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URBAN STORMWATER FLOOD MANAGEMENT IN THE CORDEIRO WATERSHED, SÃO PAULO, BRAZIL: ARE SOCIO-POLITICAL ASPECTS INCORPORATED INTO THE TECHNICAL INTERVENTION?

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ABSTRACT: In the urban Cordeiro Watershed, São Paulo, Brazil, impervious surface has reduced stormwater infiltration and the drainage system has become insufficient. Engineering firms have been contracted, under government supervision, to design and implement the construction of six water reservoirs to reduce the frequent flooding impacts. The main purpose of this article is to contribute to the study of the relation between technical and socio-political aspects of urban stormwater drainage, as technical solutions alone have been considered not sufficient. A research carried out shows that local actors see themselves as responsible for the main cause of urban stormwater flooding – solid waste dumped in public places – and that they construct protective infrastructure in their homes and businesses. However, no effort is made by the constructing firms, or by the local government, to involve them in strategies to increase the benefits of the engineering technical solution and meet the collective interest. Relevant literature suggests that attention given to social-political complexities during planning and construction of technical solutions and a stronger interaction between technical staff, social actors and local government offer an opportunity to evolve from individual self-reliance into a collective strategy of resilience, enhancing the effectiveness of flood risk management practices.

Key Words: Resilience; Flood Risk Management; Socio-political; Urban Stormwater.

1. INTRODUCTION

Once water returns to safe levels after a flood, community life too returns to its normal. Future critical events are neither envisaged nor prepared for. In general, residents and business people have other immediate priorities and newly elected local government officials are rarely willing to get involved in vulnerability issues of local communities, as this might impact negatively on the required investments and further economic growth (Cutter et al. 2008). As a major individual and spontaneous action of self protection, quite often the urgency of taking individual defence, avoiding losses and further damage due to floods, does not allow for systematic collective arrangements. These would, however, be needed to reduce future disaster risks. An approach integrating technical and socio-political aspects of urban flooding events is suggested by the literature as the hydraulic technical engineering solution alone is not a definite solution (Frerks, et al, 2012) and, therefore, might not bring the expected collective benefits.

The objective of this article is to explore how the incorporation of socio-political aspects into the implementation of drainage infrastructure interventions, as the water reservoirs in urban watersheds, is being achieved. A literature revision and a research conducted in São Paulo, Brazil, suggest ways to transform the implementation of individual solutions towards a collective action. The purpose is to meet the public interest through strengthening the interaction between residents and business people located in a watershed frequently hit by floods, engineers and technical staff responsible for the construction of the drainage infrastructure interventions and the local government, and maximise the benefits of the technical solution.

2. SELF-RELIANCE EVOLVING INTO RESILIENCE

Feeling capable of protecting family and/or property during critical events, such as floods, and the ability to do so, are the two sides of *self-reliance*. On the other hand, the concept of *resilience* denotes a more systemic, structural, collective and long-term quality, present (or to be promoted) at different levels of social organisation (Frerks et al. 2012). Resilience has been analysed in a variety of approaches: in connection to social vulnerability (Oliver-Smith et al. 2012); as a strategy for disaster risk reduction through the capacity to absorb stress or destructive forces through resistance or adaptation, to manage or maintain certain basic functions and structures during disastrous events and to recover or 'bounce back' after an event (Twigg 2007); as a set of adaptive capacities to prepare for when disaster strikes and for functioning and adapting in the post-event (Norris et al. 2008); as the ability to prepare and plan for, absorb, recover from or more successfully adapt to actual or potential adverse events (Cutter, 2010); as the shared capacity (of a group, community, society) to anticipate, resist, absorb and recover from an adverse or disturbing event or process through adaptive and innovative process of change, entrepreneurship, learning and increased competence (Frerks et al. 2012); and as a more pro-active and positive expression of community engagement in natural disaster reduction (Cutter 2008).

Resilience, then, involves more than just returning to the former state by individuals in isolation. Increased learning and competence leads to increased sustainability which calls for a connection among the main stakeholders affected by stormwater drainage risks and responsibilities – policy makers and government authorities, technical experts engaged in construction work, residents and the private sector, strengthening social networks (Clark 2012). This connection is needed as stakeholders' views about risk and safety differ: residents and the private sector have their own perception because they are located in the area where the problem occurs and suffer its direct impact; decision-makers tend to use a cost-benefit approach; and experts tend to face the problem from a technical-risk point of view (Kolen et al. 2012).

