commented on what makes local risk assessments effective, what types of data are valuable, and barriers encountered to consistent climate risk mapping.





Key Conclusions

The online learning discussion suggested the following key conclusions related to climate vulnerability assessments and mapping in African, Asian and Latin American cities:

- Successful mapping exercises will likely involve multi-stakeholder groups, including community members, will be backed with political support and integrated into city plans
- Quantitative data from community members is extremely valuable because they best understand the local reality of risks
- Lack of political concern for climate issues in cities, and the resultant lack of funding for climate initiatives, is a major barrier to meaningful urban climate risk mapping. Climate change continues to be considered a rural issue in many areas
- Risk mapping alone is not enough, because often community members continue to occupy high risk areas; risk mapping should therefore be accompanied by awareness campaigns and strict monitoring of land use

CONTENT

Discussion - Urban Climate Vulnerability and Risk Assessments

[Page 3](#)

Interview with Martha Barata from the city of Rio de Janeiro, Brazil

[Page 7](#)

Interview with Andrea Young from the city of São Paulo, Brazil

[Page 9](#)



Discussion: Urban Climate Vulnerability and Risk Assessments

Learning Focus

Discussion 2 of the Learning Alliance on Climate Resilient Cities focused on urban vulnerability and risk assessments in the light of climate variability and climate change projections. In cities in Latin America, there is an increasing trend to map risks and vulnerabilities geographically, in order to understand where to focus attention. Case studies from Rio de Janeiro and São Paulo, Brazil, were used to exemplify this trend. The reason being that in order to increase urban climate resilience it is necessary to understand which risks pose the greatest threats and in which areas of the city, and thus identify which segments of the population are most vulnerable to climate change.

The purpose of this discussion was to identify whether cities throughout the global South are also mapping vulnerability to the changing climate in ways similar to those seen in Brazilian megacities. What is more, participants were encouraged to consider the elements that make risk mapping effective, and identify barriers to climate vulnerability mapping in their respective cities.

Discussion 2 was guided by the following questions:

1. Are similar climate vulnerability and risk assessments being developed or undertaken in the cities that you live and work in? If so, how might the results be utilised to improve climate resilience?
2. If climate vulnerability and risk mapping is a new concept for you, how might your city go about carrying out such an exercise? What might assist or hinder the undertaking of such an exercise?

Latin American Case Studies

For this discussion, case studies from the two largest cities in Brazil were presented to the Learning Alliance participants. In order to provide direct insight, interviews were carried out with Dr Martha Barata and Dr Andrea Young, both key players in the climate vulnerability mapping carried out in the State of Rio de Janeiro and in São Paulo respectively. Both interviews are included at the end of this document.

Discussion Participation

Twenty-one countries were represented in this discussion - 8 African, 4 Asian and 6 Latin American - with contributions from 46 participants.

Summary

There was a mixed response to the question on whether or not exercises like the climate vulnerability mapping of Rio de Janeiro and São Paulo were being implemented in participants' countries. We learned that some cities, including Guwahati, Indore and Surat (India), Ho Chi Minh (Vietnam), Kampala (Uganda), and La Paz (Bolivia), had



indeed developed climate vulnerability maps; some cities had carried out a range of mapping exercises without a climate change focus or without covering the whole city; while other cities had not carried out any risk mapping. A range of actors were responsible for leading these exercises, including government, academia and NGOs.

Even in cities where mapping had been carried out participants felt that further steps need to be taken to genuinely reduce climate risk.

“The local government of La Paz, Bolivia, has made efforts in developing vulnerability and risk maps...these maps are used to develop policies and regulations that help to determine where to expand the city and where to allow construction and where to limit the same...However, in practice the new informal neighbourhoods do not follow the rules and are located in these risky areas”

*- Alan Octavio Vera Valesco, Bolivia
Government Official*

When thinking about how to improve climate vulnerability and risk assessments, participants converged on the idea of involving multi-stakeholder groups, particularly local community members and sharing the results meaningfully with all affected groups.

In addition to involving community groups, participants felt it necessary for policy makers to support and initiate such exercises, and consequently integrate the results into city level climate change plans, such as those addressed in the [Discussion 1](#). Many participants agreed that climate change issues are not a political priority in their cities, and as such, investments in mapping exercises such as these are lacking. In countries such as Bangladesh, Brazil and India it was felt that a lack of coordination between government agencies is a significant barrier, and that if these agencies work together to make climate resilience a priority, then real progress would be made and risks would be better understood and addressed. In addition to these barriers, it was felt that specific skills and capability to map climate risks and vulnerabilities is lacking, because there is no training or demand.

