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Session title: E2 Methods for mainstreaming adaptation in urban development policy

Evaluation of Resilience through Urban Policies in a context of climate change and extreme precipitation.

Abstract:

According to the most recent climate change scenarios related to greenhouse gases anthropogenic emissions, the frequency and intensity of extreme precipitation events will rise in mid-latitudes. Since those changes can also be perceived as disturbances that urban systems have to respond, the contribution of urban policy to the creation of resilient cities, regarding this phenomenon, should be studied and evaluated. This paper is part of a PhD investigation with the provisory title "City, climate change and floods. A contribution to the urban resilience study" and present the first evaluation results through assessment methodologies in urban planning. The case study presents here is a small watershed located in the Metropolitan Area of Lisbon were the most problematic area related with floods was recently intervene by a urban regeneration process. The evaluation aims to understand if the flexibility of urban areas has improved with the intervention trough the analysis of urban indicator before and after the application of urban policies.

Keywords:

Climate Change, Urban Policy, Extreme Precipitation Events, Urban Resilience, Risk evaluation

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1. Introduction

During the winter of 2010, was observed a new historical maximum rainfall in some areas of the Iberian Peninsula, particularly the west and south, in the existent records (1865-2011). This was verified at various weather stations, namely in the Geophysical Institute of University of Lisbon – Portugal. It was also observed that the days of precipitation were less frequent during the winter, leading to daily observations of more extreme values. Two years before, in 18 February 2008 there was an extreme daily rainfall amounting to 118 mm, which is also the daily maximum ever recorded (Vicente-Serrano et al. 2011).

Several publications on climate change, have been warning that this could occur in the middle latitudes of the northern hemisphere and that its repetition would be generally more frequent and more intense (Groisman et al. 2005). On the other hand, is expected that the total annual rainfall decreases. These trends are confirmed when analyzing the projected data throughout the 21st century for the Grater Lisbon Area, available in the Regional Climate Change Model developed by the Met Office Hadley Centre (HadRm3 – A1B).



Figure 1. Location of *Cacém* in *Barcarena* catchment. Source: own production.

This paper presents one methodological approach and their preliminary results to evaluate urban resilience, focusing on urban and water related policies. The case study is located in suburban areas in the Metropolitan Area of Lisbon. This area is part of a small watershed with historical episodes of flash floods (*Cacém* – *Barcarena* stream). The

policies analysis focuses in a reality resulted from a land use management process (Morgado et al. 2013).

Cacém was recently intervened by the so called “*Polis Program*”, which consists in the implementation of urban regeneration policies and redevelopment of waterfronts (MAOT 2000).

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The evaluation presented here, concerns with the genesis of the disturbance of the system that consists, in our point of view, in the large scale urbanization not always accompanied with adequate urban processes, combined with episodes of flash flooding and associated risk, whose magnitude of extreme events its very likely to increase in climate change scenarios (Kharin et al. 2007; IPCC 2011; Min et al. 2011; Vicente-Serrano et al. 2011).

We intend to evaluate through assessment methodologies in urban planning already available and used in the resilient context (see e.g. Dias et al. 2013) to respond if the changes made through the applied policies in those two systems, have modified urban resilience through a more adaptable and flexible territories, in future situations related to climate change.

2. Methodology

Before the evaluation of a particular urban area, it is necessary to access the forces that can modify the socio ecological system (Resilience Alliance 2007). To do so it was identified the main policies in different planning levels as European Union, national regional and local. This paper focuses the attention to the resilience study in urban areas although some guidelines for the Metropolitan Area of Lisbon are mentioned.

The methodology approach for urban resilience evaluating, was developed under the scope of SUPER-CITIES project entitled “sustainable land use policies for resilient cities”. It is divided in seven main steps, which corresponds to: i) Identification of the main territorial issue at stake, ii) Identification of the concerns expressed in planning documents - Policies, Programmes, Plans and Projects (PPPP), iii) Identification of the policies/measures explored in the document (evaluation of the PPPP), iv) Selection of the policies/measures able to be evaluated under the framework of the resilience concept, v) Identification of the resilience attributes and formulation of the evaluation questions, being proposed as attributes of resilience Capital Building, Complexity, Connectivity, Adaptive capacity, Flexibility, Recovery and Transformability, vi) Selection of the relevant dimensions of resilience and measurement of the corresponding indicators, at both PPPP formulation and implementation phases, vii) Synthesis and conclusions with a critical appraisal of the applicability and usefulness of the resilience concept (Pinho et al. 2013).