In isolation, these different stakeholders often do not consider the others' perspective. This is crucial, as resilience implies evolving from an *individual* self-protection strategy to a *collective* effort, when collective and public interest are taken into consideration. Individual self-protective or self-reliant action might lead to a lack of perception of externalities, whereas collective action, by contrast, may well lead to a more durable and sustainable solution, social learning and improvements. From this perspective, self-reliance is seen as a first step to organised action and community *resilience*.

As a process of collective learning aimed at attending the public interest, resilience involves the interaction of all parties interested in safety strategies, in the durability of implemented works and in social action. It includes the perception of disaster risks; it results in learning from past experience, present attitudes in relation to the event, values and future expectations, besides the crucial organized community preparedness. Research carried out by Souza (2011) in an area affected by extreme drought in Northeast Brazil revealed that those who had gone through past experiences concerning drought and its impacts showed a lower sense of fear about the impacts than those who had never been in such a situation. Likewise findings by Shippee et al.(1982 *in* Kirschenbaum 2004) and Kirschenbaum (1992) suggest that residents outside a flooded disaster area fear for their lives and property at higher levels than households much closer to the actual danger zone. Those who have been systematically hit by 'natural' disasters are likely to respond to them in a more organized way, will be better able to develop strategies and learn from experience about how to protect themselves from future events. Their drive for safety tends to enhance motives and feelings of solidarity, trust and support among those situated in the disaster area, and sets the stage for a stronger social-cohesion.

3. FLOOD EVENTS IN SÃO PAULO CITY

Stormwater flooding in the city of São Paulo has been affecting families, businesses, transportation and the environment, besides other impacts on social and economic organisation. The city is located in one of the larger regions considered among the global hotspots for hydrological and drought disasters risks (Dilley et al. 2005). Flooding is a recurrent problem, and investment in technical interventions has become a priority. In the City's Pluriannual Plan 2014-2017, recently sent to Sao Paulo`s City Council for approval, investment in stormwater drainage infrastructure represents 13.16% of all planned investments, while

both housing construction and investments in equipment to improve access to education correspond to 6.81% each and investment in health care to 6.34%.

Among other initiatives, a city Drainage and Stormwater Management Master Plan (FCTH, 2011) is being developed. An evaluation of the present macro-drainage system and a proposal for the implementation of structural and non-structural solutions for the reduction of flooding impacts in the short, medium and long terms have been accomplished during the first phase of the Master Plan elaboration. Also a capacity-building programme for managers and technical staff focussing on the incorporation of socio-political aspects in drainage is proposed as well as a programme for the involvement of residents and local government officials in practices that help improve the drainage public works to be constructed. Involving residents in specific practices is seen as crucial, as evidence shows that the dissemination of information and of knowledge alone does not transform attitudes or behaviour (Constanzo et al. 1986; Kaplan 2000; Madajewicz et al. 2007). Actions for the involvement of residents, private sector people and other groups located in risk-prone areas in a systematic disaster risk reduction programme with a view of implementing a disaster resilient community (Twigg 2007) are needed and the Master Plan brings an important contribution in this regard.

Do flood risk management mechanisms give attention to social-political aspects and open space to achieve resilience in watersheds hit by frequent floods and where technical interventions are being implemented? Answers to this question are explored in the next sections.

4. THE RESEARCH GEOGRAPHICAL FOCUS: THE CORDEIRO WATERSHED

Located in the Southern part of São Paulo city, the Cordeiro Watershed covers an area of 15.9 km^2. While part of the Cordeiro stream has been paved over, making it an underground flow, pockets of the stream remain open. The exact population located in the watershed is not known, as census information is available only for the districts that have some of their area in the watershed.

Due to ongoing urban land occupation and soil sealing, the stormwater flow has increased over time obstructing both the natural and constructed drainage infrastructure. Government omission in regard to the occupation of environmentally protected and risk areas by residents and the private sector is a common feature in the Cordeiro watershed. Flooding occurs frequently during the summer months (from December until end of March) with an impact on households, commerce, transportation and social and economic life in general.