It was suggested that public-private funding mechanisms would strengthen the credibility and reliability of such mapping exercises, because this would allow for specialists to be contracted, and furthermore would make risk mapping possible in many places where at present governments are not investing in climate mitigation or adaptation in urban areas.

Interestingly participants from Bangladesh, Ghana, Kenya, Nepal and Zambia commented on the fact that climate change is considered a rural issue, and as such, risk mapping and contingency planning is more common outside of urban areas.

“Very little attention has been given to the vulnerabilities of low income populations in urban centres in India. For example populations living in the slum areas are most vulnerable to the impact of climate change...until now most of the attention has been given to the rural population’s adaptation to the impacts of climate change.”

*- Manas Dwivedi, India
Civil Society, Disaster Management Expert*



In terms of how vulnerability mapping exercises should be carried out, there was much discussion about whether top-down approaches such as those seen in Rio de Janeiro and São Paulo are effective. Several participants noted that where vulnerability maps do exist, they are mostly used in academic circles and tend to be based on quantitative data. The Latin American experts interviewed for this discussion agreed that a major challenge is to get this information integrated into action plans.

“Vulnerability assessments in Zambia are mainly top-down surveys and there is urgent need to verify these assessments on the ground through community based vulnerability assessments.”

*- Willem Collenbrander, Zambia
Civil Society*

“For things on climate change to work we have to focus on practical solutions...The communities that are affected by climate change do not read literature and data; they are practical people and therefore appreciate practical solutions and suggestions.”

*- Adodo Adih-Nuviadenu, Ghana
Civil Society*

In some cases, climate vulnerability maps have been translated into specific programmes and actions to increase urban climate resilience. Divya Sharma from India shared information about the ACCCRN and TERI initiatives, which do just that. Links with more information on these initiatives can be found below.

Overall, it was felt that to improve the accuracy and usefulness of risk maps, both qualitative and quantitative data should be incorporated into the process. Qualitative data may be collected from many sources, but again participants stressed the importance of integrating information from the community because local inhabitants are the ones that best understand the reality of risks.

“It is important to incorporate other types of data collected through community risk mapping exercises... in order to bring out finer details to guide appropriate action”

*- Jorgelina Hardoy, Argentina
Civil Society*

The additional benefit of involving community members in the identification of risks is that they will be more likely to actively participate in actions aimed at reducing their vulnerability. Climate vulnerability maps and related action plans are meaningless unless awareness and understanding is raised in the community.



“Throughout my career, participatory methods have proven very instrumental in achieving greater success both in the planning and implementation phases of a project. Most importantly, they allow space for learning to take place and contrasting views to emerge.”

*- Tito Bonde, Mozambique
Disaster Management Consultant*

Key Lessons

- Across a range of African, Asian and Latin American cities comprehensive climate risk and vulnerability mapping is relatively rare. While some cities have transformed these maps into action plans, in many cases they remain in academic circles and are put to little practical use, only cover part of the city, or are non-existent.
- The barriers to climate risk and vulnerability mapping include a lack of urban political will to invest in reducing climate risk, a lack of skills and expertise and poor coordination between government agencies and other institutions. In various instances vulnerability mapping exercises had been carried out by academics, but the results were not translated into politically supported action plans. It is also the case that many governments in the global South consider climate change to be a rural concern.
- Both top-down and bottom-up methods should be used to source quantitative and qualitative data for climate vulnerability and risk maps. This process is more effective when a range of stakeholders are involved, notably community members whose involvement can help to improve the accuracy of maps and galvanise actions to reduce vulnerability at the local level.

Supplementary Materials

Participants were provided with the following resources in preparation for this discussion:

- [Video: Interview with Martha Barata - Rio de Janeiro](#)
- [Andrea Young: Mapping Risk and Vulnerability in Sao Paulo](#)
- [Andrea Young: Environmental-risk Mapping in 4 Cities in Brazil](#)
- [ELLA Climate Vulnerability Mapping](#)

During the exchange, participants shared additional resources and links to relevant organisations:

- [Surat \(India\) Resilience Strategy; Framework for City Climate Risk Assessments](#)
- [Planning for Urban Climate Resilience](#)
- [ACCCRN](#)
- [Ho Chi Minh City \(Vietnam\) Report](#)
- [Caribbean Participatory Approach](#)



Interview with

Interview with Martha Barata from the city of Rio de Janeiro, Brazil



Martha Barata acts as a strategic advisor for the Institute Oswaldo Cruz (IOC/Fiocruz), a scientific institution based in the City of Rio de Janeiro famous for its research and development in biomedical sciences. A leading expert in environmental economics, Martha originally implemented and coordinated the internal Commission for the Environmental Management of the institute.

