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Workshop:

TOWARDS URBAN RESILIENCE

International Workshop, May 2017, 23th & 24th
for young Researchers, Master- and PhD-students

hosted by:

ESARQ School of Architecture UIC Barcelona

organised by:

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International Cooperation
in Urban Development



Hans **Böckler**
Stiftung



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Annette Rudolph Cleff

TU Darmstadt, left

Carmen Mendoza Arroyo

UIC Barcelona, right

Together towards Urban Resilience - Promoting Young Researchers

The collaboration of young researchers is an important step for international cooperation in urban development and for a substantive dialogue on resilience. The complexity of urban systems and the uncertainty of the impact of urbanization and climate change asks for new ways of thinking about planning objectives and solidarity in action. We certainly can't change the urban dynamics, but we can point at the existing and emerging issues to provoke both critical and creative thinking. Resilience is an anticipatory concept that changed profoundly the perspectives in planning and urban research. A look at the technical infrastructures on the one hand and the discussion of socio-ecological systems on the other hand display two sides of research on urban resilience. Both research fields overlap in urban space and therefore require an interdisciplinary dialogue.

The workshop for young researchers at the UIC Barcelona gives us the opportunity to discuss strategies "towards urban resilience" in four thematic sessions and two key-note-lectures: Critical Infrastructures, Resource-sensitive Urban Design, Resilience and Multi-Level Governance and Post-Crisis Emergency Reconstruction. The cooperation with UN-Habitat - City Resilience Profiling Programme (UN CRRP) and the Urban Resilience Institute in this workshop offers also an international network for applied research on urban resilience and critical infrastructures. Thematic networks are a key element in interdisciplinary research and at the same time a good way to reflect on individual research approaches in the context of other research projects.

The workshop aims to exchange scientific information and experience and to promote dialogue among young scientists. Our goal is to strengthen higher education in urban sustainability and transitions towards internationalisation of academic institutions and networks. This includes also the further development of binational doctoral procedures and the greater involvement of international scientists in the supervision of doctoral studies. One third of the Master's graduates in the international Master's Programme "International Cooperation in Urban Development-Mundus Urbano" are aiming for a doctorate. Together with the partners of the Mundus Urbano consortium, a binational supervision of dissertations (Cotutuelle) is therefore offered since 2014. The introduction of an European Joint Doctorate is planned by the consortium partners in the MU-Programme.

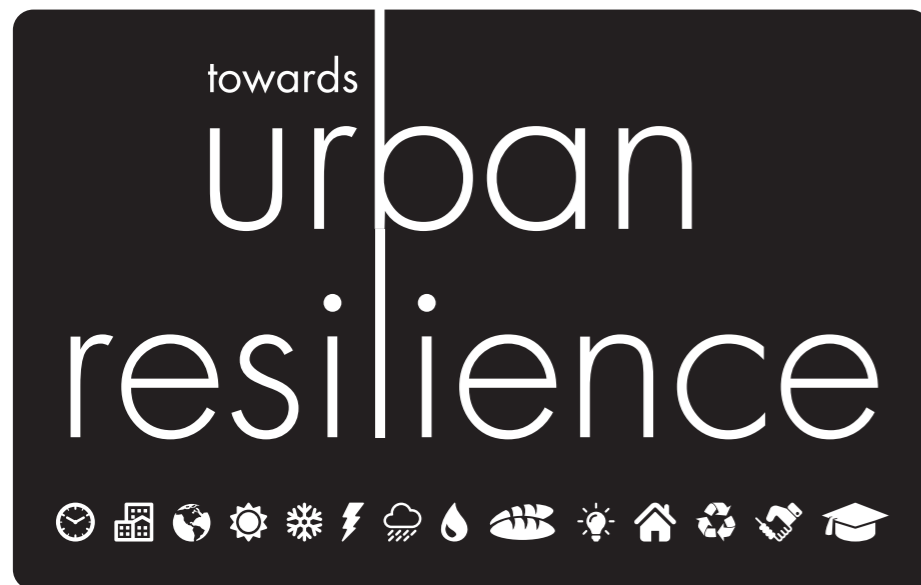
This thematic network meeting invited young researchers from different Universities and disciplinary backgrounds: PhD students in binational supervision, fellows of the Africa-Programme "Urban Infrastructures in Transition" focusing on developments in the East-African cities Dar es Salaam and Nairobi and young researchers of Research Training Group (RTG) "Critical Infrastructures: Construction, Function Failures, and Protection in Cities" funded by the German Research Council (DFG) and doctoral students of the Graduate School Urban Grad at TU Darmstadt. The workshop was open to all interested young researchers at the partner universities of the Urban Resilience Institute and we are very pleased that some of the participants of the network meeting took very long ways (i. e. Canada) to discuss their disciplinary and methodological approaches in research on resilience with us.

I would like to take this opportunity to thank my colleagues at UIC for organizing the research workshops "towards Urban resilience" as wonderful hosts, especially Carmen Mendoza and Lorenzo Chelleri, and my colleagues in the consortium for the good and trustful cooperation. Special thanks are also due to my colleagues who accompanied this workshop as keynote-speakers, chairs and discussants and as an attentive audience, especially Jean- Michel Roux, Jochen Monstadt, Gerrit Schenk, Katrin Golda-Pongratz, Carmen Apen Ruiz and Mbongeni Ngulube and Nina Gribat.

Dr.-Ing. Björn Hekmati has organized all phases of the workshop with calm and precision, from the call for paper to the present report, for which I would like to express my sincere thanks to him. Last but not least, I would like to thank the PhD students and young scientists who have made these two days such an awarding experience with their research results, their contributions to the discussion and their deep interest in research on urban resilience.

My sincere thanks to all of you!

Annette Rudolph-Cleff



Call for Papers

Release Date 24.03.2017

CFP: Towards urban resilience

International Workshop at UIC Barcelona Mai, 23th & 24th

Organised by :: est :: Urban Design and Development, TU Darmstadt, Germany

The complexity of urban systems and the uncertainty of the impact of urbanization and climate change ask for new ways of thinking about planning objectives and solidarity in action. Cities are complex, adaptive systems of networked services and infrastructures. Growing urban populations, the concentration of resources and capital, unclear contingency planning, the often inadequate and environmentally unsound water supply and sewage management, the menacing continual destruction of ecosystems, and out-dated infrastructures and buildings, all present massive challenges to city planning.

With the goal of strengthening resilience, there has been a lasting change of perspective in planning. The scope has been broadened from a specialized viewpoint to an interdisciplinary understanding of interactions and processes within the cityscape. Resilience is an anticipatory principle that transcends risk reduction and attempts to mitigate the effects of system failures while increasing capacities.

The overall aim is to combine resilience strategies and sustainability by:

- i) enhancing sustainable urbanization
- ii) improving ecosystems and nature-based solutions
- iii) developing climate change adaptation and mitigation
- iv) strengthening community-based approaches and social resilience

Developing a network is an important step to promote resource-sensitive urban design and enable educational and professional shift towards resilience and sustainability. Thus, the International Workshop at UIC Barcelona in cooperation with UN-Habitat's City Resilience Profiling Programme (CRPP) and TU Darmstadt will offer the possibility to bring innovative ideas on resilience to discussion.

The joint research hub, Urban Resilience Institute (URI), in cooperation with UN-Habitat CRRP aims to analyse practices and processes in the design of resilient and sustainable cities. The hub will gather young researchers from the European Joint Doctorate Programme within the Mundus Urbano Consortium, and from the Fellowship Programme on "Urban Infrastructures in Transition: The Case of African Cities," as well as the research group on Critical Infrastructures at TU Darmstadt.

Currently working from academic institutions based in Europe, researchers from Germany, India, Italy, Kenya, Lebanon, Uganda, and Spain, will present their research projects in four sessions covering the topics of: critical infrastructures, resource-sensitive urban design, housing and land management, and post-crisis emergency reconstruction; opening for discussion on conceptual approaches "towards urban resilience" with international researchers, Master- and PhD-students.

- We accept proposals for academic papers of approx.. 250 words
- Selected papers will be considered for publication (paper compendium)
- Sessions are going to be limited to ~ 2-4 papers
- Deadline is April, 14th, 2017
- Submissions should be addressed to :: est :: staff member Bjoern Hekmati: hekmati@stadt.tu-darmstadt.de, subject: "TUR BCN17 - proposal"

Possible areas of engagement analogous to the planned sessions are:

A_Critical Infrastructures

As the dependency on technology increases, there is a growing need to reflect on the role of infrastructures to sustain human activities. Infrastructures are critical for the functioning of society, not only as the physical components in cities, or 'hardware,' but also as structures embedded with the intangible essence of human groups and our understanding of them in specific contexts and throughout time.

B_Resource-sensitive Urban Design

In face of rapid urbanization and the negative impacts of climate change on natural and built environments, this session calls analysis of practices and processes of resource-sensitive urban design. Urban design can contribute towards an educational and professional shift towards resilience and sustainability by focusing on integrative approaches, such as district-based networks, low-impact approaches, and climate-adaptive planning and building.

C_Resilience and Multi-level Governance

This session seeks cross-scalar and multi-level frameworks which help in understanding cities as complex and adaptive systems. Contributions should problematize urbanization processes and include tools and strategies which explain scalar arrangements of nature and power. The role of international and global frameworks will deem necessary in laying the base for transition and transformation of cities, and to contribute to the development of urban resilience.

D_Post-Crisis Emergency Reconstruction and Upgrading

This session aims at understanding refugee camps as a form of urbanization and sets the basis for rethinking camp design and their temporality. Contributions should bridge social structures and their physical transformations, as a means for their integral regeneration. This session looks at examples where resilience in the social fabric of informal settlements and low housing estates can create a sense of belonging and act as a force for their physical upgrading.



Arturo Crespo, Jochen Monstadt, Richard Little, Anaïs De Keijser, Anshika Suri

Tuesday, May 23th

Session A: Critical Infrastructures

Chair: **Jochen Monstadt**, University of Utrecht

Discussant: **Richard Little**, Rensselaer Polytechnic Institute, Troy, NY

Anaïs De Keijser, TU Darmstadt:

Analysing 'fend for yourself' approaches to urban infrastructure provision and maintenance:

Resilience and System-D the case of surface water drainage in Bujumbura

Anshika Suri, TU Darmstadt:

Everyday encounters with infrastructures in cities of East Africa: A critical feminist technology assessment of gender inequality in sanitation service provision

Arturo Crespo, TU Darmstadt:

Preparedness & Prevention Strategies for Critical Infrastructures: The Relevance of Disruption Programs in Engineering More Resilient Commuter Railway Operations

Analysing ‘fend for yourself’ approaches to urban infrastructure provision and maintenance: Resilience and System-D the case of surface water drainage in Bujumbura

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Abstract

This paper aims to analyse how ‘fend for yourself’ processes in the provision and maintenance of infrastructure in contexts with high degrees of uncertainty and failure affects resilience. Through the case study of surface water drainage infrastructure in Bujumbura, Burundi, the paper introduces the concept of System-D; a grounded concept referring to ‘fend for yourselves’ approaches to urbanisation. It questions the role of such active citizen involvement and its effect on resilience. As the case study illustrates the policy and legal structures that encourage such an important involvement of the people in the provision and maintenance of the infrastructure. Thus enabling the authorities to shift the core responsibilities in regards to infrastructure provision from the state to the people. This in turn has consequences on both a micro- and macro- level within the city bringing up questions of scale. By analysing fend for yourself approaches to urban infrastructure maintenance and provision, locally referred to as system-Ds, the work highlights on the one hand how such urbanization approaches can be legitimized and encouraged. On the other hand it analyses the consequences of such an approach, through a multi-scalar analysis of resilience.

1. Introduction

Bujumbura, Burundi’s capital city is situated on the north-eastern border of the Tanganyika Lake. Due to the local topology and climate the drainage of surface water is difficult to manage. In the plane this results in recurring floods and stagnating water; and in the slopes it results in erosion, landslides and the consequences thereof. This in turn affects the existing housing- and infra-structures which result in high economic losses. Due to the authorities inability to provide adequate surface water drainage across the city a call for the active involvement of all citizens in the provision and maintenance of such infrastructure has been made. The concept of ‘community work’ has existed in Burundi since before colonisation (Bujumbura News, 2017). During the monarchy it was called ikibiri, and during colonisation ikiboko (Ibid.). After independence these were known as works of public interest that required residents active participation in the provision and maintenance of infrastructure on Saturdays (interview 1). Today these public works are continually encouraged by the authorities and led by the local chiefs and political elites (Bujumbura News, 2017). On the image hereunder you can see the president participating in community work with the population.

This approach to community work is further encouraged through public calls for actions as well as through the sharing of best-case examples of success. Such examples illustrate that community work can lead to substantial positive changes in the living environment of the Burundian people. There are equally many signs around the city of Bujumbura making such calls for involvement, as can be seen in Figure 2 (next page).

1)
The president participating in community work
(<https://goo.gl/images/BUFE7g>)
accessed 16.05.2017 at 14.59)





2)

sign stating:

*'Maintained infrastructure = sustainable infrastructure'
illustrating an inhabitant maintaining the infrastructure*

Since the political crisis of 2015, Burundi has become the world poorest nation. This statement was published on May 1st 2016 by the Mail and Guardian Africa newspaper. The country's limited resources are insufficient to provide the necessary state-provisioned infrastructure. This creates a situation in which people have few alternatives and are left to fend for themselves. This reliance on 'fend for yourselves' systems is what is locally referred to as System-D.