In 2007, the city government contracted engineering firms to design a project, under government supervision, that would help reduce flooding impacts. The project involves, mainly, the construction of six water reservoirs spread out over the length of the Cordeiro watershed and its implementation has started in 2013. According to PLANSERVI, the engineering firm contracted by the Municipality of São Paulo for the elaboration of an Environmental Viability Study, EVA in Portuguese, the total amount of water to be retained is meant to reach up to 256,571 m^3 (PLANSERVI 2010). If from the technical point of view this may be a small intervention, it may well have a significant impact for households and commerce.

The EVA characterises the population located in the Cordeiro watershed according to three different regions. This characterisation was considered sufficient for the purposes of the environmental viability study[1] and was used by the research carried-out in the area which is the object of this article. Further characterisation resulted from the research itself: the illiteracy rate in each one of all three regions – 30% in Region 1, 22% in Region 2 and 7% in Region 3; the general proportion of homes and businesses owners in all three regions – around 57%; and the proportion of residence owners – around 71%. The latter reflects a general trend in Brazil, where the incentives to home ownership predominate, a theme

[1] No official density or other data for each one of the regions is available, as the census does not cover the limits of a watershed – which may cover areas of different districts – let alone of the neighbourhoods forming these three regions.

discussed by Kowarick (2009) in his *Living under risk: about socioeconomic and civil vulnerability*: to own a house is more important than the conditions of the houses' infrastructure. A visit to the site reveals the striking differences between the various regions, as illustrate in Figure 1.

Region 1 – presents the highest population density in the intervention area, most houses are precarious, often located in irregular settlements and risk areas, along the borders of the Cordeiro stream, and not connected to water supply or sewage networks; domestic and solid waste is usually dumped in public areas; urban pests are common; commerce is mostly limited to local clients, and public transportation is available only in the main avenue. Illiteracy prevails among 30% of the population.	
Region 2 – population density is not so high, most houses are brick houses, economic activities are more diversified, and some buildings are of a social and even high standard. Economic activities are more developed. The Nabuco Park is the largest green area in the whole of the watershed and is used for recreation. The Cordeiro stream flows here underground. The illiteracy rate is around 22%.	
Region 3 – has the lowest population density; mostly high standard living conditions; commerce is much diversified including two big water extraction industries, real-estate businesses and shops selling plants and garden utensils as well as a luxurious shopping mall can also be found In this region. Most homes are situated in spread-out gardens surrounded by high walls, and. a few apartment buildings are also to be found, as well as parks and clubs in green areas. The Cordeiro stream flows underground. Residents are rarely seen walking on streets but prefer private cars or are seen inside super-markets and shopping malls. The illiteracy rate is around 7%.	

Figure 1 – Some features of the three regions covered by the Cordeiro Watershed.
Source: Based on PLANSERVI (2010) and the research findings.

5. THE FIELD RESEARCH CARRIED OUT AND ITS MAIN FINDINGS

The present section draws on the methodology and some of the results of the research carried out in the Cordeiro watershed in September and October 2012. Its objective was to understand how social actors (local residents and business people) in the watershed area cope with flooding in their households and businesses, the support they get from local government safety organisations and community associations, and, finally, how those responsible for the construction of the six reservoirs incorporate these social-political aspects into the planning and implementation of the technical intervention.

Due to the difficulty in determining the exact population size in the watershed area, the sample size was calculated for an 'infinite' population, resulting in 271 respondents[2].

Interviews were carried-out based on a semi-structured questionnaire, earlier tested in the watershed area. A total of three hundred and seven interviews were made along the Cordeiro stream and close to each one of the locations where the six water reservoirs are to be constructed. Three hundred and one questionnaires were validated. Respondents where approached on shops, restaurants, streets, parks and other public places, according to the researcher judgement (based on Miller & Salkind, 2002). The interviews followed a list of written questions, and space was left to write down the reasons for the answers given. Seventy percent of the questionnaires where answered by residents and thirty percent by local business people. The answers obtained through the questionnaires were treated with the Statistical Package for the Social Sciences (SPSS), considered one of the most popular programmes used for statistical analysis in social research, a programme chosen due its facility to create graphs from any tabled data, which is confirmed by Miller & Salkind (2002, p. 437). Listed below are the main subjects referred to in the questions made and some of the significant results achieved. The questions aimed at illustrating how residents and business people see themselves as actors capable of implementing self-defence strategies and if they interact with other stakeholders, especially with those planning and implementing the hydraulic technical solution. The answers revealed the community's perception about the causes and who are the main responsible for flood events, their perception concerning improvements in the flooding situation, their perception on the levels reached by the stormwater, how they cope with floods and who offers first help to the victims.

