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Flood Disaster Risk Reduction at municipality-scale in Rio de Janeiro State

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Introduction

Floods constitute an important type of disasters in the state of Rio de Janeiro. During the period from 1991 to 2012, 190 floods were recorded in the state that resulted in several damages and deads. The features of urban pressure under the Rio de Janeiro watersheds have intensified the damages caused in recent years. These features are: deforestation of the river banks, unauthorized modifications of the river course, accumulation of garbage in the water bodies as well as land occupation in the high risk areas. Additionally, several municipalities still ignore and even encourage the occupation in risk areas, disrespecting the environmental and urban legislation.

In this context, a key issue is: **In what extend, the weak inclusion or/and implementation of the flood risk in master plans and environmental (state and local) and urban (municipal) licenses have contributed to increase environmental disasters in the state of Rio de Janeiro?**

1. The 2011's disaster in *região serrana*: a learning process leading to modify environmental and urban policies in Brazil

In January 2011, the *região serrana* (mountainous region) of the state of Rio de Janeiro was hit by an atypical phenomenon of heavy rains that lasted more than 10 days. As a result there was a combination of floods, mudslides and landslides mass, resulting in a disaster with catastrophic proportions over 1,000 deaths and more than 30,000 affected.

Figure 1: Areas affected by the disaster in the mountainous region of Rio de Janeiro (January 2011)

The experts identify two increasing factors of the damages caused by disasters:

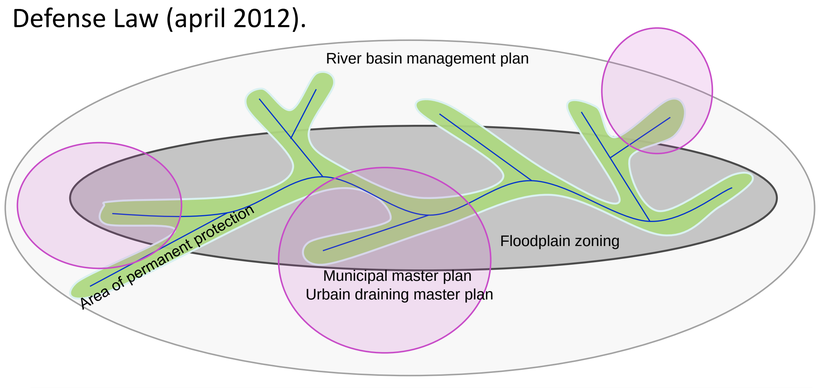
- failure to take account of the flood risk in the master plans, as well as in planning and environmental licenses
- lack of land use control.

Although traumatic for the people, the tragedy in the *região serrana* initiated a learning process leading to modify environmental and urban policies in Brazil at once at federal, state and municipal levels.

2. A new framework for flood managment in Brazil

2.1. The National Policy for Prevention and Civil Defense

Since the disaster in the *região serrana*, the federal government defined several measures for protection, recovery and disaster prevention through the National Policy for Prevention and Civil Defense Law (april 2012).



	Regulatory tools	Reference area	Legislation	Reponsible institution
	Area of permanente protection	River banks	Forestry Code (Federal Law n. 12.608/2012)	Environmental state institution Environmental national agency
	River basin management plans	River bassin	National policy of water resources (Federal Law n. 9.433/97)	Basin committee
	Floodplain zoning	Floodplain	National Polity of Civil protect and defence National policy of water resources	Environmental state institution Urbanism municipal institutions
	Municipal master plan Urban draining master plan	City	Master plan (Municipal Law) National polity of basic sanitation (Federal Law n. 11.445/07)	City government

Figure 2: Regulamentary tools and related areas and institutions

This new framework in the Brazilian Urbanism Code requiring that municipalities review their master plans taking into account flood risks previously mapped, and their *compatibility* with the plans of water resources defined at the watershed scale.

This measure is essential because many existing regulatory tools related with water and risk applied partially or totally on the same territory but through different philosophies of action. For instance, as stated in figure 2, urban rivers banks are regutated by 4 different tools: river bassin management plan, floodplain zoning, municipal master plan and area of permanente protection. The global coherency is then a key issue.