System-D comes from the French term 'système-débrouillardise'. Based on a Dictionary definition (Larousse, 2016) 'débrouillardise' refers to:

- finding whatever way possible to arrange something
- Sorting things out with your own means
- being content with what you have
- Arranging something with someone
- being able to cope- to be okay

As can be seen from the broad scope and variety of what the concept encompasses it is clear that the simplified, official translation into English to the word 'resourcefulness' does not encompass the entirety of the term's meanings. The term refers to a manner of responding to challenges through adaptation and improvisation to ensure that what needs to be done is done.

This paper analyses the effect of this System-D approach to infrastructure provision and maintenance and its effects on resilience. The paper is structured in the following way; it first introduces the concept of System-D its use in francophone academia and how it has been introduced into the Anglophone academic debates. It then, describes the research design as well as how the data was collected and analysed. In the fourth section two specific examples of System-D will be analysed in depth one of which illustrates System-D on a household scale and the other on a community scale. This illustrates the advantages and disadvantages of such approaches on different scales supporting the need for such multi-scalar analysis. The final section will then discuss the findings and summarise the conclusion of the paper.

2. Resilience and System-D

System-D refers to a mentality of resourcefulness, where actors find solutions to problems with the opportunities at hand. Through it, self-reliance materialises enabling the provision of services to those who find themselves beyond the capacity of the centralised infrastructure be it in terms of access or failure. During field research in 2015 the work came across the concept System-D. Considering its apparent relevance in the provision and maintenance of infrastructure as well as in broader urbanisation processes as a whole the question came up as to where this term came from and whether or not it was currently already being discussed within academic literature.

The concept System-D has its origin from the French military context of the mid-nineteenth century (Murphy, 2015). It referred to a sort of coping mechanism an ability to get out of a mess, and was considered essential to thrive within French society (Murphy, 2015). As stated by Murphy (2015, p.351) "La débrouillardise and its many derivatives (se débrouiller, débrouillard, and Le Système D) are central to the French and Francophone cultural imagination ... it is a response common to any reasonably alert and clever French person." In more recent francophone debates the concept has come to be seen as a powerful interdisciplinary concept that can help us better understand the current dominant reality (Murphy, 2015). This has equally been supported by Neuwirth (2011) who introduced the concept into Anglophone debates and describes it as "how much of the world survives, and how many people thrive, yet it is ignored and sometimes disparaged by most economists, business leaders and politicians". This resonates in the findings of this paper where System-D can be seen as the everyday reality of many, if not all, city residents. Neuwirth (2011) has accentuated that the concept itself, how it is called, how it is framed, is very context dependent. He states that System-D as a concept has been sculpted by former French colonies to fit their own social and economic reality.

When looking within the local context a clear influence of the concepts sculpting and local understanding has come from the neighbouring Democratic Republic of Congo. This became clear due to the use of the reference Article 15. As stated by Vlassenroot & Raemaekers (2004, p.170) Article 15 is "a fruit of popular imagination, was added to the fourteen real articles of the constitution, and represents the essence of thirty-two years of Mobutu dictatorship". It can be considered an implicit social pact between the state and its citizens (Vlassenroot & Raemaekers, 2004). In both the case of Mobutu Congo and current day Burundi the idea of Article 15 is in some form institutionalised and tactically approved by the authorities. Vlassenroot & Raemaekers contextualise the concept illustrating that through its use as a lens of understanding and analysis of the observed realities it creates a context in which the difference between legality and illegality has no more sense (Ibid.). This enables us to keep debates on informality out of the analysis enabling a focus on all processes, both within and outside the legal framework. Neuwirth (2011) calls system-D a product of intelligence, resilience, self-organization and group solidarity, and states that it follows a number of well-worn though unwritten rules through which he argues makes it a system.

According to the City Resilience Framework developed by the Rockefeller Foundation resilience is "the capacity of cities to function, so that the people living and working in cities –particularly the poor and vulnerable- survive and thrive no matter what stresses or shocks they encounter." In that sense System-D can be seen not so much as a product of resilience but rather an essential element of resilience. System-D enables systems, communities and individuals to be resilient and this is what this paper aims to illustrate through specific case examples.

3. Research Design and Methodology

Focusing on a single case study is beneficial as it allows the combination of a variety of sources, types of data and research methods (Denscombe, 2007). Through semi-structured-interviews with selected stakeholders, the research aspires to understand in-depth accounts of relationships, experiences and processes occurring in the provision and maintenance of drainage infrastructure in Bujumbura. This way an in-depth understanding of system-D and its relation to resilience can be achieved.

The argument presented in this paper is constructed in the following way. In its theoretical part, section 2, the paper introduced the concept of system-D and discussed its relationship to resilience. In order to illustrate the relation between system-D and resilience, the paper analyses two case examples. The first case is the investment into road and drainage infrastructure by a community in the Zone of Gihosha at the eastern extremity of the city. The second case is that of household construction of drainage infrastructure on a plot equally in the zone of Gihosha. These examples will be contrasted to the general problems in relation to surface water drainage and analysed in order to understand the relation between system-D and resilience at different scales. The findings in this paper are based on 4 household interviews and 2 expert interviews that were held during field visits in March 2015 and February-March 2017.

4. 'Fend for yourself' approaches to the provision and maintenance of surface water drainage in Bujumbura

Surface water drainage in Bujumbura is considered an infrastructure of key importance not merely because of the large amount of rainfall that has to be managed in the city but equally because it is used for the disposal of grey water. This is household wastewater without faecal contamination. Due to the fact that less than 10% of the population is connected to sewerage infrastructure (Bideri, 2008) the surface water infrastructure takes over part of its role.



3)/4)

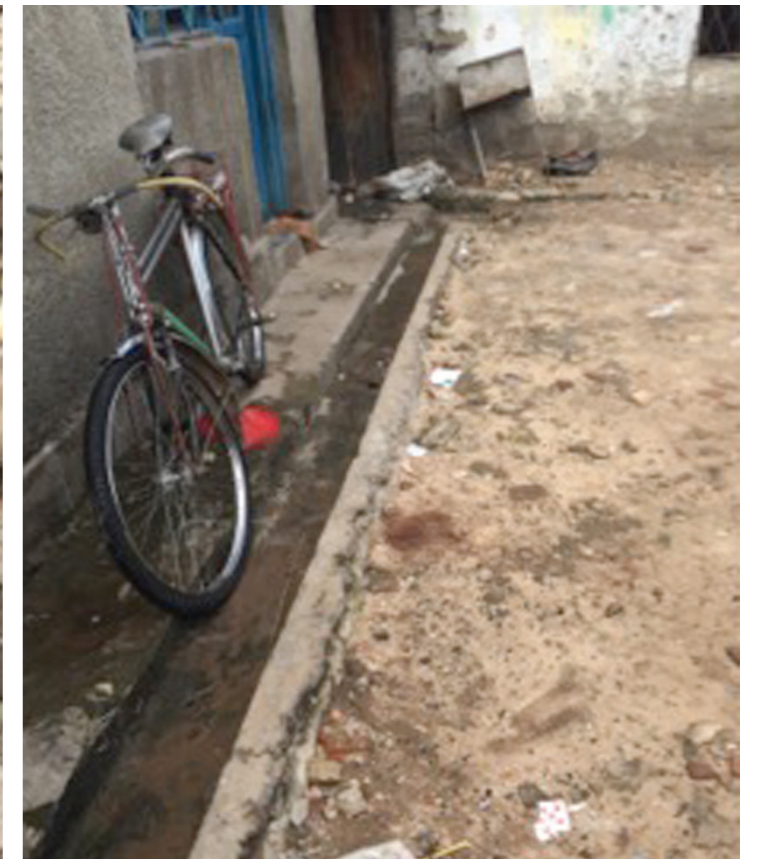
Surface water drainage as a collection point for grey water as well as solid waste

Such use of the infrastructure leads to blockage, which can lead to failure of this specific infrastructure. Considering the open character of this infrastructure a consistent maintenance of the infrastructure is required. This generally looks like figure 4, where the solid waste will be taken out of the drainage in order to avoid it stocking up. However, sometimes the use appropriated to the infrastructure is different from the intended use. Such cases of self-appropriation of the infrastructure for alternative uses can lead to contradicting involvements with the infrastructure. Figures 5 & 6 show how the drainage infrastructure has been blocked with a large stone in order to be able to stop the water from flowing, stock up and provide the individual with a free water reserve that can then, such as in this case, be used to clean bicycles and provide the individual with income. The potentials for income generations continue beyond such examples as some also collect and sell the sand that is being transported through this infrastructure. This contributes to the perceived importance of the infrastructure.

5)/6)

Rock stopping the flow of water in the surface water drainage infrastructure in order to collect the water for an alternative use

As people value this infrastructure they believe it important to construct and maintain it themselves if the state fails do to so.



4.1 Community road and drainage infrastructure project in Gihosha

The community under analysis in this first case study is one connected through the fact they all live along or perpendicular to the nameless road in red on the map hereunder.



As this is a new neighbourhood the community has been struggling to get the infrastructure they have official rights to. Despite having legally bought the land and it having been specifically allocated for the construction of a new residential neighbourhood, the lack of coordination between the different public bodies results in the communities need to fight battles at different fronts in order to get access to different service. After a community initiative to pressure the public utility responsible for water and sanitation (REGIDESO), the area has received access to water and electricity. This has enabled a process through which an informal community structure has developed through which neighbours can share their concerns and organize themselves through System-D.

Officially the neighbourhood is planned to receive both road and rain water drainage infrastructure as some point, but many consider that to mean they will need to wait a long undetermined amount of time (Interview 1, 2017). Considering that they have agreed that they cannot or rather do not want to wait that long they have thus decided to collect money from all homeowners living along the street in order to invest into their own neighbourhood road and drainage infrastructure project (Interview 2, 2017).

As the neighbourhood is build into the steep slope of the mountains the rainwater comes down at very high speeds. This has two main consequences. First, it affects the quality of the street, through which people nearly need a four wheel drive to access their homes (Interview 2, 2017). This situation is worsened during heavy rainfall, as nearly the entirety of the street becomes a river (Ibid.). Second, it affects the infrastructure as it creates erosion along the walls, polls; pipes, which lead to the need to continually, re-invest into the maintenance of such other infrastructures (Ibid.).

Map 1)
Bujumbura, Gihosha and the community's street



7)
The road in question

An interviewee (Interview 1, 2017) living perpendicular to the most eastern part of the road said such a project is urgent as he is paying a lot having to keep sending his car to the garage. He said that they still needed to talk to the homeowners in the bottom half of the road but that he was quite confident they would be able to collect the needed funds (Ibid.). He equally added that as his house is 50 meters from that road he and his next-door neighbour were planning to make the investment from the last bit of road until his gate by themselves (Ibid.).

4.2 Household construction of drainage infrastructure on a plot



In contrast to the neighbourhood scale many people also decide to take action on their own, for their own. This results in what we see in image 7 and 8, where household construct for themselves an illusion of the infrastructure, as the water is only carried across the plot to the be released back into the urban environment. Somehow a collective understanding of the consequences thereof seems to be missing, as these interventions tend to worsen rather than improve the general situation. Yet, these interventions are common as they provide the homeowners with a certain social standing.

5. Conclusion

Article 15, System-D represent local conceptions of the fend for yourself mentality. This mentality is encourage both from the top as well as from the bottom and materializes in different ways. As illustrated through this paper, such approaches can form structures that are contradictory or even harmful to the overall system. The case of system-D on a community level illustrates that through it, the community manages to be resilient giving them a strategy through which to counter the stresses they are faced to. It strengthens the power of the community and provides them with the power to construct and maintain infrastructure that benefits more than solely the people involved. On the other hand, the use of System D on a household level has a negative effect on the broader scale. The build infrastructure has no functional role but rather only a visual communication of socio-economic class. This infrastructure in some cases worsens the situation for the neighbours and illustrates a lack of collective efforts or considerations. System D can thus materialise in many different ways that can either contribute to the resilience of communities and households or contribute to vulnerabilities thereof. It is important that System D is relied upon with an inherent consideration of the negative effects it might cause, rather than focusing on the solution it brings. Overall, the concept of system D an analytical framework provides insights into the positive and negative effects of fend for yourself approaches to urbanization. It provides an innovative way of understanding the reality on the ground.

8)/9)

'Fend for yourself' surface drainage infrastructure

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Mail and Guardian Africa newspaper, May 1st 2016, Burundi battered by year-long crisis, it has now fallen to the poorest country in the world, <http://mgafrica.com/article/2016-05-01-burundi-battered-by-year-long-crisis-it-has-now-fallen-to-the-poorest-nation-in-the-world>. Accessed: 16.05.2017

Interviews:

Interview 1 Resident of Gihosha, Part of the community initiative, Bujumbura, March 2017

Interview 2 Resident of Gihosha, Part of the community initiative, Bujumbura, March 2017

Everyday encounters with infrastructures in cities of East Africa: A critical feminist technology assessment of gender inequality in sanitation service provision

Anshika Suri

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Abstract

Women's everyday encounters with technological artefacts are rarely recognized and remain invisible. This paper focuses on the examination of sanitation infrastructures as one of the existing technologies that mostly affect the lives of women. Previous studies show that one in three women still lack access to safe toilets worldwide which leads women to confront health issues, harassment, attacks as well as fear shame and indignity. Indeed, when dealing with sanitation infrastructure, it could be argued that planning is often far removed from women's needs, their socio-cultural practices, existing gender constructs and is rather determined by engineering, environmental and public health concerns. Although substantial research on gender and sanitation is focused on health and hygiene, it fails to comprehend the magnitude of gender based disparities and inequality in accessing sanitation infrastructure. Drawing on feminist scholarship in science and technology I investigate how gender inequality in urban spaces, manifested in the different relations women and men establish with sanitation facilities in informal settlements, could also be seen from the lenses of women's ambiguous relation with technology (as users but removed from design). By using qualitative data collected through semi-structured interviews conducted in Dar es Salaam and Nairobi with female residents of informal settlements, I highlight how women interact, inform and transform infrastructure contributes to its social shaping. Preliminary conclusions reveal that inadequate access to sanitation infrastructure may be propelling fear of violence further accentuated by reductive technological design strategies.