5.1 Solid Waste Dumped In Public Places Is Indicated As The Main Cause Of Floods

Domestic and solid waste are indicated as the main cause of floods in the watershed area, receiving the highest percentages among all causes mentioned. This is the opinion of 52% of residents and 37% of businessmen. When combined with other causes of floods –lack of public works, bad administration by government, land occupation and topography– domestic and solid waste dumped in public places is mentioned as a cause of floods by 70% of residents and 62% of businesses. The lack of public works and infrastructure is the second highest factor referred to as the main cause of floods. A higher proportion of those who consider that solid waste is the main cause of floods appears in Region 1, an expected result inasmuch as this is the only area where the Cordeiro stream is still open and serves as an attractive place for dumping waste. No mention is made to heavy rains as a cause of floods.

Research by Armelin (2011) has produced evidence of the precarious state of water (detention or retention) reservoirs in the São Paulo metro area, and their capacity to reduce flooding impacts, due to solid waste dumped in public areas. The large accumulation of solid waste found inside water reservoirs does not leave enough space for stormwater conducted by the drainage system into these hydraulic structures. Evidence on the importance of the involvement of residents, private sector businessmen and others in solid waste management has been the result of research carried out by Anschütz 1966; Zurbrügg & Ahmed 1999; Rathi 2005; Srivastava et al. 2005. In urban areas, solid waste management has challenged the capacity of engineering technical and structural solutions (Tucci 2004). These authors suggest that planning and implementing these hydraulic solutions would benefit from an interaction with the social actors located in the area.

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[2] For a confidence level of 90% and the corresponding Z-score 1.645, the sample size is calculated as:
n = (Z-score)² – StdDev*(1-StdDev) / (margin of error)² or:
n = ((1.645)² x .5(.5)) / (.05)²
n = (2.706025 x .25) / .0025
n = .67650625 / .0025
n = 270,6025 respondents or 271

5.2 The Main Responsible Actors For Dumping Domestic And Solid Waste In Public Places Are 'Residents', 'People', 'Population', 'Persons', 'Humans'.

Residents and businesses people consider *themselves* as the main responsible actors, whether in isolation or in combination with other responsible for dumping solid waste in public places and causing floods. Fully 90% declare that those responsible for this situation are the people themselves. In second place, politicians in combination with residents are considered responsible for floods. This also implies, indirectly, the lack of serious and regular domestic and solid-waste collection system, on the part of the municipality. Only very few consider flood a consequence of land topography and such an opinion appears only in combination with the role of government and politicians, who they perceive as those who are responsible for the Cordeiro watershed modified topography. Only a few refer to God or Nature as responsible for flooding events.

5.3 Most Of Those Affected By Floods Declare That The Situation Remains The Same Or Has Worsened Over Time

Fifty-five percent of residents and businessmen claim that they have been and still are affected by floods, and that floods in the area are a frequent event during the summer months and rainy days. In general, 66% of those hit by floods declare that this has occurred at least 3 times per year. In Region 3, 78% of the respondents feel that the situation has worsened while 17% of respondents in that region say they have been affected by floods at least 7 times per year.

5.4 Stormwater Flooding Can Reach Up To Over One Meter High

Residents' perception on the height water reaches indicates that, on average, stormwater level is estimated to reach 104.14cm in Region 2 and 96.71cm in Region 1. In Region 3, the average height reached by stormwater is somewhat lower, 83,70cm, but still also considered a very high inundation level. And, as earlier seen, Region 3 is where floods occurs more frequently, a result also obtained by PLANSERVI (2010). Indeed these levels reached by floods are sufficiently high to put all three regions in maximum alert.

5.5 Only Those Who Are Hit By Floods Know How To Protect Family And Property

Self-protection and the possibility to cope with floods is a strategy known only by those hit by flooding events, a question posed to all respondents, independently of whether they were affected or not by floods. Many appear to have no pre-determined strategies. 'Escape', 'climb to the roof' and all other similar types of spontaneous behaviour show that residents and businessmen are not well prepared in case of floods, as these are sporadic strategies which may fail to bring people or property into safety. On the contrary, other strategies of self-protection were considered more adapted to face such events: furniture placed in higher brick pillars; the construction of protective cement barriers; floodgates built in front of doors and flood steps; and, even parking the car in a previously chosen higher street corner as soon as it starts to rain. Such adaptive protective defence strategies were used by around 65% of households and businesses. The percentage of households and businesses hit by flood and who built protective infrastructure in their homes or businesses is significant: 63% in Region 1, 66% in Region 2 and 54% in Region 3.