Martha is also a member of the Urban Climate Change Research Network at Columbia University where she is responsible for coordinating the research group on climate change and the impact it has on urban health.

Briefly summarise the vulnerability assessments carried out for the state of Rio de Janeiro

Our study investigated the effects of climate change and the vulnerability of the population in the state of Rio de Janeiro. We assessed the vulnerability of each of the 92 counties in the state, so that they could be compared accordingly. To do this, we collected indicators on the environmental, social and health vulnerability of the population.

Why did you carry out this vulnerability assessment?

It was the Environmental Secretary of State that requested this study. For some time they had been implementing a climate change adaptation policy in the state of Rio de Janeiro. They understood that to prepare a good plan for adaptation policy and practice it is important to evaluate the vulnerability of the local population first.

What were the indicators that you considered?

Our vulnerability indicators considered health, environment and socio-economics. For the health indicators, we collected data on the most common diseases and those that are influenced by climate variation, such as dengue fever and infant mortality. In terms of socio-economics, we used income as a baseline. We also considered the way people live, including whether they have access to sanitation services, household size, type and construction materials, and access to mobility. Of course it was also very important to include the education and training of young people within this indicator, because they are the ones that will be acting in the future to reduce vulnerability. Finally, we considered the environment. For example, for the city of Rio de Janeiro we rated vulnerability according to the existence



of the coastline, the vegetation, biodiversity and number deaths due to extreme hydro-meteorological events. These were the main indicators, but they vary between locations. In fact, they are location-specific.

What were the outcomes of the study?

We identified the areas most vulnerable to climate change. In the case of Rio de Janeiro, we found Campos de Goytacazes was more vulnerable, and Búzios was less so. This knowledge provides an opportunity to plan improved forms of adaptation at the state and city levels. We presented the results to the Environmental Secretary of State. In the meeting various actors were present including city authorities, academics, NGOs and representatives of local governments. After this meeting, the Secretary presented the results to the various cities in the State. We now hope they are implementing adaptation actions based on our work.

What were the main challenges?

Major challenges included concerns about having adequate information, a robust database, and data that is scientifically accepted by the government. In addition, we did not carry out primary research, but used data that was already in existence, some of which was already out-of-date. Another challenge was the way in which we presented the results of the study. As I said, we presented the study in a meeting with the Environmental Secretary of State, but we did not make individual presentations to each of the 92 counties. This could mean that the results did not have the highest impact possible. Our presentation had an academic slant, because we are from the academia. So we realise that we need to find a way of disclosing the results in a way that is useful for the whole population.

What are the next steps?

The next steps of our work are, as I said, thinking about how to share the results in a way that is useful and applicable for the entire population. Before anything else, we must update the information. We presented the results in 2011 and we have since had a census, carried out by the Brazilian Institute of Geography and Statistics (IBGE). We are now updating our study with the results of this census and we then intend to share this updated information with the public.

Our first presentation was attended by the Secretary of Climate Change for the city of Rio de Janeiro, and he thought that similar mapping work would be very useful for planning adaptation actions at the city level. This work has been requested and we are now in discussions about how to get it up and running.



Interview with **Andrea Young** from the city of São Paulo, Brazil



Andrea Young is an architect with a PhD in Urban, Regional and Environmental Planning from the State University of Campinas (UNICAMP) in Brazil. She is a specialist in Remote Sensing, Geographic Information Systems (GIS), demographic analysis and public policy (in Brazil). In 2010, Andrea was a post-graduate professor in Geographic Information Systems for Social Science at UNICAMP.

Why are vulnerability assessments for climate change important in cities?