Introduction

Cities around the world are experiencing growing inequalities; posing incremental challenges for development practitioners and policy makers. Access to sanitation is one of the millennium developmental goals that spectacularly failed with 2.4 billion people still lacking access to improved sanitation facilities; leading what can be perceived as a global sanitation crisis in the 21st century¹. The lack of sanitation has been identified as one of the main causes of increasingly complex urban health dynamics amongst urban dwellers in African cities² and the promotion of basic sanitation is largely focused on hygiene awareness, health and environmental benefits.

¹ Domestos Unilever et al "WE CAN'T WAIT: A REPORT ON SANITATION AND HYGIENE FOR WOMEN AND GIRLS", 2013

² Astrid Hendriksen et al, "Participatory Decision Making for Sanitation Improvements in Unplanned Urban Settlements in East Africa." *The Journal of Environment & Development* 21 (1) 2011: 98-119.

The WHO /UNICEF Joint Monitoring Programme, which is a key component to the success of the Sustainable Development Goals, provides the global measure for access to sanitation and incorporates internationally agreed definitions for “improved sanitation”. However, this monitoring currently does not provide a breakdown of access for men and women separately despite previous research indicating that the most significant impact of poor sanitation is on the safety, well-being and educational prospects of women. Indeed, several studies reveal that one in three women still lack access to safe toilets worldwide, a lack that is manifested in risking shame, health issues, indignity, harassment and even attack³.

Along these lines, research emphasizes the vulnerability of women to physical and sexual violence if they are forced to wait until early morning or late evenings to look for a secluded place to defecate⁴. In addition, as several studies have shown, violence becomes more pronounced towards women of lower socio-economic strata living in informal settlements⁵. Lack of sanitation in addition, considerably contributes to poverty⁶ with the casting out of many sites, groups and practices of the urban poor as unsanitary⁷. Furthermore, problems of poverty faced by female-headed households in rural areas of Africa were shown to be caused, in part, by unequal access to essential resources. This helps draw attention towards women who stand on an intersection of multiple categories like inadequate access to sanitation infrastructure, poverty and gender violence.

In summary, the extensive research on gender and sanitation fails to capture the magnitude and scope of gender-based disparities and the inherent lack of gender equality in accessibility of sanitary infrastructure⁸. The studies show a dearth of empirical evidence regarding the intersectional relationship of women’s everyday interaction with sanitation infrastructure. Hence, in this article, I argue that there is a need to examine the injustice against women through infrastructural inadequacy. In the next section, I delineate the theoretical framework that enables me to explore gender inequality manifested through sanitation infrastructure. I organized it around the discussion of two themes: the discussion of ‘woman’ (with)in development and the interactions between gender and technology by analysing women’s experiences with sanitation infrastructure.

3 *Domestos Unilever et al.*, 2013. “WE CAN’T WAIT: A REPORT ON SANITATION AND HYGIENE FOR WOMEN AND GIRLS.”

Naeemah Abrahams, Shanaaz Mathews, and Petunia Ramela, “Intersections of ‘Sanitation, Sexual Coercion and Girls’ Safety in Schools.’” *Tropical Medicine & International Health* : TM & IH 11 (5)2006: 751–56.

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B. Suresh Reddy, and M. Snehalatha, “Sanitation and Personal Hygiene: What Does It Mean to Poor and Vulnerable Women?” *Indian Journal of Gender Studies* 18 (3)2011: 381–404.

4 *ibid*

5 *Anvita Anand, and Geetam Tiwari*, “A Gendered Perspective of the Shelter–Transport–Livelihood Link: The Case of Poor Women in Delhi.” *Transport Reviews* 26 (1)2006: 63–80.

6 *Hendriksen et al*, “Participatory Decision Making for Sanitation Improvements in Unplanned Urban Settlements in East Africa.” 98-119

Renu Desai, Colin McFarlane, and Stephen Graham, “The Politics of Open Defecation: Informality, Body, and Infrastructure in Mumbai.” *Antipode* 0, no. 0 (August 22, 2014): 1–23.

7 *Ibid, Joshi et al*, “Health, Hygiene and Appropriate Sanitation”, 91–111.

8 *Sylvia Chant*, “Cities through A ‘gender Lens’: A Golden ‘urban Age’ for Women in the Global South?” *Environment and Urbanization* 25, no. 1 (March 11, 2013): 9–29.

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9 *Jaya S. Anand*, “Self-Help Groups in Empowering Women : Case Study of Selected SHGs and NHGs.” *Thiruvananthapuram*, 2002:5.

10 *Scampini and Raaber*, *Re-Envisioning Development, Exploring Alternative Constructions Across the Globe*, 4

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11 *Chandra Talpade Mohanty*, “Under Western Eyes : Feminist Scholarship and Colonial Discourses.” *Boundary 2* 12, no. 3 (1984): 333–58, 344

12 *ibid*

13 *Jennifer C Nash*, “Reithinking Intersectionality,” *Feminist Review* 89 (2008): 1–15.

13 *Reeves*, “Mainstreaming Gender Equality An Examination of the Gender Sensitivity of Strategic Planning in Great Britain.”, 198

14 *Kimberle Crenshaw*, “Mapping the Margins : Intersectionality , Identity Politics , and Violence Against Women of Color,” *Stanford Law Review* 43, no. 6 (1991): 1241–99

15 *Valentine*, “Theorizing and Researching Intersectionality: A Challenge for Feminist Geography.” *The Professional Geographer*, 10

16 *Ibid*.

17 *ibid*,

Gabriele Winker and Nina Degele. “Intersectionality as Multi-Level Analysis: Dealing with Social Inequality.” *European Journal of Women’s Studies* 18, no. 1 (January 20, 2011): 51–66.

Leslie McCall, “The Complexity of Intersectionality,” *Signs, Chicago Journals* 30, no. 3 (2005): 1771–1800

18 *Nash*, “Reithinking Intersectionality.” Pg:2

Situating ‘Women’ (with)in the Development Discourse

Regardless of the various ways in which development has been envisioned and implemented, women and their rights have been portrayed as being perpetually subject to marginalization or instrumentalization. Nobel laureate Amartya Sen (1999:203)⁹ however, poignantly states that ‘nothing, is as important today in development than an adequate recognition of political, economic, social participation and leadership of women’.

When the notion of gender equality began to enter the development agenda, it did not lead to equality but rather to strategies on how to incorporate women into models to engender the analyses, goals and strategies¹⁰. Chandra Mohanty¹¹ elaborated on the problematic of use of ‘women’ as a group by stressing on the implicit assumption of ‘an ahistorical, universal unity between women based on a generalized notion of their subordination’. She argued that such simplistic formulations can be reductive and ineffectual in designing strategies to combat oppressions¹². Many feminist scholars have also voiced calls to destabilize the notion of a universal ‘woman’ by highlighting how contested the term is due to the experiences of women being comprised of subjects with vastly different interests¹³.

Additionally, feminist ethnographers in the early 1990s also questioned the value of including women as an isolated ‘category’ and called for a shift away from an analytical lens from a ‘women only’ focus¹⁴. These studies, revealed that it was not possible to separate out multiple categories of gender, race and class and to explain inequalities through a single framework. Hence, intersectionality emerged as a concept to theorize on and empirically analyse the relationship between different social categories: gender, race, class, sexuality, ethnicity and so forth¹⁵. The term intersectionality, coined by legal scholar Kimberle Crenshaw, underscored the ‘multidimensionality’ of marginalized subjects’ lived experiences¹⁶. Intersectional analysis describes acts of discriminations, concealed power relations and how they construct identities through sustained interventions of multiple categories¹⁷. Intersectionality rejects the ‘single-axis framework’ and analyses ‘the various ways in which race and gender interact to shape the multiple dimensions of Black women’s (...) experiences’ (Crenshaw, 1991: 1244).¹⁸

However, the intersectional approaches in social sciences have paid less attention to the significance of space in the process of subject formation¹⁹. Little research has also been conducted in rethinking intersections of systems of oppression and structures of power that frame social positions of individuals and gender inequality²⁰. Feminist scholars from the global south have stated the need for an intersectional perspective on oppression by highlighting how western feminist discourses bind women through the normative sociological notion of the “sameness” of oppression while ignoring the pluralities of different groups of women in diverse social classes and ethnic frameworks²¹. These discourses often fail to acknowledge that it’s not the “sameness” of oppression but rather the sameness of “experiencing” oppression²². Furthermore, the way socio-technical arrangements mediate these systems of oppression and women’s unequal access to critical infrastructures has been largely neglected in the debates on intersectionality. Instead of merely summarizing the effects of a singular oppressive category, intersectional analyses stress on the links between multiple categories and how they can mutually strengthen or weaken each other²³. Hence, the following sections focus on the interrelation of these categories namely gender(ed) interaction with technologies and intersection of violence with urban space.

Gender(ed) Interaction with Technologies and Technical Infrastructure

This section focuses on firstly, how publicness and privacy are negotiated through embodied spatial practices and the negotiation of access to public space. Everyday appropriations of urban public spaces (like communal/shared toilets) by marginalized groups represent their claim for a space of privacy and security. The different ways in which spaces are invested by individuals and groups puts an emphasis on how they seek to shape the city to their needs. Building up on these everyday interactions of users and infrastructure, the section then digresses to discuss how the female users become a socio-political tool within urban infrastructure regimes. Technology is often observed as a significant site of gender negotiations where both masculine and feminine identities are constructed and deconstructed²⁴, however, women’s everyday encounters with technological artefacts are rarely recognized²⁵ with one in three women still lacking access to safe toilets worldwide.

Women have been observed to give higher priority to sanitation than men because of health benefits and privacy. The social facilities to which women need access are often inappropriately located²⁶. Moreover, an inappropriate design of sanitation arrangements can deter their use or exacerbate maintenance problems. In many cases, the failure to involve women in the design of infrastructure facilities may result in inappropriate standards and technological artefacts and it can restrain their commitment to maintenance²⁷. Additionally, what is provided as sanitation is often determined by engineering, environmental and public health concerns that are far removed from women’s needs, their socio-cultural practices and existing gender constructs. Thus, while sanitation needs are indeed universal, more research is needed on the gender-related constructs and implications in the design and promotion of basic sanitation infrastructure within diverse groups.

In addition to spatial analysis, discourses in gender and technology studies also highlight the role of users (of technology or technical systems like sanitation infrastructure) in interpreting, using and talking about technologies, to contribute to their social shaping. In this sense, a look to feminist studies of science and technology could bring an insightful perspective to analyse gender inequality in sanitation. Indeed, feminist researchers of technology have emphasized the need to focus on women’s “lived experience” as a way to give women a voice in the construction of new knowledge²⁸. Hence, the following paragraphs describes how women as users inform, interact and transform infrastructure and technology.

19 *ibid*

20 Valentine, “Theorizing and Researching Intersectionality: A Challenge for Feminist Geography.” *The Professional Geographer*, 10

21 Mobanty, “Under Western Eyes: Feminist Scholarship and Colonial Discourses”, 337

22 Sumi Cho, Kimberlé Kimberlé Williams Crenshaw, and Leslie McCall, “Toward a Field of Intersectionality Studies: Theory, Applications, and Praxis,” *Signs: Journal of Women in Culture and Society* 38, no. 4 (2013): 785–810, doi:10.1017/CBO9781107415324.004.

23 Winker and Degele. “Intersectionality as Multi-Level Analysis: Dealing with Social Inequality.” 51–66.

24 Maria Lohan, “Men, masculinities and ‘mundane’ technologies: The domestic telephone”, in “Virtual Gender: Technology, Consumption and Identity”, ed. Eileen Green and Alison Adam, (London and New York: Routledge, Taylor and Francis Group, 2013), 149.

25 Wendy Faulkner, “The Technology Question in Feminism: A View from Feminist Technology Studies,” *Women’s Studies International Forum* 24, no. 1 (2001): 79–95

26 Rakodi, “Cities and People: Towards a Gender-Aware Urban Planning Process?”, 541.

27 *ibid*

28 Mary Margaret Fonow and Judith A. Cook, “Feminist Methodology: New Applications in the Academy and Public Policy.” *Signs, Chicago Journals* 30, no. 4 (2014): 2211–36.

29 *ibid*

30 Judy Wajcman, “FROM WOMEN AND TECHNOLOGY TO GENDERED TECHNOLOGY,” *Information, Communication & Society* 10, no. 3 (n.d.): 287–98. pg 294

31 *Ibid*.