Note that in Region 3, where flooding occurs more *frequently* per year and where a population living in better housing conditions and a higher educational level can be found in the watershed area, a smaller number of residents and businesses people who are hit by floods in their homes or businesses have built individual protective infrastructure when compared to those in the same situation in Region 2. Although not an outstanding difference, this shows that preparedness does not depend on higher levels of income and education, as already found by Kirschenbaum (2004). The findings in the Cordeiro watershed indicate that where stormwater hit the highest levels, i.e. Region 2, a higher proportion of protective infrastructure is built.

The proportion of those engaged in self-protection behaviour in the Cordeiro watershed reveals an independent motivation inasmuch as there are no local government campaigns, there were no organized visits by social communication or technical staff, nor even community organizations exists to facilitate the dissemination of information on flood risks and how to cope with them. This is especially significant when compared with data resulting from research carried out in the Netherlands, a country susceptible to flood risks, a serious threat to the population especially when related to the forecast of sea-level rising. While the Dutch Government strives to promote self-protective actions through campaigns, only few citizens engage in self-protective behaviour (Kievik and Gutteling 2010). This result suggests that to be hit by floods is a stronger motivation to implement self-protection strategies than information campaigns and other organised communication efforts: the *concrete experience* of having suffered from flooding catastrophes in the Cordeiro watershed prevails above the *idea* of being strongly susceptible to it.

5.6 First Response Comes Mostly From Neighbours

In case of flooding, 52% of residents and businessmen state that neighbours are the first to offer help to those in need. This proportion is higher among residents (56%) than among private-sector people (43%). On the other hand, a total of 27% declare that no one comes to help, and that residents and businessmen have to rely only on themselves. This is the opinion of 37% of businessmen and only 23% of residents, which indicates that solidarity among residents is higher than among businessmen who have to rely more on their own effort to protect their property.

5.7 Government And Safety Agencies Come Afterwards

As flooding often happens suddenly and, in the absence of a formal official strategy, the only alternative for local people is the response from neighbours or to rely on themselves. Research data reveal that mainly of those not affected by floods tend to think that the municipality and the governmental safety organisations offer the first response. In order to confirm the correlation between 'who offers first response' and 'affected by flooding events', a chi-square test was performed with a resulting 'p-value' = <0,001, which confirms this association. The same result was found for the three regions, although a slightly higher proportion of first response by neighbours is seen in Region 1, where a higher population density can be found and the type of occupation favours life at doorsteps and, therefore, more contact among neighbours.

5.8 Social-Networking Is Scarce

Among residents and businesses men, 75% do not discuss with others about floods or the six water reservoirs to be built. This percentage is slightly higher among business people (81%) than among residents (73%). Even informally, there are few social contacts on this subject in the area, on the streets, in churches or in an association. No mention was made to community associations as a forum of discussions about flood risks or as supportive entities for those in need of help during floods.