3. Cacém: towards the improvement of urban resilience

Some Portuguese cities - which is especially true in Cacém – result from: i) urban extensions, frequently fragmented and with low levels of social and technical infrastructures which

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contribute to underprivileged urban life conditions; ii) spatial segmentation by age within the metropolitan area that promotes ageing in the core centers (e.g. Lisbon) and younger populations relocation in suburban areas, farther away from the centers; iii) growing traffic congestion due to daily commuting to job centers; iv) fast urban landscape degradation, with lack of green and public spaces, often constrained by extremely dense dwelling areas and by the intense use of private transport without proper parking capacity (MAOTDR 2006).

The growth of Cacém depends firstly on commuting, due to its geographic proximity to Lisbon and to the suburban railway line. Later, improvement of life conditions and generalization of the use of private cars reinforced this circumstances contributing to the current development of a residential area. That is why the actions envisaged by the Cacém intervention gave priority to the revitalization of the city as an urban center, by promoting mixed land uses and the development of a regional centrality (MAOT 2000).

Over the years, the steady urban expansion over the Jardas' stream bed and floodplain has caused a continuous increase of the surface of impermeable soils, increasing, in this way, the risks of floods, even with moderate levels of precipitation. Indeed, Jardas stream was known as one of the streams in the Metropolitan Area of Lisbon with higher risk of floods.

As an attempt to solve the problems that the fast urbanization process originated, a strategic program (Polis Cacém Strategic document – 2000) and a Detailed Plan (2003 reviewed in 2008 with the end of the Polis Program) was created under the scope of the special framework developed for the National Polis Program. Measures proposed by these two documents are to be analyzed from the resilience viewpoint, in the light of its contribute to flexibility (Golden et al. 2000; Godschalk 2003), as a proactive form of reaction to change.

Amongst the various actions envisaged, urban and infrastructural reorganization, environmental qualification and the introduction of mixed land use are of particular relevancy, as they were considered to be sustainable and less susceptible to react negatively to economic crises (EU 2007). These documents aimed for the development of solutions to constraints due to a fast, often not qualified, urbanization: the general improvement of the public realm, the inhabitants upgrading of the quality of life, the development of the area's centrality, potential synergies and, finally, in the Jardas Stream, biodiversity promotion, flood risk prevention and, where needed, its mitigation.

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3.1 The results of Flexibility in planning

The evaluation of flexibility resorted to several indicators coming from different stages of planning, which were grouped according to different planning policies/measures and resilience dimensions (Table 1).

The first group of indicators tackles with the planning policy/measure urban requalification, and aims its evaluation in the built environmental dimension. For that, in the Cacém Plan, built area to demolish and to maintain was quantified. In the Plan's implementation stage the effective demolished area, according to the proposal, was quantified.

Selecting these indicators had in mind the built environment remarkable change after the implementation of the Plan. To complement this analysis, results of a survey, conducted in 2003 to the resident population (NEMUS), are presented. This survey states clearly the perception of the population with regard to the contribution of the Plan to the improvement of the public realm.



Figure 2. Existing and proposed building and green areas. Source: own production with information from Cacém's Detailed Plan (PP).

This first group of indicators includes, as well, the quantification of leisure and strolling areas along the Jardas Stream, besides bicycle lanes (existent and planned), comparing previous and subsequent results to the Plan's implementation. Once again, the objective of the analysis falls on the public space qualification and availability against previous constraints due to fast urbanization.

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The second group of indicators engages in with the policy/measure environmental requalification, through the analysis of indicators coming from the implementation of Cacém Detail Plan (PP/Plano de Pormenor) monitoring process. The analysis focus in the existent sound levels, with the objective of verifying changes in the population quality of life and public health. With this respect, data referring to sound levels allowed by the National law were collected in areas of conflict before and after the implementation of the Plan.

As far as this policy/measure is concerned, considering that one of the main goals of the Strategic Plan (Plano Estratégico/PE) and, as a consequence, of the Detail Plan of Cacém (PP/Plano de Pormenor), consist on the requalification of the Jardas Stream and its surroundings – in which the stream channel reconfiguration and the linear park are vital – open green space availability and importance is also evaluated. These circumstances are relevant as they may contribute to flood risk mitigation, under torrential rain.