32 Els Rommes, Ellen van Oost and Nelly Oudsboorn, “Gender in the design of the digital city of Amsterdam” in “Virtual Gender: Technology, Consumption and Identity”, ed. Eileen Green and Alison Adam, (London and New York: Routledge, Taylor and Francis Group, 2013), 191

33 *ibid*

34 *ibid*

35 *Ibid*.

36 Faulkner, “The Technology Question in Feminism: A View from Feminist Technology Studies,” 91

37 *ibid*

38 *Ibid*.

39. Abrahams et al, “Intersections of ‘Sanitation, Sexual Coercion and Girls’ Safety in Schools’.” 751–56.

40 *ibid*

41 Tanusree Paul, “Space, Gender, and Fear of Crime: Some Explorations from Kolkata,” *Gender, Technology and Development* 15, no. 3 (October 31, 2011): 411–35, doi:10.1177/097185241101500305.

42 Reddy and Snehalatha, “Sanitation and Personal Hygiene: What Does It Mean to Poor and Vulnerable Women?”, 381–404.

It has been argued that technologies gain gender identities when they enter into our everyday structural relations and cultural meaning systems and can become actors or agents in the material and symbolic practices of everyday lives²⁹. The interpretation, reading and making sense of technologies is now understood to be a constant feature within the everyday life. Indeed, the concept of gender itself is now understood ‘as a performance or social achievement, constructed in interaction emerging from collective and individual acts of interpretation.’³⁰ However, much of the available scholarship on women and technology fails to capture or explain women’s ambivalence about technologies they encounter. This can be attributed to the fact that technology is often seen as ‘socially shaped, but shaped by men to the exclusion of women.’³¹

Traditionally, users have been regarded as important actors in the diffusion and acceptance of new technologies³². However, innovators often construct many different representations of users and objectify these representations in technological choices³³. This results in technologies containing ‘scripts’, which assign specific competences, actions and responsibilities to its envisioned users. Users of technology often tend to experience them as gendered and hence, when the scripts reveal a gendered pattern, they are called ‘gendered scripts’³⁴.

Earlier research has revealed that scripts also contribute to the exclusion of specific users if designers’ image of the envisioned users only represents a selective set. Furthermore, feminist techno-science debates describe how the materiality of technology can inhibit particular gender power relations by exposing how the concrete practices of design and innovation lead to the absence of specific users.³⁵ This accentuates the mismatch between the designer’s image of the users and the actual users of the infrastructure and technology.

However, some studies have also shown that technology can aid female empowerment by appropriating individual technologies in practice by including wider gender contexts within which they are designed and used³⁶. Critical feminist technology assessment highlights the need to give voice to the full range of interested groups in technological design by starting a critical debate on what and whose needs are to be met³⁷ and how the world we live in is designed, and for whom. Although it is challenging to specify design characteristics of artefacts that would guarantee more inclusiveness, it is imperative that women are involved throughout the processes and practices of shaping technological innovation. ‘We live in a technological culture, a society that is constituted by science and technology, and so the politics of technology is integral to the renegotiation of gender power relations.’³⁸

In addition to the earlier mentioned risks faced by women users, an inadequate access to sanitation services and existing infrastructure designs can also expose women to acts of violence and reports indicate increased violence around sanitation infrastructures³⁹. Such gender-based violence has been observed to instil a mobilizing fear and insecurity in the public space⁴⁰. Hence, the next section discusses the intersection of women with violence and urban space.

Intersection of Violence with Urban Space: Urban Routines, Fear and Insecurity

Feminist analyses are tethered to spatialities and temporalities. Urban routines constitute an infinite range of occurrences: from the everyday life, to events, such as disruptions of access to public space. Most literature pertaining to women’s access to public spaces is imbued with evidences of fear of crime as a key constraining factor⁴¹. Fear has been conjectured to be emanating from feelings of uncertainty, helplessness, and vulnerability, and could vary depending upon the level of social well-being and racial and class affiliations. Previous studies reveal that one of the challenges women face with sanitation infrastructure is their need to look for a secluded place to defecate in poor areas⁴², which often leads to increased risk of them being subjected to violence.

Fear is also experienced differently by men and women⁴³. In a patriarchal society like India, women fear public places as they relate it to ‘fear of shame and dishonour associated with being out-of-place’. They tend to avoid places that are lonely, deserted, or marked by disorderly and disreputable behaviour, since visibility in these places is fraught with the dangerous consequence of being socially stigmatized⁴⁴.

A discussion on gender violence requires that we understand how power crosses both concepts. As said earlier, gender is always a definition of a relationship between what it means to be men and women in a particular society and time frame, and taking into account that our world is intrinsically socially and economically unequal, gender relations are also immersed in a field of power relations. On the other hand, violence is also closely related to power since acts of violence are extreme and dramatic exercises of power.

An important factor to take into account when examining violence is the changing role of women in the society that has led them to access public spaces more and this leads to clashes with existing cultural practices and unequal gender relations. Despite women facing violence in private homes, ‘it is the spaces clearly defined as ‘public’ that they fear most’ and that ‘research demonstrates that this fear of public spaces is true for women of all socio-economic classes, ages and stages in the life cycle’⁴⁵. Access to public space also brings in the debate on socio-economic independence for women and provides them more visibility and participation in public spaces which is pointed as ‘traditionally a male prerogative’⁴⁶. Hence, ‘spatial design as a device of social control and exclusion (between spaces/ places of the city and between private and public spaces) has negative effects on gender relations as it disempowers women and with perverse effects on city public spaces’⁴⁷. Therefore, what seems clear is that there is a need to go beyond awareness of gender as an important variable in development, and to impart skills which can translate this awareness into concrete practice.

In the next section I describe the methodology used during fieldwork and I also provide some data collected that enabled me to propose some conclusive remarks concerning the relations between gender and inequality in the study of sanitation infrastructures.

Methods: Delineating the Agenda and Interviews

I approached the question of gender inequality in sanitation through a mixed-methods research to substantiate the need to tackle the growing gender based violence around communal/shared sanitation facilities in informal settlements, but specially to furnish the study with some qualitative depth that brings forth the voices and experiences of women. I conducted preliminary ethnographical fieldwork in Dar es Salaam and Nairobi in March-April 2015. The selection of these two research contexts was based on the fact that both are currently shaped by collaborative & co-productive arrangements of informal and/or self-organized provision of services that coexist (with some contestation) with municipal service provision. Both cities had a similar colonial and post-colonial trajectory and have been previous sites of infrastructure upgrading programmes led by the World Bank. However, despite the apparent similarities in the context namely the language, population size and urban development trajectory, the cities also have a contrasting view of tackling the growing informal settlements and provision of formal services to its residents. Based on these rationales, I chose Mlalakua informal settlement in Dar es Salaam and Jangemi ward of Mathare informal settlement in Nairobi as case studies.

I conducted semi-structured interviews and chose to firstly interview women residents of both the settlements to highlight the coping mechanisms used by them to tackle the safety and insecurity they face while accessing shared sanitation facilities. While I also interviewed male residents, for this article I

43 *ibid*

44 *ibid*

45 Y. Narayanan, “Violence Against Women in Delhi: A Sustainability Problematic,” *Journal of South Asian Development* 7, no. 1 (July 19, 2012): 1–22, doi:10.1177/097317411200700101.

46 Neha Dixit, “Rape in India Reading between the Lines *AlJazeera America*,” *Al-Jazeera America*, 2014, <http://america.aljazeera.com/articles/2014/6/15/rape-in-india-readingbetweenthehlines.html>.

47 C. Levy, “Gender and the Environment: The Challenge of Cross-Cutting Issues in Development Policy and Planning,” *Environment and Urbanization* 4, no. 1 (April 1, 1992): 134–49, doi:10.1177/095624789200400114.

48 Yamini Narayanan, “Violence Against Women in Delhi: A Sustainability Problematic,” *Journal of South Asian Development* 7, no. 1 (July 19, 2012): 1–22

chose to present the everyday experiences of women. Previous literature often tends to portray the distinctive voices of women as either stereotyped or additions in development studies despite being vitally relevant in these aspects. However, women’s views and experiences should be central in informing urban development planning and implementation. This allows gender to be understood as a participative and inclusive, rather than a reactive element and where gender is a major category of analysis while conceptualising as well as implementing policy⁴⁸.

The aim of the semi structured interviews was to understand women’s experiences of using a shared toilet, the challenges faced (if any) in accessing the service, their preference for a toilet type and finally their infrastructural priorities in daily life. I intended to substantiate my presumptions with the interviews and chose firstly, a focus group of teenage mothers in 4A village in Mathare Informal Settlement in Nairobi and secondly, women residents of Mlalakua Sub-ward in Dar es Salaam as I identified them to be key players in my research due to their perceived vulnerability. The interviews were conducted with the help of a female research assistant who also acted as a translator since I did not speak Swahili which is the local language in Dar es Salaam and Nairobi. I felt that due to the existing sensitivity surrounding sanitation due to socio-cultural constructs, I needed a translator for the women to feel safe about talking about issues of sexual harassment and health related problems (e.g. Urinary Tract Infection). It’s imperative for my research that the women talk freely and feel comfortable while expressing their concerns and opinions and hence, my female research assistant was able to make the discussions easier for the discussants in Swahili. The data collected was then transcribed and preliminary findings were then highlighted.

Focus Group Discussion: Mathare, Nairobi, Kenya

I conducted two focus group session consisting of a total of 22 women from the Teenage Mothers Programme run by the NGO Mathare Children’s Fund (MCF) in the 4A village in Mathare Informal Settlement over the course of two field visits in March-April 2015 and February-April 2016. The interviews used during the focus groups were primarily focused on the provision of toilets in/nearby their household, the challenges faced in accessing the infrastructure with children and their experience (if any) with gender based violence. The women ranged between an age group of 16-23 years and were all learning the craft of tailoring and stitching.

The discussants divulged firstly, most of them used shared communal toilets with other households. All of them agreed that the toilets were not maintained and complained of contracting UTI (Urinary Tract Infection). Secondly, most women also found it difficult to access the toilet at night with one discussant claiming to “not drink any water at night after 6pm”, the next saying that ‘toilets were mostly locked at night’, a third one claimed that she ‘takes different routes to open defaecation at night’ and another stated the “lack of light at night” in the settlement as challenges. All respondents stated their toilets to be ‘unhygienic’ and then as a group discussed how the community toilets in the settlement were ‘too expensive’ for them to afford with them being charged ‘10 Kenyan shillings’ for one time usage.

Lastly, upon inquiring about the coping mechanisms used by them to tackle the inadequate sanitation facilities, one discussant stated that she ‘uses the toilet at nearby school in day’, a second responded by saying ‘be creative at night’, another said she ‘uses a bucket at night and empties it in the open drain in the morning and finally, one after hesitation said she used ‘flying toilet at night’.

Open Sewage drainage in Mathare River in Mathare 4A informal Settlement area.

Source: Author



Semi-Structured Interviews: Mlalakua Sub Ward, Dar es Salaam, Tanzania

In Dar es Salaam, using the same interview guides, I conducted individual semi-structured interviews with 30 female residents from the Mlalakua informal settlement over the course of two field visits in March-April 2015 and February-April 2016. The women were chosen based on their willingness to speak and share their opinions. Women residents were approached with the help of a local elected official and a female research assistant. The residents were first made aware of this research being an academic study and then based on their willingness to participate in the interview; they were posed the questions from the interview guide. The interviews revealed some interesting observations.

A majority of women had access to only 'shared toilets' with the most prominent toilet type being the 'squatting pit latrine'. Hygiene issues were stated as the biggest challenge being faced by them with most of the women complaining of contracting UTI. Another question that emerged during the interviews is the difficulties that women confront in health and hygiene was also highlighted by one of the respondents' husband (who wasn't a part of the interview but was sitting outside the house and repairing his bicycle) who stated that 'his daughter complained of UTP' but was asked by his wife to not elaborate further.

Women also raised issues of fear and security in their answers. Most respondents stated that they usually asked 'someone to accompany them at night' because it made them 'uncomfortable'. What was striking was that almost all of the women when asked what made them uncomfortable at night stated 'it's dark at night'. The women also discussed feeling insecure and 'unsafe' going to the toilet at night due to a fear of being 'attacked' by robbers or 'men hiding behind trees'. One respondent stated that she was 'scared of being attacked but hasn't heard of any cases though of women being attacked'. A second one disclosed that she 'was beaten by men before' but now felt safe as 'the toilet has light now so it's comfortable'.



Structural conditions of the toilets in Mlalakua Ward.
Source: Author

Another set of questions had to do with issues related to access and design of the toilets. Women responded by claiming that the toilets made them uncomfortable because the 'door' didn't have a lock. Another respondent stated that the 'toilet has no door so we put a cloth in front but its uncomfortable'. A pictorial analysis of the various toilets present on the site also highlighted the 'lack of locks' on the toilets and 'their temporary construction'.



*Structural conditions of the toilets
in the settlement without doors.*
Source: Author

The last set of questions focused on what toilet type they preferred and their priority of infrastructures in daily life. Almost all women preferred a 'squatting toilet'. One respondent stated that she was uncomfortable in 'sharing a sitting toilet with so many people'. Most women expressed hygiene concerns of sharing a sitting toilet. Finally, all women stated being responsible for water collection for drinking and toilets for the households. Most of the women were involved in informal economic activities like selling 'Mandazis' (a homemade sweet from white flour and sugar) and one respondent stated that she uses the money she earns to 'buy a 10-litre bucket of water for 20 TZS (Tanzanian shilling) per day'.