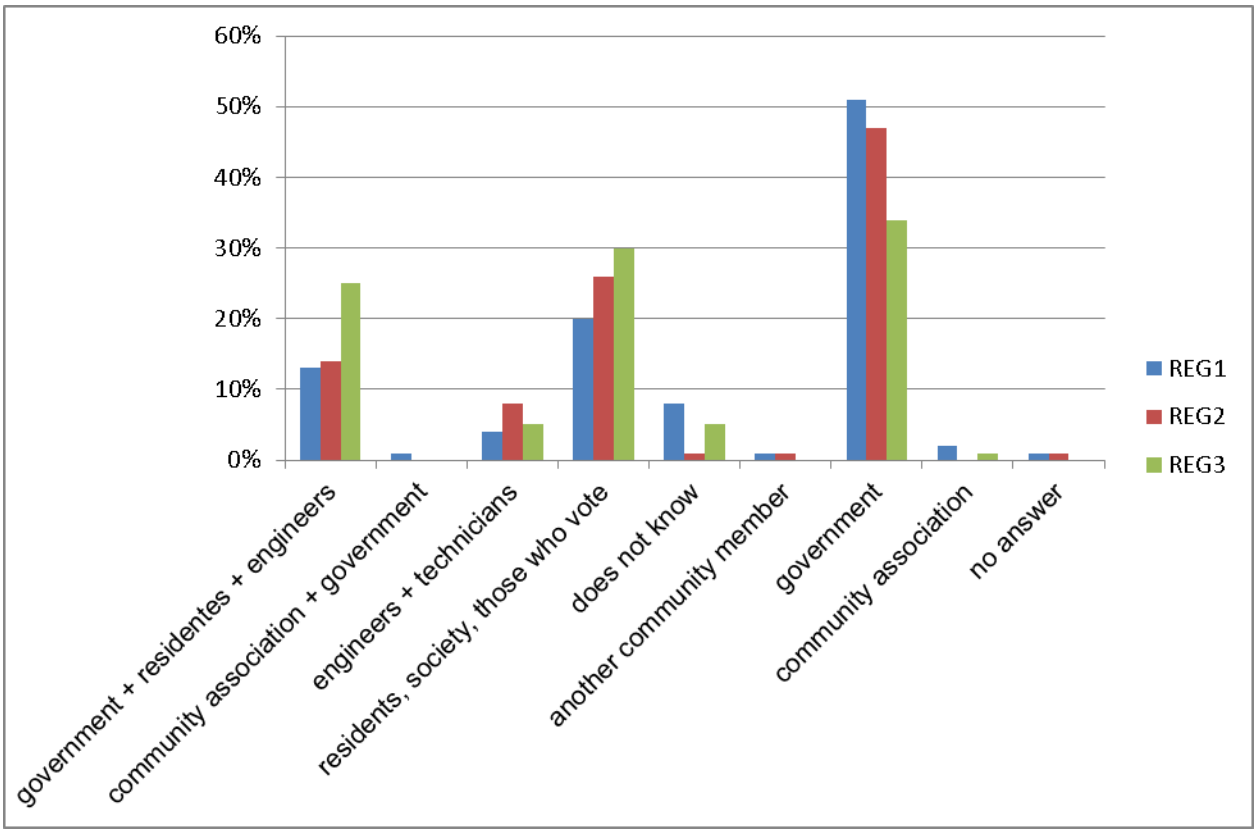
5.9 Practically No One Knows Whether Engineers Have Visited The Watershed Area

When the interviews were made, on average 95% of residents and businesses people did not know whether engineers or technical staff had been visiting the area to explain about the project for the construction of the reservoirs to eliminate or reduce flooding in the watershed. This illustrates the lack of a connection between social actors in the Cordeiro watershed and those responsible for the technical project. On the other hand, 78% of the residents interviewed claim that they would like to participate in meetings about the construction with technical staff, in order to be informed, to give their opinion and even to participate in decision making and the technical solution to be implemented.

5.10 Government Should Decide About The Reservoirs To Be Constructed In The Area, But Residents Should Also Have A Say In Decision-Making

Decisions about the public works to be constructed in the area should be made by the government as stated by 45% of residents and businessmen. However, another 24% declared that 'residents', 'society',

'people', and/or 'those who vote' should take part in such decision-making, while 17% declared that the decision making process should be shared by a combination of residents, government and engineers. In general, the participation of residents was mentioned by 42%. This means that there is also a relative degree of recognition of the importance of the involvement of residents and private sector people in the decision-making process about the construction of the reservoirs, that is to say about flood risk management mechanisms. It is also striking to find that community associations have low representation and recognition in this regard, as shown in Graphic 1, where the opinions by residents and business people are presented for each of the three regions.



Graphic 1 - Who should decide about the water reservoirs to be constructed in the Cordeiro watershed area, in each one of the three regions.

6. DISCUSSION AND FINAL CONSIDERATIONS

6.1 Does the Cordeiro Watershed constitute a `disaster community`?

According to the Brazilian National Water Resources Policy, the watershed is the territorial unit for the implementation of the water resources policy and management. This means that the problems concerning water resources should be taken care of at the watershed level, the place where natural, biotic, social and economic systems are interconnected owing to the hydraulic system. This is the geographical unit where its relief is connected by a drainage network and, consequently, the ideal place for planning and for intervention activities (Porto and Kelman 2000; Porto and Porto 2008) also in densely populated urban areas (Tucci 2004). Conflicts due to the limitations concerning water use and other problems may occur in the watershed, especially because of different and incompatible interests, the reason why this is the place *par excellence* for water resources management.