2.2. Application to *região serrana* (Rio de Janeiro)

The state government of Rio de Janeiro with financial support from the federal government and collaboration of the municipal government held several emergency measures to recover the affected areas in região serrana, as well as measures to reduce the risk of future floods. These measures are structural (such as dams or river banks recovery) or non structural (such as vulnerability map) and involve different types of actors (see table1).

Table 1: Status and scales of flood management measures in *região serrana*

Measures	Type of measures		Type of actor					Achievement				
	S	NS	FG	SG	MG	PP	PS	BD	AD	SD	IP	NP
Flood areas maps		X		X					X			
Vulnerabitily map		X		X					X			
Floodplain zoning		X		X					X			
Evacuation plans with community participation		X		X					X			
Training of community agents		X							X			
Contingency plan to civil protection		X			X				X			
Exercise in disaster preparedness		X			X				X			
Floodplain parks for public use	X			X					X		X	
Risk information		X		X	X					X	X	
hydrometeorological monitoring		X								X		
Early warning system		X								X		
Dredging rivers	X			X						X		
Residential demolition on floodplain	X			X					X			
Built houses to relocation	X		X						X			
Dam and other water works	X									X		
Recovery of river banks	X			X					X			
Consideration of flood risk in the local planning		X			X						X	
Reforestation of river banks	X			X	X						X	
Flood insurance		X				X	X					X
Rugged construction / adapted to flooding	X					X	X					X
Adaptation in urban infrastructure	X					X						X
Monitoring the evolution of the occupation of risk areas		X			X	X					X	
Urban draining master plan		X			X						X	
Research about flood risk management		X		X	X	X	X				X	
River basin management plans	X			X				X				

Type of measure: S - structural; NS – non-structural,
Actor type: FG – federal government; SG – state government; MG – municipal government; PP - population; PS - private sector.
Achievement: BD - before the disaster; AD - after the disaster; SD - strengthened after the disaster; IP - in progress; NP - not performed.

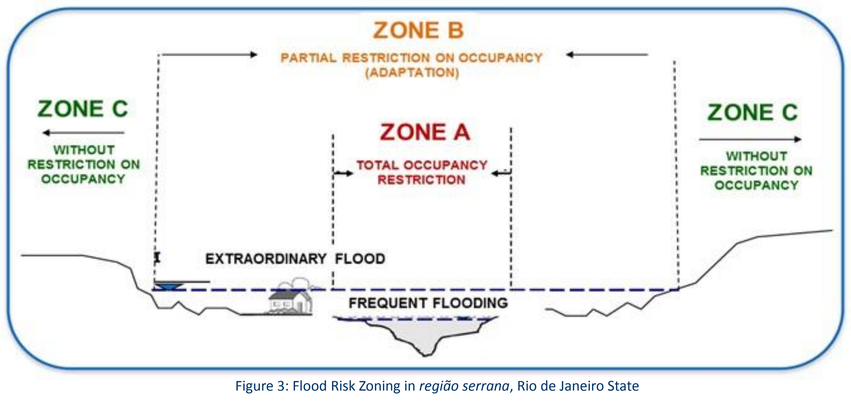


Figure 3: Flood Risk Zoning in *região serrana*, Rio de Janeiro State

All these measures contribute to prevent from or better manage flood disasters. However, many of them have been defined only for affected areas by the 2011 disaster: the other risk areas of the state of Rio de Janeiro still remain vulnerable.

Moreover, some of the risk areas affected in the 2011 disaster have been reoccupied by the population, demonstrating the inability of the affected municipalities to regulate and control the occupancy of their territory.

3. A policy marked by institutional complexity and fragmentation of responsibilities

The integrated management approach adopted by the new brazilian policy of protection and civil defense gave new dimension to the flood risk management (FRM) including several institutions (federal, state and municipal) in this process.