Conclusions

The everyday experiences described by the women during the fieldwork pose some theoretical challenges to analyse the complex question of women's access to sanitation. The women interviewed in Dar es Salaam and Nairobi expressly described their fear and insecurity while trying to access the shared sanitation facility that's provided due to inadequate space for a private toilet within their residences. They utilise various coping mechanisms to negotiate their daily lives and growing fear of urban public spaces. These everyday interactions with shared/communal sanitation facilities highlight how gender inequality in urban spaces is manifested in the access routines women establish within informal settlements. These negotiations also highlight that sanitation for women users is determined by not only health and hygiene concerns but also a growing fear of facing violence while accessing shared toilets. However, the continued advocacy for 'shared toilets' by governmental and developmental agencies raises questions of reductive design and planning strategies as provision of this infrastructure has not shown a decrease in the violence faced by these women due to open defaecation.

Furthermore, the women residents also present an informed framing of these issues which can help in enabling appropriate policies and design strategies to be articulated and implemented. The narratives of individual women in informal settlements and their lived experiences shed a light on how women inform, interact and transform infrastructure in informal settlements. Hence, this highlights the need to incorporate women users in the design of technology and technical artefacts. Additionally, the empirical evidence also highlights the role women users are playing in re-writing the gender script of the sanitation infrastructure. The role women residents play in shaping infrastructure and technology needs not just mere acknowledgement but incorporation within the gendered scripts of the infrastructure. Critical feminist technology assessment has led to calls for the voice of the users to be included in a more dominant manner. Hence, there is an emerging need to not just incorporate women as merely 'informants' but to acknowledge the emerging power of women residents as knowledge producers in design and planning of infrastructure.

Preparedness & Prevention Strategies for Critical Infrastructures: The Relevance of Disruption Programs in Engendering More Resilient Railway Operations.

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Abstract

Mass transportation systems are critical elements required for the proficient development of large urban areas. Around the world, cities have been arranging ever more interconnected and compound public transport networks making them more susceptible to sudden and often unpredictable disruptions. Bearing in mind the relevance of transit systems within densely populated urban environments, special emphasis must be given to safeguarding the stable operation of those with the most preeminent hauling capabilities (i.e. Rail based systems). In particular, commuter rail systems with their stringent operational features (e.g. high frequencies in their core routes) are able to transport significant numbers of passengers, yet these characteristics put enormous pressure on securing their constant and reliable functioning. Their mounting complexity, namely their physical expansion and protracted integration with other systems (e.g. IT, electromechanical, etc.), has engendered increased vulnerabilities and made them more susceptible to a broader range of disturbances. Consequently, with the purpose of enhancing the coping capabilities of commuter rail networks against these unavoidable occurrences, different rail operators across Europe have been producing pre-structured disruption programs (better known as DRPs).

DRPs are preconfigured protocols that allow dispatchers to handle the manifestation of a wide array of disruptive events more efficiently. This article recognises the crucial role that preparedness and prevention strategies play in the provision of more robust mass transport services in this arena. What is more, it argues that disruption programs are crucial assets, which lay at the crux of conceiving more resilient urban railway operations. By consolidating existing protocols across different commuter rail systems, placing particular emphasis on the German disruption programs for “S-Bahn” lines, it discusses the ability of disruption programs to protect user related transport qualities, increase network robustness and in turn, benefit the urban fabric in which they are deployed.

1 Introduction

The habitability of dense urban centers can only be sustained by providing a steady access to basic services. From drinking water, to sewage, waterways, roads, railroads or communication networks, all make life within cities possible (Godschlak, 2003). Infrastructures are considered to be ‘critical’ in nature, when the roles they fulfill (e.g. health, safety, transport, etc...) are vital for maintaining basic societal functions, security and the overall wellbeing of the population they service (O’Rourke, 2007; Bach et al, 2014). The prominence of these elements is such that if any of their functions ceases to perform as expected by the general population, they would be forced to deal with the most precarious of conditions. Consequently, paramount emphasis must be given to upholding and safeguarding the constant operational integrity of these infrastructural systems, particularly,

in the face of any external or internal hazards that may affect their normal operations. The primary focus of this article lies on commuter rail systems and the indispensable need to manage any disruption to their operations.

Safeguarding critical infrastructures and service reliability is a dynamic process that transcends the notion of considering vulnerability reduction as a matter of procuring stronger or more robust infrastructures (Godschlak, 2003; Chelleri et al, 2005). Primarily, critical infrastructures are characterized to be among the most complex forms of infrastructure. Their complexity derives from the fact that they cover vast geographical areas, cluster a broad arrangement of different components and interlace with deep socio-economical functions. These features also account for making them particularly susceptible to a wider range of risks and ultimately hindering their capacity for adaptation (O'Rourke, 2007). It has been understood that an adept way to cope with the unexpected manifestation of such tribulations has been through risk mitigation or by developing broader preparedness and prevention strategies.

Introduced throughout the first half of the twentieth century in the context of critical infrastructure as "Distributed Preparedness" (Collier & Lakoff, 2008), this concept has laid the ground work for the current emergency or disaster risk, management framework (i.e. preparedness, prevention, response and recovery) (King, 2006). Nonetheless, preparedness and prevention have been essentially considered as one conjoined concept. They have not only been packed together within the term "mitigation", but recognized as to be utterly contingent on one another (see, King, 2006). Hence, preparedness and prevention (P&P) will be discussed as a joint notion within this article.

Together, P&P strategies lay at the crux of any system's ability to handle the manifestation of atypical and ominous events as they inherently recognize the inescapable possibility of an impairing incident. In this regard, P&P strategies prompt a set of policies, plans or strategies intended for diminishing the overall reach and occurrence probability of a disaster (Haimes et al, 2008). A further interpretation expands their focus towards considering them an enhanced management tool of emergencies and a proficient path towards achieving some degree of operational continuity in the course of failure or disruption (Hémond & Robert, 2012). Ideas such as the operational continuity of critical infrastructure reside at the core of the broader resilience seeking agenda. Therefore, it becomes necessary to place P&P strategies within the expanding debates about resilience and their liaison with the urban environment.

The clear objective of this article is to discuss P&P strategies as chief elements within critical infrastructure operations and integral parts for their resilience agenda. So as to build up this appreciation, a practical example is analyzed around how P&P strategies are able to promote more reliable and stable critical infrastructure services during disruptions. Commuter railway operations offer just such an example, as their prominence within the urban environment has been steadily rising over the past few decades. The core of this illustration is described by a set of operational protocols developed within the German commuter rail disruption management for their heavily patronized "S-Bahn" lines. As a whole, the example intends to depict P&P strategies as integral features fundamental to achieving more resilient operations. Clear limitations are considered when referring to these strategies since they are exclusively centered on rail operations and leave aside more infrastructural or physically related measures. In order to reach a worthy conclusion, first it is important to frame P&P strategies within the critical infrastructure resilience understanding and elaborate on the relevance of commuter rail systems as critical infrastructures within the urban arena. Then the article discusses the importance of P&P strategies for the reliable operation of large, dynamic and complex systems (i.e. commuter rail networks) and subsequently, explores the benefits and drawbacks of the assessed P&P strategies

through the lens of critical infrastructure resilience. Ultimately, enough evidence is to be presented so as to conclude how relevant P&P strategies are in the search for more resilient operations. Two major themes characterize this assessment. On the one hand the ability of P&P strategies to adapt the overall system's operational capabilities while securing some degree of operational continuity is scrutinized and on the other their capacity to open a window of opportunity allowing the systems to develop much broader evolutionary forces is considered.

2 P&P Strategies and Critical Infrastructure Resilience

A deep exploration into scholarly debates about resilience is beyond the scope of this work. However, it is necessary to acknowledge their impact on existing critical infrastructure considerations as well as its relation to P&P strategies. Resilience in its broader sense is used to describe the ability or condition of a system to interact with external forces. Within this context, P&P strategies and the resilience agenda find a mutual objective in critical infrastructures as they concern themselves with the reliance of urban environments on these systems and with the attainment of a continuous and more reliable service capabilities.

In the context of this article the understanding of resilience will be approached through the broad framework provided by Bach et al, as it delivers insightful interpretations for the concept as a whole. Within the infrastructural realm, they describe resilience not only as a characteristic that enables systems to regain or maintain their original functions in the shortest time possible after the manifestation of a disruption (bouncing back), but as having the capacity to preserve service qualities and adjust as well as retaining adequate interactions with other systems (Bach et al, 2014). Nonetheless, such an appreciation lacks the acknowledgement of what scholars refer to as a continuous learning and uncertain evolutionary process proclaimed over the basis of adaptable persistence (Folke et al, 2010; Chelleri, 2015; Hémond & Robert, 2012). Therefore, resilience in regard to critical infrastructures must take account of the ability of these systems to cope with external forces, adapt to suddenly changing conditions while upholding as many service capabilities as possible and eventually boost transforming, learning or evolutionary capacities.

The combined reach and further appreciation of P&P strategies within a resilience framework is quite broad, and not fully asserted within critical infrastructure debates (Haimes et al, 2008; Mattsson & Jenelius, 2015, Hémond & Robert, 2012). However, for the purposes of this article, two relevant understandings employed in describing the association of these two concepts have been identified.

On the one hand, P&P strategies have been portrayed as fixed strategies that need to be guided toward developing a more resilience-related agenda (Hémond & Robert, 2012). Here, P&P strategies are read as a set of rigid protocols that follow a strict timeline and as a consequence they perpetuate the pre-existing character of the system. Thus, it is maintained that due to their static structures they are not able to foster authentic adaptive capacities (Hémond & Robert, 2012, 412). Such a flaw becomes the principal reason for upholding the view that P&P strategies must evolve towards a more resilience related framework.

On the other hand, P&P strategies are said to be already existing assets within a resilience focused framework, which require to be better balanced with further aptitudes (i.e. response, adaption) (Haimes et al, 2008; Mattsson & Jenelius, 2015, 20). In this regard, P&P strategies are promptly considered a corner stone within resilience, aimed at protecting the integrity of the system's overall service capacities, and a decisive enabler of adaptable capabilities following shocks (Haimes et al, 2008; Mattsson & Jenelius, 2015). Within this description, a key notion emerges. That being the "acceptable level of functioning" (Hémond & Robert, 2012, 413). Ascertainably, the "acceptable level of functioning" lays the ground work for understanding that failure is unavoidable and clear measures are

needed to deal with degraded situations. In the context of critical infrastructure dealing with degraded conditions means adapting complex systems to a broad range of unknowns. Consequently, P&P strategies seek to secure the link between stable operations and degraded situations, while guarding the welfare of critical infrastructures users.

Together, both perspectives allow visualizing critical infrastructures P&P strategies within more dynamic and adaptable approaches, demonstrating common objectives to those of the resilience agenda. The first perspective brings attention to the strict nature of P&P strategies and advises to develop more resilient qualities instead. However, this understanding shows a complete disregard for the way P&P measures are able to boost critical infrastructures' ability to ensure operational continuity. At this point, it must be recognized that if these strategies or protocols were not in place the system would collapse in the early moments of a disruption, restraining its adaptive capacities and endangering user welfare. The immediate consideration when developing P&P strategies consists of the exploration of unexperienced operational levels. Thus, it is uniquely then that it is possible even to consider exploring ideas of system transformability and/or evolution. Consequently, P&P strategies will be understood as convergent elements inside the critical infrastructure resilience framework.

3 Rail Systems as Critical Infrastructures

The important role played by mass transport systems, and in particular commuter rail systems, within the urban fabric, puts great pressure on safeguarding their reliable service capabilities. A deeper appreciation of transit mechanisms indicates that they ultimately define or influence a wide array of urban structures. Within the current global dynamic, each component servicing densely populated areas ought to capably cater to the needs of the population and environment. In this regard rail systems have slowly been recovering the significance they once held as the leading transport mechanisms, while displacing the prevalence of a private motorized mobility paradigm.

Transport systems, especially those servicing densely populated areas, are critical infrastructures intended for the uninterrupted functioning of society. In cities around the world, globalization has reinforced the unavoidable necessity to erect large, complex, and interconnected mass transportation systems so as to enable a more efficient transfer of passengers, goods, services and ideas (Tamvakis & Xenidis, 2012). Kenworthy & Newman explain, mass transit systems will ultimately: "...facilitate economies to create wealth while reducing automobile dependence ... enabling sustainable development, increasing livability and reducing poverty..." (2015, 77). However, in order to incentivize the ridership necessary to achieve the benefits public transit offers to society it becomes indispensable to provide users with a robust, first class system that guarantees, above all other things, a stable serviceability. Accordingly, public transportation systems must be as reliable and as time efficient as private vehicles, while ensuring the overall commuting experience remains comfortable (Newman et al, 1999). In essence, transit systems not only enable society to aptly exploit the benefits of living in urban agglomerations, but in fact they constitute a critical component in supporting the continuance of their regular activities and strived development.