As a watershed and a geographic site where flood disasters occur, the Cordeiro watershed may be considered a potential 'disaster community' in the sense elaborated by Kirschenbaum (2004), inasmuch

as all three regions are hit by the same storm water, at the same time, and are receiving the same technical intervention to reduce flooding. Also, during flood events, temporary social networks take place, like the family-kin and the micro-neighbourhood social networks. These play an important role and indicate that in Cordeiro the 'disaster behaviour' reflects an 'emergency aid supply' due to its temporary nature. During or after flood events, solidarity bonds are revived while cases of looting or other forms of aggression have not been indicated by respondents. Neighbourly support is recognised by many as the first response received by those hit by floods. However, a 'disaster community' would still demand a 'community risk reduction' effort through a sustainable 'community network' (Kirshenbaum, 2004), which does not occur in the Cordeiro watershed.

Community associations, which would help construct a 'community network' are not recognised as supportive entities for those in need of help during flooding, or as entities that should be involved in decision-making processes about the public works to be installed in the watershed. The literature suggests that volunteer and spontaneous participation in associations or other forms of systematic meetings are generally not found in the Brazilian society. Research by Kowarick (1980) shows that 93% of the population located in urban low income areas do not voluntarily and systematically participate in any sort of associations. Not even formal official strategies, as the São Paulo State programme for the prevention of natural disasters (Brollo and Tomiaga, 2012) indicate the need to create a formal association for the involvement of community members in longer term activities aiming at the reduction of natural disasters' risk.

6.2 The role of social actors and their connection with the public works' technical staff

The concepts brought forward in this article suggest the ways in which social actors in the Cordeiro watershed respond to disaster-risks and handle responsibility for their survival. Based on their own experience and knowledge, motivated by their interest of self-benefit and using their creativity, residents and private-sector people who are affected by repeated flood events use their autonomy as actors to achieve individual survival goals and enhance their livelihoods. In their individual action, however, actors fail to perceive externalities, as a result of which meeting the public interest remains a challenge yet to be overcome. They act independently from social and institutional structures or only in temporally built family-kin or micro-neighbourhood social networks which are formed under the pressure of emergency responses. Responses from local government, community associations or safety organisations and the connection with six reservoirs construction planners are rare to non- existent. To use the local social actors' capacity to complement the benefits of the technical infrastructure project in the watershed is not envisaged.

6.3 An opportunity to advance in the process of achieving resilience the Cordeiro Watershed

Authors who discuss the concept of resilience point-out to the importance of the interaction among the main stakeholders affected by stormwater drainage risks – policy makers and (local) government officials, safety organisations, technical staff engaged in construction work, residents and the private sector. The interest shown by residents and the private sector in the Cordeiro watershed to participate in meetings with technical staff about the construction of the six water reservoirs clearly opens space for the connection among these two 'sub-cultures': the 'non-experts' and the 'experts'.

The literature revised suggests, also, that a purely technical hydraulic interventions have been proven insufficient when social (community organisation, self-reliance, resilience) and political (local government response to flooding events, policy interference) aspects are not taken into consideration. In the Cordeiro watershed, during the period of the research, hardly any contact had been established by the technical staff responsible for the construction of the water reservoirs with residents and business people.

Organised and systematic discussions about the public works being implemented, their benefits and the problems that might occur and other relevant issues affecting community life open space for interaction: recurrent flood events help to make this interaction happen, as suggested by the literature revised.

Practical steps to complement these discussions refer to the implementation of a capacity building programme for technical staff and local government officials on socio-political implications of drainage infrastructure public works as well as a programme to involve residents, business people and local government officials with the six reservoirs construction technical staff in order to motivate interaction and to address special topics:

a. Flood risks management and meeting the collective interest;
b. Increase of green areas in homes, businesses and public places;
c. Reduction of soil sealing in homes and public places;
d. Implementation of sustainable-structural measures in homes and businesses;
e. Elimination of irregular disposal of sewer, solid and domestic waste in public places and water courses;
f. Improvements on a regular solid waste collection system;
g. Restraining irregular soil use and occupation by government.

Incorporating such social-political complexities in the six reservoirs construction process and their maintenance might give insight into the ways of evolving from self-reliance to resilience.

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