Attributes of resilience / criteria	Dimensions of resilience	Policies /Measures	Indicators			Sources	
Flexibility	Environmental	Urban Requalification	PPPP – PP/ PE Cacém FORMULATION: Constructed area scheduled for demolition to correct situations of dead end roads, alignment of buildings or other situations of disconnection between areas.	(2003)	m ²	%	PP CACÉM / own production
				Total surface built	82.967	100	
				Buildings proposed for demolition	24.210	29,2	
				Buildings to remain	58.756	70,8	
			IMPLEMENTATION: Percentage of demolished areas in accordance with the Plan. OBJECTIVE: To evaluate the Contributions of the intervention to improve public and urban spaces and architectural image. FINDINGS: The demolitions were carried out with the aim of alignment of buildings, improving of the urban image and public space and improving of the road circulation conditions through the resolution of deadlock situation. Taken together, these changes imply improvement in living conditions of populations.	(2008)	m ²	%	PP CACÉM / NEMIUS / own production
				Demolished	20.079	82,94	
				Not demolished	4.131	17,06	
				Population survey (2003)	Contribution of intervention to improve public and urban spaces and architectural image		
			Contributed or contributed a lot			67	
			Contributed little or nothing			4	
	Do not know, or not answered		29				
PPPP – PP/ PE Cacém FORMULATION: Existing and proposed areas of public spaces to recreation and leisure confining with the Jardas stream.	(2003)	Existent	Proposed	PP CACÉM			
	Public spaces to recreation and leisure confining with the Jardas stream (m ²)	0	9.943				

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			Extension of cycling path (m)	0	3.000		
		IMPLEMENTATION: Level of implementation of the rehabilitation along Jardas stream. OBJECTIVE: To assess the availability of qualified public spaces. FINDINGS: This intervention was carried out in areas previously occupied by urban fabrics that were gradually obstructing the floodplain of Jardas stream. The creation of public spaces, combined with the demolition of buildings in the floodplain, allows mitigated flood situations caused by that stream in downtown of Cacém.	(2008)		%	PP CACÉM	
			Public spaces to recreation and leisure confining with the Jardas stream executed under the Plan (m ²)	9.943	100		
			Extension of cycling path (m)	3.000	100		
Flexibility	Environmental	Environmental Requalification	PPPP – PP/ PE CACÉM	(2003)	Existent	Proposed	PP CACÉM
			FORMULATION: Existing and proposed qualified urban green areas.	Linear park of Jardas stream	0	22.313	
				Other qualified green areas (Recreational areas, except for the previously requalified urban park.)	0	39.485	
			IMPLEMENTATION: Qualified green spaces	(2008)	m ²	%	
			Objective: Availability of qualified green areas	Linear park of Jardas stream	22.313	100	
			FINDINGS: Improvement of public spaces and attractiveness for recreation and laser. The creation of permeable areas through the implantation of the Linear Park and the regularization of Jardas stream, are considered as measures to mitigate situations of flood as a result of torrential rains.	Other qualified green areas	9.832	24,9	
	Population survey	Contribution of intervention for re-qualification of the Jardas stream and surrounding areas. (2003)		%	PP CACÉM / NEMIUS		
		Contributed or contributed a lot		62			
		Contributed little or nothing		8			
		Do not know, or not answered		30			

Table 1 – Indicator for resilience evaluation

The Plan has allowed for redesigning the urban space, e.g. after reorganizing the road network and buildings alignments. By this, new areas for public space and building were made available, which, according to the Strategic Plan should host new land uses other than housing, offering new opportunities to private investors. As such, these indicators aim the evaluation of the way these changes are currently being implemented, in parallel with the results of the population survey.

As a means to deal with hard situations due to the fast urbanization process, almost 30% of the built area under the Plan's scope had to be demolished. By the end of Detail Plan's legal force, under the scope of the Polis Programme, 83% of the planned demolitions were done, allowing for the reorganization of the urban fabrics, the eradication of dead ends, which used

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to be frequent in downtown. As already referred and stated by the survey to the population, these changes contributed largely to the improvement of the public realm.

In addition to the general upgrading of the urban conditions, demolishing large built areas brought the effective requalification opportunity to the Jardas Stream. This waterline crosses the central area of Cacém, and was mostly a backyard of buildings which had occupied the floodplain of the stream. As a result, new areas for public space became available by the water. The linear park with reasonably large open green space holds now a 3 km long bicycle lane. Where public space was scarce, it is possible to verify that, with this respect, the Plan was fully implemented under its binding force period.

Altogether, the interventions allowed for the enhancement of living conditions and contributed to flood risk mitigation, by unblocking the embankments and stream channel reconfiguration. As for the issue environmental requalification several measures were undertaken and monitored, amongst which sound levels monitoring and strategies for its decrease are of particular interest.

4. Evaluation main findings

As seen, the Polis Programme inherits the previews interventions knowhow, and instates a simplification of procedures and introducing an important flexibility capacity in the planning process (Folke et al. 2002). Therefore, the urban and environmental requalification process in Cacém, allowed for the restructuring of the area and solving most of its constraints.

Drawing upon the adaptive cycles (Holling 1973; Folke et al. 2002) it can be said that Cacém was in a “renewal or reorganization” phase, and from this perspective, it was promoted a shift to a phase of “rapid growth”.

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