At this juncture in time, with the rearrangement of urban transport priorities, it becomes necessary to pay much closer attention to electrically powered vehicles with superior hauling capabilities (e.g. trains, metros and trams). In the most densely populated cities, rail based systems constitute the backbone of the transport networks (Litman, 2007). It has been argued that rail based transport in the form of regional railways, metros and commuter rail lines has a comparative advantage over other forms of transportation, evident in their efficient energy and space consumption, as well as the alternative they provide to mounting road

congestion (Tamvakis & Xenidis, 2012). In general terms, rail systems have started recovering their historical importance as their patronage has been growing at a constant rate throughout the beginning of the twenty-first century (Kenworthy & Newman, 2015, 15). In particular, commuter rail systems across major urban areas have been experiencing a substantial increase in their patronage, service levels and operational speed, making them on average faster than most road traffic (Kenworthy, 2008; Nielsen et al, 2012). In turn, these systems are being expanded so extensively that some transport scholars maintain, "...we are entering a new Golden Age of rail ..." (Kenworthy & Newman, 2015). All in all, rail based systems are ready to reclaim their relevance within modern urban fabrics as they expand to accommodate the complexity of cities.

The efficiency and tremendous hauling capabilities of commuter rail networks gives these systems a strategic role within local transport structures. A clear instance of such prominence is captured by the German commuter rail lines known as the "S-Bahn", present throughout most of the country's major urban areas. The large number of passengers served by these regional networks makes their consideration of particular relevance. In Berlin alone, the "S-Bahn" network services 1.3 million passengers every working day and manages a network of 327 Km with 166 stations (DB AG, n.d.). These numbers are comparable in other German metropolises. For example, in Munich the "S-Bahn" transports 840 thousand people every day and manages a network of 530 Km and 150 stations (DB AG, n.d.). Within their core routes, the "S-Bahn" lines operate at very high frequencies and respect tight transport quality specifications. The system's efficient and effective service capabilities are only possible through specific infrastructural elements which enables it to move users without interrupting additional city functions. In most cities the "S-Bahn" main lines traverse the urban areas through tunnels (e.g. in Frankfurt or Stuttgart) and bridges (e.g. Berlin) where their operations gain particular complexity by the intricacy of the infrastructure. Conclusively, a disruption occurring at any of these sections may radically hinder the capacity of the entire network thereby affecting the urban area as a whole.

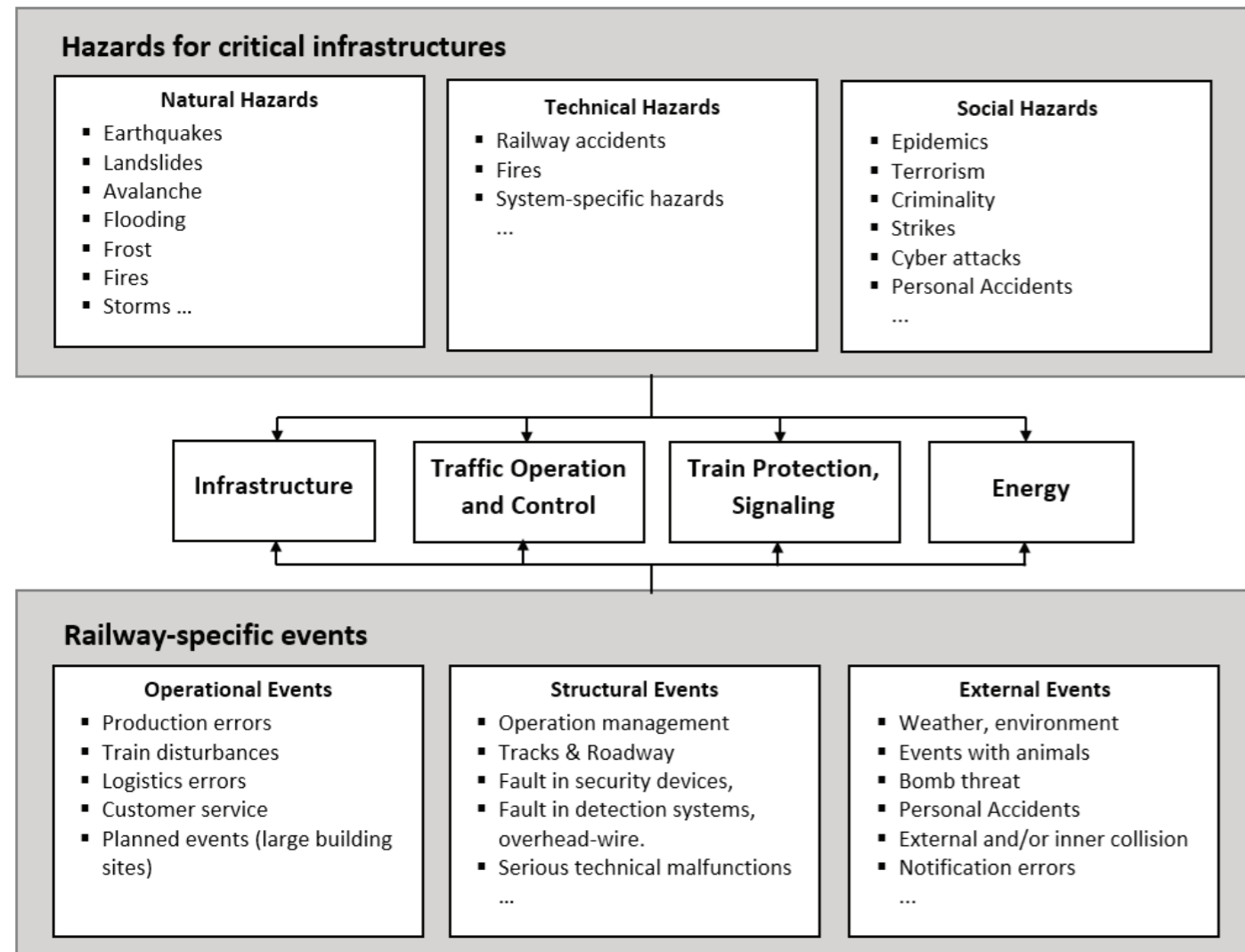
4 Railway Complexity and the Need of P&P Strategies

The growing prominence and intricacy of cities obliges regional rail systems to develop in parallel and operate within tight schedules so as to satisfy their transport demands. In contrast, railway operational stability is persistently threatened by the systems' own compound and convoluted character. These conditions make rail operations particularly vulnerable to the advent of any disruptive event. In view of this, it is necessary to examine issues regarding these systems' operational continuity in the midst of disruptive events.

Railway systems are characterized by their multidimensional nature and regarded as large dynamic, interdependent and complex systems (Kurant & Thiran, 2006; Newman ME., 2003; Chu, 2014). Their extensive geographical allocation together with their widespread assemblage of dissimilar elements and processes (i.e. stations, tracks, switches, vehicles, personnel, passenger traffic, signals, operation control, timetables, etc...) poses excessive burden on the control and maintenance procedures required for their operation. Consequently, managing railway networks becomes a highly composite undertaking influenced by ever changing external conditions, new interdependencies, as well as an extensive array of internal components that require close oversight (Tamvakis & Xenidis, 2012; Regianni et al, 2015; Nielsen et al, 2012). For these reasons, railway systems face an impending probability of failure as part of their most basic and inescapable nature.

As expressed above, the magnitude and intricate character of railway systems makes them prone to a multitude of potential vulnerabilities. A slightly simplified but accurate representation of the hazards that are most likely to affect critical

infrastructures, and in particular rail systems, is displayed in Figure 1. This figure is relevant due to the way it portrays threats, within four railway-specific dimensions (i.e. infrastructural, traffic operation & control, signaling and energy). Needless to say, each of the aspects represented in Figure 1, are materialized by their own convoluted features, affecting railway operations directly.



It should now be evident how the rail system's own complexity poses an immediate threat to its stable operation. Interestingly, an exploration into the causes of disruptions on rail networks has demonstrated that around 50% of the disruptions are caused by internal operational problems (e.g. vehicle problems, lack of staff, etc...), whereas the other 50% is the result of external events or indirect infrastructural breakdowns (Jespersen-Groth et al, 2006). In response, rail infrastructure and transport operators have put forward approaches to tackle the different system's features, aimed at instituting more resilient services. Perhaps, the most conventional measures focus on enhancing the infrastructural sphere through physical interventions (e.g. flood protection walls, expanding the drainage along the tracks or endeavoring to improve station designs) (Jaroszweski et al, 2014). Nevertheless, actions fixed on tackling issues of traffic control and other operational aspects of railway services are just as necessary. Within rail operations, it is common knowledge among practitioners that the systems' composite conditions allow for disruptions to spread rapidly over space and time and create what they call "knock-on" effects. Knock on effects refer to the way in which the deviation of a single train drive or operational process can echo throughout the entire network, causing major cumulative effects (Jespersen-Groth et al, 2006). The systems' high physical and operational inertia severely limits its physical adaptability

1) Overview of possible disruptions for critical infrastructures and railway traffic. Source: (Dobritz u. Weidmann, 2012) as cited in (Chu, 2014).

and stresses the need for enhanced operational coping mechanisms. Thus, any debate about resilience in rail systems should not only focus on their capacity to physically withstand shocks, but also the capacity of the system to remain or regain operational capabilities (adapting to the circumstances) during a disruption. Maintaining continuous operational qualities requires ensuring ample availability of highly specialized resources such as experienced dispatchers, contingency plans, communication technology, etc. Given that disruptions in rail operations can occur due to different causes, staff members need to be well prepared to address this situation rapidly (Chu, 2014; Nielsen et al, 2012). Rerouting and rescheduling of rail vehicles is a much more complex task than it would be among its rubber based counterparts (i.e. buses or personal motorized vehicles). In the event of sudden disruptions, operators must take critical decisions in short periods of time and within stringent and uncertain conditions (Nielsen et al, 2012). These decisions ultimately echo throughout the efficiency of the whole network and affect passengers' welfare (Ghaemi et al 2016). Thus, decision-making mechanisms to return to stable operations demand great determination. Building upon the German commuter rail networks example, assume a disruption were to take place inside a heavily transited tunnel section of the "S-Bahn" network in Frankfurt. As an average trunk route, it operates with homogeneous traffic with frequencies of up to two minutes per direction. This means that only 15 minutes after the disruption, at least ten or more trains will have been obstructed (Chu et al, 2013). Consequently, railway dispatchers must execute the best suiting measures within a very limited amount of time and with a restricted availability of information (Chu et al, 2012). Handling particularly relevant issues within such strained operating conditions obliges operators to develop insightful preparedness strategies so as to cope with the unforeseeable events. An adept effective way to cope with disruptions can be through the implementation of pre-structured or pre-defined P&P programs built upon specific degraded scenarios. This procedure identifies the different elements or operations that need to be maintained in order to ensure an "acceptable level of functioning" throughout the system. In a broad sense, disruption programs are pre-emptively structured protocols that allow rail systems to better cope with sudden disruptions in their normal operations. These preconceived programs, also referred to as "DRPs" (Disruption Programs) or by their German abbreviation "SFP" (meaning "Störfallprogramme") (see Figure 2.). Their main objective is to ensure that during a disruption, the scheduling, dispatching and operational flow of railway vehicles is performed in the most efficient way possible. This will lead to shorter reaction times and a more precise implementation of measures, preserving the serviceability of the overall system

2) Disruption Program Handbooks for S-Bahn lines (left: DRP for the S1-Nuremberg; right: DRP for all lines – Munich) Source: DB Regio Bayern, 2012 (left) DB Regio AG, 2015 (right)

S-Bahn Handbuch	
Störfallkonzepte für örtliche Aufsichten, Ansager, Reisendenlenker und Tf	SB 002.0100 bis SB 002.3100



S - Bahn Nürnberg Störfallprogramm S1



Bild von Marina Radic

The size and derived complexity of rail systems sets the stage for the inherent pursue of adequate coping mechanisms, aimed at managing a broad range of vulnerabilities. DRPs are currently integral parts of this intricate objective. They must enable the system to cope with its operational shortcomings and provide an “acceptable level of functioning” during disruptions. In the quest of more resilient commuter rail operations, it is of critical importance to develop a holistic set of strategies. Therefore, the development of DRPs is a preeminent example of the way in which complexity within such compound critical infrastructures can be dealt with. Nonetheless, the factual benefits and drawbacks of these programs need to be further scrutinized, by having in mind the resilience understanding discussed in Chapter 2.