In the case of Brazil, despite increased awareness since Rio 1992 (the Earth Summit), the health of Brazilian urban areas had deteriorated at an unprecedented rate. The population in urban areas has grown (about 80% of the total population lives in urbanised areas), where social inequality is very high. The national government has focused on economic growth without controlling air pollutants, water contamination, toxic waste sites and waste of energy. Over the last decade, a series of disasters occurred causing a significant number of deaths in different states including São Paulo, Rio de Janeiro and Santa Catarina; many of them caused by extreme events associated with climate change. The challenge now is to go beyond responding to disasters, to shaping environmental cities. Within this perspective, vulnerability assessments are very important for identifying areas at risk, taking action and reversing this situation. In Brazil, no city has a structure that is sustainable, but for the first time in history, the outlines of what a sustainable city would look like are becoming clearer. Definitely, risk needs to be reduced and this will involve reducing poverty and social inequality. Adaptation and mitigation constitute part of this urban restructuring; it is a process of no return, to which which any economy is hostage since natural resources are used without any accountability. Using Geographic Information System (GIS) and mapping tools such as Digital Elevation Models (DEM), it is possible to identify the main areas affected by floods, landslides, and outbreaks of disease.

What led the metropolitan area of São Paulo to map urban climate vulnerability and risk?

There have been an increasing number of disasters caused by intense rainfall; the possibility of urban system collapse (days of chaos and incalculable losses) with damage caused to road systems and other infrastructure generated interest in such a study. The British Embassy wanted to fund a study and a



group of research institutions came together to respond to the call - the National Space Institute ([INPE](#)) within the Ministry of Science and Technology, along with the University of São Paulo ([USP](#)) and the University of Campinas ([UNICAMP](#)).

How was the mapping conducted?

The universities started research into climate vulnerability at the beginning of 2009 after consultations with local government. A local government advisor working on environmental and climate change issues worked closely with the research team. The British Embassy funded a series of fora with other institutions and NGOs that helped with the approach and research concepts. The objective of the study was to evaluate climate vulnerability at specific geographic locations based on social and environmental indicators and to produce different predictive risk maps for the São Paulo Metropolitan Area (SPMA). Within this perspective, these maps integrate meteorological (i.e. precipitation, temperature, humidity, etc.) and public health information (i.e. floods and landslides cases, hospital admissions, number of deaths, etc.). We evaluated the geographical areas that are most likely to be at risk (based on climate change hazards). We used ArcGIS to integrate the spatial information and non-spatial attribute data, where each spatial feature and its attribute information were linked. The ArcGIS also provided a module to perform mathematical operations in order to analyse the geographical patterns (i.e. land use, slope, soil and hydrography) and trends of the region (i.e. precipitation, floods). As a result, different vulnerability maps were produced based on risk evaluation (i.e. flood, landslide, health risk). Many agencies, local government, and universities participated in forums and discussions about the analysis and results.

When we presented these maps to local authorities, they wanted to know what might happen in the future and what a future city might look like. At this point, we decided to produce an urbanisation scenario map for São Paulo, projecting city growth up to 2030, so that city authorities could understand which new areas could be affected by climate change.

What were the strengths of the mapping tools that you used?

The integration of meteorological and socio-environmental data. We used very detailed meteorological data and matched it up with social data collected in the same period. It was hard to find data about which areas suffered from a lack of water, and for that we used satellite imagery. We integrated data from many different sources, from institutes that do not usually coordinate with one another.

What were the challenges?

The challenges were also largely to do with the integration of data, it was a very complex task. In addition, there was the challenge of working with the different public bodies that do not work together in a coordinated, integrated manner.



What were the results of the mapping exercise?

The results were delivered to the National Council for Scientific and Technological Development (CNPq), the Foundation for the Support of Research of the State of São Paulo (FAPESP), the Climate Network (Rede CLIMA), the City Hall of São Paulo, the [British Embassy](#), the National Space Agency ([INPE](#)) (which published the data on its website for the general public) and Campinas State University ([UNICAMP](#)).

The city government said that it would use the different maps in the development of climate change legislation, building codes, and when thinking about investment in expansion of the city. As of yet, we have not seen any concrete actions, but in fact a medium to long term change is needed within the city, and thus we hope to see results in the coming ten to twenty years.

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To learn more about the Learning Alliance on Climate Resilient Cities, or any of the specific themes raised in the Learning Alliance Highlights, contact the author and Learning Alliance moderator, Charlotte Olivia Heffer, ELLA Brazil Project Coordinator at the Environmental Laboratory at the Federal University of Rio de Janeiro (UFRJ), at charlotte@lima.coppe.ufrj.br.

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