However, despite setting responsabilities to the three levels of government (federal, state and municipal) the new legislation does not specify to what extent each is responsible for shared obligations.

To illustrate this phenomenon, the following table presents the main institutions currently involved in the issue, as well as its basic tasks or actions in this regard, its main subject areas, the stage of FRM which involved, and the nature of their participation (P - planning, E - execution, C - control).

Table 2 institutions involved at flood risk management in Brazil

Authority / Institution	Scale Level	Function	Stages of FRM				Subject area								
			Prevention	Protection	Crisis management	Post-crisis management	permission to build	Build housing for homeless	Water management	Environmental license to build	Protected areas	Solid Waste	Information and communication	Defence and Civil Protection
National Department to Civil Defense (SEDEC) / Ministry of National Integration (MI) • Civil defense actions • Consolidation of hydrometeorological monitoring data (National Center for Risk and Disaster Management - Cenad)	F	P / E			X	X							X	X
Center for Monitoring and Alerts Natural Disasters (CEMADEN) / Ministry of Science, Technology and Innovation (MCTI) • Natural disasters forecast	F	P	X										X	
National Geological Service (CPRM) / Ministry of Mines and Energy (MME) • Hydrometeorological events maps	F	P	X			X							X	
Ministry of Health • Assistance to affected people	F	P / E			X	X						X		
Ministry of Cities • Urban Infrastructure works • City Planning Policies • housing construction in risk areas	F	P / E	X	X			X	X				X		
Chico Mendes Institute for Biodiversity Conservation (ICMBio) • Creation and management of protected areas	F	E / F	X								X			
Secretary of State for the Environment (SEA) • Environmental policies to risk areas	E	P	X	X					X	X			X	
State Environmental Institute (INEA) • Demarcation of protection area • floodplain maps and risk areas zoning • Environmental licenses and fiscalization	E	E / F	X	X					X	X			X	
State Department of Civil Defense • civil defense actions	E	P / E / F			X	X							X	X
State Department of public works • Recovery and reconstruction of affected areas	M	P / E / F		X						X	X	X		
Municipal Civil Defense • Civil defense actions	M	P / E / F			X	X							X	X
Municipal Department of urbanism •Built permits / licenses •Master Plan and zoning	M	P / E / F	X				X							
Municipal Department of environmental • Environmental License to built and environmental monitoring	M	E / F	X							X				

However, the flood prevention is not the primary mission of some of these institutions. In addition, they have different scales of action, focused on different subject areas, and so, inter-institutional coordination is still a challenge in the Brazilian reality.

Moreover, the lack of clarity of the specific role of the state and municipality in the different FRM stages has led to inaction by some institutions.

For example, this occurs with the mapping of flood risk areas. According to federal legislation, it should be discussed in a collaborative way by the municipality and a state (or federal if not possible) institution. However, the legislation does not precise which of them should perform it.

Perspectives

The lack of clarity of the Brazilian legislation in precisely defining the responsibility for risk areas mapping (state or municipality), has resulted in the absence of this information in many Brazilian cities, impeding the effective implementation of a preventive policy where flood risks are considered before the granting of environmental and urban planning permits.

Even after the disaster in the *região serrana*, some environmental agencies (state and municipal) continue licensing builts in flood areas, as well as the city planning agencies (municipal) continues to award licenses for the urbanisation in these risk areas.

In this context, this research adopts the following hypotheses:

- The lack of regulation by municipal legislation regarding the restriction of the use and occupation of land in flood risk areas as well as the disregard for environmental and town planning legislation (federal and state) expose the local population to disasters caused by heavy rainfall or prolonged.

- The lack of a clear definition of responsibility of each of the levels of government (federal, state and municipal) in certain stages of flood risk management and the multiplicity of actors involved in this process complicate the implementation of an effective flood prevention policy in the Brazil.

Considering the particular case of disaster in the mountainous region, the municipality of Teresopolis has been chosen as case study to check the hypotheses of the research by analyzing the actual implementation strategy of the new brazilian policy on flood risk management at local scale.