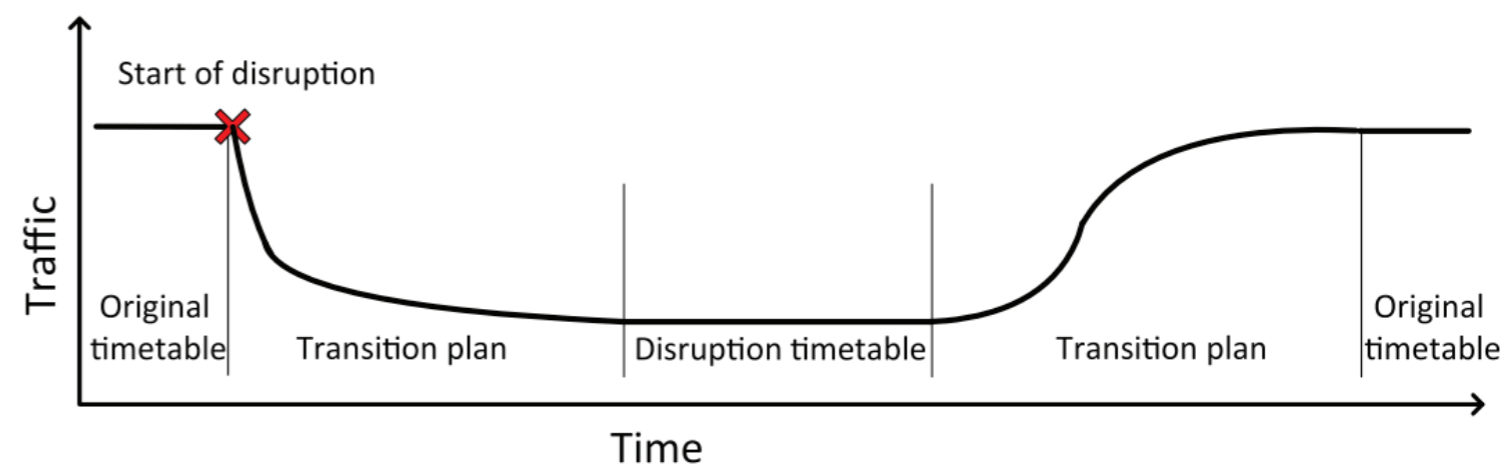
5 DRP's as P&P strategies within Critical Infrastructure Resilience

DRPs provide a remarkable advantage in safeguarding the continuous serviceability of rail operations. As a whole, they can be implemented in several different contexts (e.g. long distance rail operations, medium or regional rail operations, cargo rail operations, etc...) and are increasingly being recognized as the foundation of robust rail services (Christoforou et al, 2015). Their proficiency is such that operators throughout many different European rail systems (i.e. Switzerland, Germany, and the Netherlands) have started benefiting from their development (Nielsen et al, 2012, Chu & Oetting, 2013). DRP's mainly function as dampers on the rapidly escalating operational consequences (“knock-on effects”) unchained by disruptions and their consequent impact on passenger transport experiences (Christoforou et al, 2015). In the case of commuter rail networks, they are prominent tools to protect their high shares of users from a disruption in their operations. The overarching goal of DRPs is to allow the system to adapt to a degraded situation while upholding as many competences as possible.

The German regional rail operator (DB-Regio), has started tapping into the benefits of implementing disruption programs. In Munich, Frankfurt and areas in Germany's Northwest region, the “S-Bahn” networks have started to employ DRP's to tackle the occurrence of disruptions in their most transited lines (Chu et al, 2012). Through an extensive gathering of dispatchers' collective knowledge and experience, DB-Regio in its “SturM” (Strategies for a dynamic traffic management in railway regional passenger transport) project, has developed a guide for the general establishment of DRPs. The project's main focus consisted on the development of operational and passenger transport strategies for specific scenarios, considering different disruptive situations (Chu et al, 2012). In due course the adequacy of the considered set of protocols, to transfer the whole system towards a degraded but stable operational state, was further asserted.

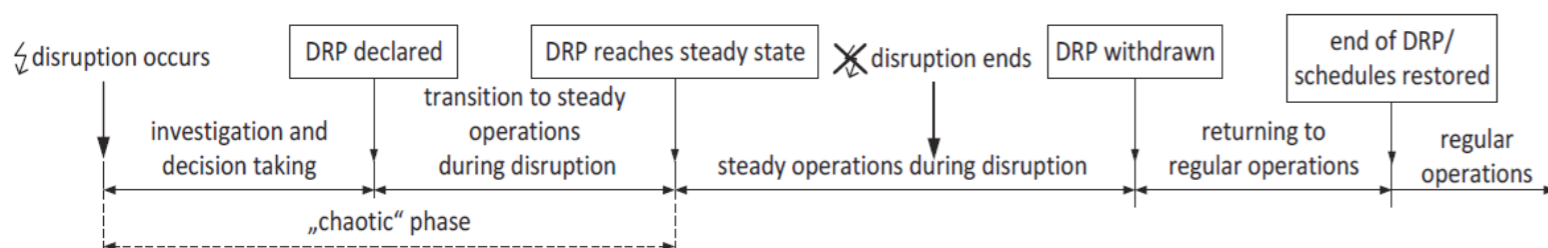
Following the occurrence of a disruption in a certain location of the network, the deployment of a DRP develops in a systematic procedure (see Figure 3).

3) Phases in the management of a sudden disruption. Source: Chu et al. 2012.



4) Throughout the DRP implementation, the network's capacity is largely hindered and the available infrastructure cannot support the existing amount of traffic (see Fig. 4). Therefore, immediate actions need to be put forward in order to handle the existing trains and manage the network's transition toward a stable degraded situation. At this time, DRPs provide specific operational guidelines to manage the different lines in the network. An available catalogue of scenarios gives dispatchers a clear overview of how to grip the situation and identify the best suited measures to be applied (see Figures 5 and 6 next page). As seen in these examples, the programs provide for a specific scenario detailed information like: what section of the lines need to be canceled, which frequencies need to be terminated, where to turn the trains around on both sides of the disruption or even what transport substitution may be offered affected passengers. In sum, these are the chief operational benefits conveyed by the information within each DRP, namely providing a series of precise actions preventing the total collapse of the system in a disruption.

Model illustrating the needed change in traffic level during a disruption. Source: Ghaemi et al, 2016 (modified by the author).



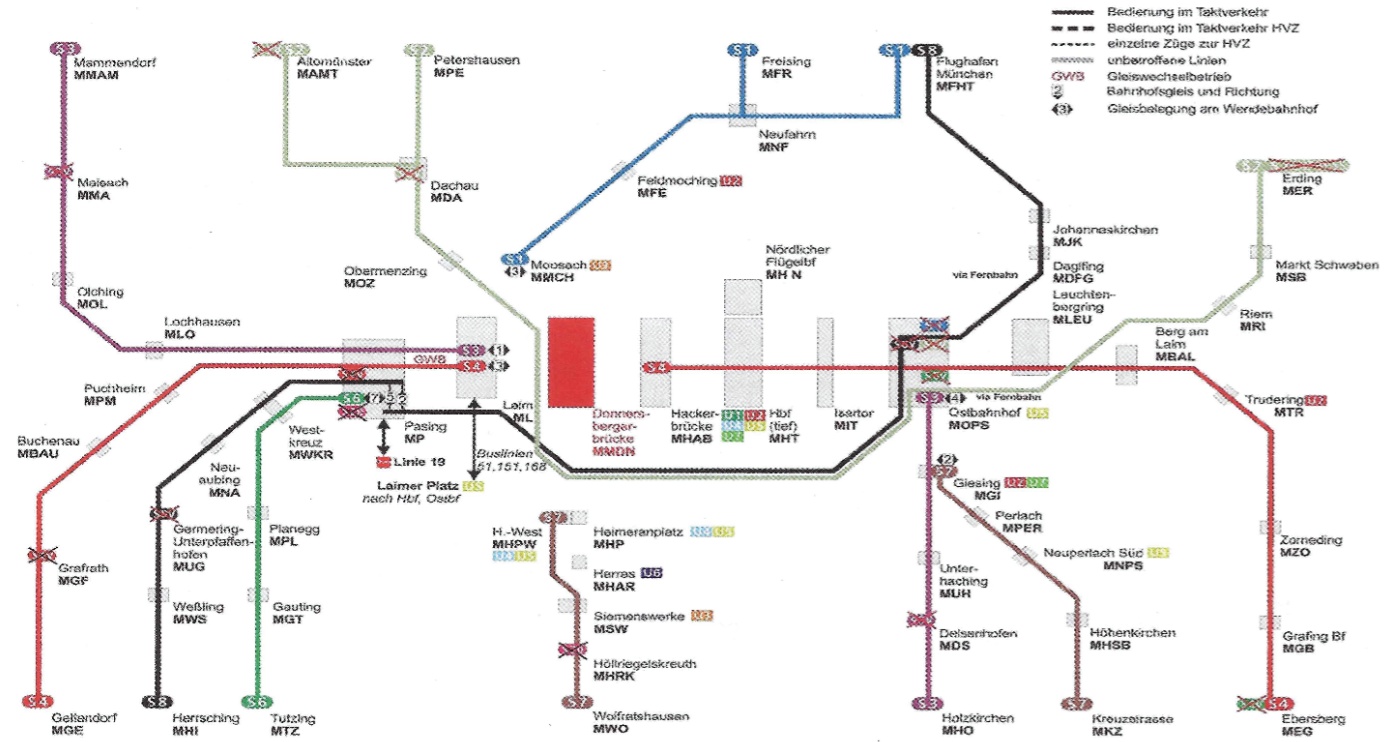
Subsequently, once the definite actions within a DRP have been implemented, the impaired system is able to transition into a phase of steady operations. However, information first needs to be distributed and communicated to all parties involved. An additional benefit of DRPs includes the designation of a clear path for an improved transmission of key information between staff members and/or with the customers. This is achieved by pre-assessing the adequate communication channels and including the most relevant information to be conveyed (e.g. operational decisions, transport compensation for passengers) (Chu et al, 2012).

5) *Protocols for the disruption case J+ included in the DRP handbook – Munich.*
 Source: DB Regio AG, 2015.
 (modified by the author).

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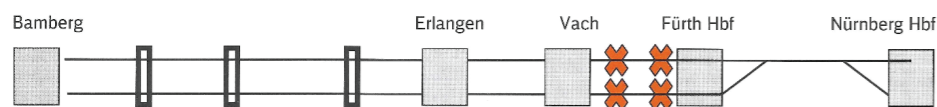
Disruption case J+ Donnersbergbrücke Total Disruption incl. Long Distance Station

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Information	West Bound	East Bound
	S1 Freising/Airport turns in Moosach	
	S2 Peterhausen/Erdring from Obermenzing no stops thru Südring until East Station and continue without stops to Reim	
	S3 Mammendorf and S4 Geltendorf turns in Laim	S3 Holzkirchen turns in East Station
	S6 Tutzing turns in Pasing	S4 Ebersberg turns in Hackerbrücke
	S7 Wolfratshausen turns in Heimeranplatz	S7 Kreuzstraße turns in Giesing
	S8 Airport to Pasing no stop thru Südring until East Station and continue without stops to Daglfing	
	Cancel frequencies 10'	Cancel frequencies 10'
	Cancel S20	

Disruption Program G Fürth - Vach



In case of a total disruption between Fürth - Vach:

- S1 from Nürnberg turns in Fürth Hbf
- S1 from Forchheim turns in Vach

6) *Protocols for the disruption case G included in the DRP handbook for the line S1 - Nuremberg.*
 Source: DB Regio Bayern, 2012.
 (modified by the author).

A clear example of this situation can be seen in Figure 7 where, depending on the decision taken by the dispatcher, a recommended message is proposed for transmitting the most relevant information to the passengers. Furthermore, in order for staff members to better guide the passengers towards the most suitable transport substitution DRPs include a detailed scrutiny of different alternative public transport potentials.

7) Announcements for track disruption / Emergency Bus Services gem. Ril 60120:

Announcements in the case of track disruptions and Emergency bus systems for line S1 - Nuremberg.
 Source: DB Regio Bayern, 2012.
 (modified by the author).

Rerouting

Dear passengers.

Your attention please! Due to [reason] between the stations of [station name] and [station name] our train will be rerouted today. Passengers traveling in direction towards [station name] are kindly requested to change trains in [station name] or to take the provided buses [in case there are some...].

I repeat: Due to [reason]. We beg your pardon.

Please note: Mention all intermediate stations where the train won't stop.

Track Disruption without Bus Emergency Services (BES)

Dear passengers.

Your attention please! Due to [reason] this train exceptionally terminates in [station name]. The journey from [station name] to [station name] can be completed with [buses/trams/taxis] departing from [provide the specific location].

I repeat: Due to [reason]. We beg your pardon.

Track Disruption with Bus Emergency Services (BES)

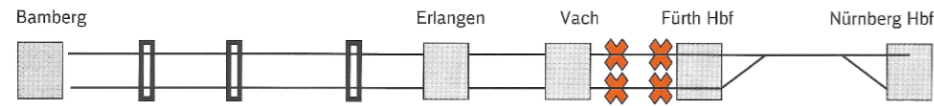
Dear passengers.

Your attention please! Due to [reason] this train exceptionally terminates in [station name]. A replacement bus service from [station name] to [station name] has already been requested. Please stay on the platform. We will keep you informed.

I repeat: Due to [reason]. We beg your pardon.

Figures 8 & 9 illustrate these strategies, showing specific examples for the “S-Bahn” network in Nurnberg and Munich. Figure 8 displays specific directions for deploying an emergency bus service (case of Nuremberg) and Figure 9 provides clear representation of a redirection of passengers towards other existing public transport options (case of Munich). Overall, DRPs not only allow operators to put forward the most suitable measures, but also to distribute information and safeguard passenger welfare during a chaotic situation.

Disruption Program G Fürth - Vach



Transport Alternatives:

U1 between Fürth-Klinikum and Fürth Hbf

Particularities:

The station Fürth-Klinikum due to its location can not be directly serviced by EBS. Passengers need to take the U1 until Fürth Hbf and there change to the EBS.

Emergency Bus Service (EBS):

The EBS would provide a service between Fürth Hbf and Vach.

Comment Regarding the EBS:

After the number of buses required for the S-Bahn were made available, express buses between Erlagen and Fürth Hbf (without restriction) must be confirmed according to the number of buses for the RE trains.

Necessary Buses for the Disruption Program:

Time Interval	Montag - Freitag:		Samstag:		Sonntag:	
	S-Bahn	Expressbusse	S-Bahn	Expressbusse	S-Bahn	Expressbusse
00:00 - 04:00	1 Bus		1 Bus		1 Bus	
04:00 - 05:00	1 Bus					
05:00 - 06:00	2 Busse	3 Busse	1 Bus	3 Busse	1 Bus	3 Busse
06:00 - 07:00	4 Busse	12 Busse	1 Bus	3 Busse	1 Bus	3 Busse
07:00 - 08:00	8 Busse	20 Busse	1 Bus	6 Busse	1 Bus	3 Busse
08:00 - 09:00	6 Busse	9 Busse	2 Busse	10 Busse	2 Busse	4 Busse
09:00 - 10:00	4 Busse	9 Busse	2 Busse	11 Busse	2 Busse	6 Busse
10:00 - 11:00	3 Busse	8 Busse	3 Busse	10 Busse	2 Busse	9 Busse
11:00 - 12:00	4 Busse	7 Busse	3 Busse	9 Busse	2 Busse	7 Busse
12:00 - 13:00	4 Busse	7 Busse	3 Busse	7 Busse	2 Busse	7 Busse
13:00 - 14:00	5 Busse	9 Busse	4 Busse	10 Busse	3 Busse	6 Busse
14:00 - 15:00	3 Busse	8 Busse	3 Busse	8 Busse	3 Busse	9 Busse
15:00 - 16:00	5 Busse	13 Busse	3 Busse	5 Busse	2 Busse	9 Busse
16:00 - 17:00	6 Busse	15 Busse	3 Busse	10 Busse	3 Busse	12 Busse
17:00 - 18:00	6 Busse	17 Busse	2 Busse	11 Busse	4 Busse	10 Busse
18:00 - 19:00	6 Busse	8 Busse	5 Busse	10 Busse	3 Busse	12 Busse
19:00 - 20:00	4 Busse	6 Busse	3 Busse	7 Busse	3 Busse	7 Busse
20:00 - 21:00	2 Busse	4 Busse	3 Busse	5 Busse	2 Busse	6 Busse
21:00 - 22:00	2 Busse	3 Busse	3 Busse	6 Busse	3 Busse	5 Busse
22:00 - 23:00	1 Bus		2 Busse		3 Busse	
23:00 - 00:00	1 Bus		2 Busse		1 Bus	



8) Passenger transport substitution in disruption case G - DRP handbook for the line S1 -Nuremberg. Source: DB Regio Bayern, 2012. (modified by the author).

S-Bahn Handbuch

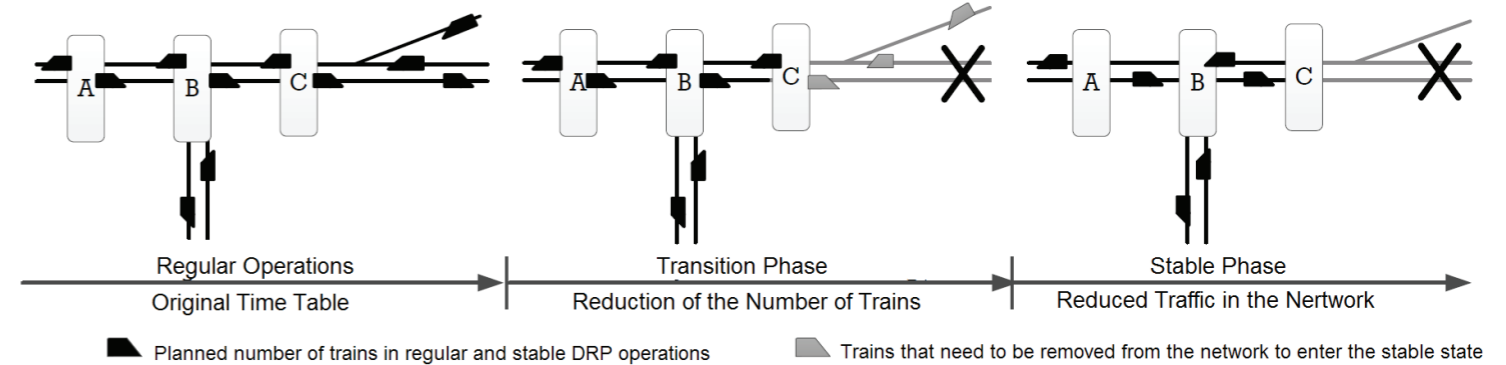
Disruption case J+ Donnersbergbrücke Total Disruption incl. Long Distance Station	SB 002.2000 Seite 1 von 2
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Alternatives	West Bound	East Bound
MVV at East Station	U5 Passengers traveling towards the city center switch to U5 S7 Wolfratshausen until Heimeranplatz walk towards Heimerplatz West	U5 S7 Kreuzstraße from East Station until Neuperlach-Süd
Alternatives MVV	U5 Passengers in Laim refer to the corresponding Bus connections. Passengers traveling to the center and east bound use the U5 from Laimer Platz.	
	U2 S1 Freising/Airport until Feldmoching	U2 S3 Holzkirchen and S7 Kreuzstraße and from the Main Station until Gleising
	U3 S1 Freising/Airport from Marienplatz until Moosach S7 Wolfratshausen from Marienplatz until Siemenswerke	U5 S7 Kreuzstraße from East Station until Neuperlach-Süd
	U5 S7 Wolfratshausen until Heimerplatz walk towards Heimerplatz West	
Destination Rosenheimer Platz use tram 15 & 25 and Isartor use tram 16 & 18		
Passengers at Donnersbergbrücke in previous agreement with LS use tram 16, 17, 18, 19		
If necessary use regional and long distance trains between the Main Station and Pasing		

9) Passenger transport substitution in disruption case J+ - DRP handbook Munich. Source: DB Regio AG, 2015. (modified by the author).

In contrast to the clear advantages of DRP implementation, it should be noted that in the occurrence of the disruption, the network’s capacity is highly compromised until the system regains a certain degree of stability. As previously stated this interim period, or “Chaotic Phase” (see Figure 3), stands out as the most sensitive stage of the whole DRP implementation. It is within this uncertain juncture that most of the operational problems occur and where there exists the foremost necessity for developing a broader theoretical understanding and more structured operational procedures. For instance, seasoned practitioners explain that the transition phase rarely functions as planned and many problems still need to be solved on the spot (Chu & Oetting, 2013). Given that there is no standard procedure in place to help dispatchers in dealing with some of the network’s more specific operational situations following the deployment of the selected DRP, both the network’s capacity and its serviceability are largely compromised. As seen in Figure 10, within the transition phase there is an overload of vehicles in the system (gray trains) and until the network reaches stable operations, trains need to be rerouted, reincorporated or eventually removed from the system. Currently, these (gray) trains need to be handled manually since they find themselves in positions of the network where the DRP measures are not applicable. They are located either outside the area where they can follow the DRP protocols or they find themselves immediately nearby the disrupted section (see Figure 10.). The undefined handling of this situation constitutes the main drawback of the DRPs to date, as they lack the ability to adapt themselves to the “chaotic” or transitional phase, which arises due to very specific and context related circumstances.

10) Schematic representation of the reduction in the number of trains during the transition phase. Source: Chu, 2014. (modified by the author).



Later, once the DRP reaches a stable state, a pre-defined, reduced number of trains circulate in the system on pre-defined, shortened paths. Only at this point does the system starts running with some degree of stability inside the program. Nonetheless, the average service capabilities of the system are still hindered. Lastly, when the reason for the disruption is finally overcome, the DRP is withdrawn and a return to regular operations can begin (see Figure 3) (Chu, 2014).

The experience of the German “SFPs” for “S-Bahn” lines, has elucidated the ability of DRPs as P&P tools to pave the way towards achieving the resilience objectives discussed in Chapter 2. All in all, these P&P strategies have shown to be adept tools for attaining of a very real degree of continuous operating capabilities and an “acceptable level of function” during disruptions. It is due to these strategies that staff members are able to promptly adapt the rail operations to the network’s degraded conditions, arguably safeguarding passenger wellbeing and ultimately exploring and learning from the new “stable” conditions. Thus, swift and effective attainment of operational stability during the disruption is largely achieved due to the DRP protocols. That said, there are still major gaps within their developmental and implementation frameworks. For practical purposes the existing protocols still tend to be flexible in handling the transitional phases and the actual disrupted passenger transport flows. If DRPs are too rigid, this may limit their ability to adjust to the local disrupted circumstances.

Decisively, within the current state of affairs the success of a given DRP is mostly subject to the proficiency with which the “Chaotic Phase” can be overcome and the extent to which its effect on overall passenger welfare are positive. Safeguarding passenger mobility qualities and smoothening planned operations throughout the transitioning phase lies at the center of their future advancement (Chu & Oetting, 2013). Therefore, further inquiry on DRP development ought to focus on the following two issues: 1. DRPs are in the dire need of achieving persistent passenger mobility quality considerations as targeted outcomes of their protocols and 2. as mentioned in the previous paragraph, additional procedures are still required for securing the networks’ operational capabilities during the most vulnerable stages of their implementation. Conclusively, DRPs are currently stripped from some of their benefits as both of these problems still obscure the adaptable and adjusting capacities of this strategy.

6 Conclusions

The relevance of P&P strategies within the overall critical infrastructure resilience framework has been portrayed here through an analysis of German DRPs for commuter rail lines. After reviewing the evidence of the different benefits and drawbacks of the DRPs within commuter rail operations, it can be easily said that such strategies are crucial elements in the attainment of more proficient and stable service capabilities. In general terms, P&P strategies have demonstrated enough potential to expound themselves as cornerstones of the critical infrastructure resilience agenda for rail. Initially, they have proved to be proficient enough to advance stable operational capabilities (i.e. acceptable level of service) during major disruptions, within an outstandingly complex and utterly essential urban system. Furthermore, by accepting the imminence of damaging events, they demonstrate a basic ability to adapt the general system’s conditions to overcome degraded situations. Moreover, they enable both managers as well as users to better interact and cope with adverse circumstances. Overall, securing the system capabilities as well as user welfare, and opening the window for learning and transforming capabilities, these strategies ease the impact of damaging events while allowing the system to constantly fulfill its most basic functions.

The key role played by commuter rail systems in supporting entire metropolitan areas, by means of their size, intricacy and capabilities, makes these systems particularly relevant within the critical infrastructure resilience debate. As with other critical infrastructures, the complexity and geographic scattering common to rail systems, makes them particularly vulnerable to the occurrence of unexpected events. These instances have been shifting slowly towards being included as inherent and unavoidable conditions within the theatre of normal operations. Therefore, the high likelihood of experiencing a degraded situation has underlined the need for envisioning strategies aimed at guaranteeing operational continuity and basic service qualities during these episodes. Here, in the quest of understanding the relevance of P&P having a resilience framework as background, the German DRPs for commuter rail have been able to serve as an apposite example. With a clear determination the DRPs have been able to address the difficulties by acknowledging the imminent manifestation of deviations in their planned operations and instituting means to adjust the operations to the degraded situations, while growing in parallel to their complexity. Therefore, the perception of P&P strategies, as dampers of uncertainties through their recognition of imminent failure and a “acceptable level of functioning”, have objectively proved of specific relevance for critical infrastructure resilience.

Bearing the overall critical infrastructure resilience objectives in mind, DRPs as P&P strategies allow the system to overcome the threshold towards achieving its most fundamental aims. In principle, they enable the system to bounce back from a degraded state protecting its most basic capabilities. Thus, through

these strategies, dispatchers are able to rapidly regain control of the system in a degraded theatre, correspondingly adopting the “acceptable level of functioning” concept in their operations. Furthermore, by means of applying the DRPs, the system is able to adapt itself to the disrupted situation and reach a stable degraded operation. Therefore, it is due these strategies that evolutionary forces can present themselves within unplanned circumstances. Conclusively, P&P measures developed within the critical infrastructure arena, regardless of being conceived over fixed scenarios, are able to pave the way for infrastructural systems to adapt and eventually transform as they seek new stable operational conditions.

Among the most obvious drawbacks of DRPs is their inability to address the complexities of the “chaotic phase” during their implementation. Despite all the adaptable capacities P&P protocols are able to foster, their nature is mainly a static one. It becomes necessary to imagine more dynamic P&P structures, able to adapt to a wider range of disruptions and transition to a stable operation more rapidly. Attaining a “dynamic” character means that specific programs become factually responsive to the early operational conditions in which they are being deployed. This can be achieved for example by building a variety of standard real-time procedures within the DRPs to secure a much more efficient transition from the occurrence of the disruptive event to the phase of stable operations. Leaving behind static scenarios and attaining dynamic DRPs would imply achieving a state where the occurrence of disruptions in the rail network would have much more limited impact on the operational sphere. Here the system would be able to adapt to the situation almost immediately as the “chaotic phase” would further constricted, optimizing efficiency and operational quality.

Concerning critical infrastructures more generally and rail in particular, P&P strategies offer essential elements in the search of more resilient operations. Despite their static structures they are able to adapt the system operational capabilities and secure some degree of operational continuity. Nevertheless, as seen in the German example, these strategies still need to seek a much more dynamic structure so as to enhance the presence of transforming capabilities.

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Manas R. Marathe, Simon Gehrmann, Irene Gargiulo, Hug March, Jean-Michel Roux

Wednesday, May 24th

Session B: Resource-sensitive Urban Design

Chair: **Hug March**, UOC Universitat Oberta de Catalunya + UIC Barcelona

Discussant: **Jean-Michel Roux**, UFR Institut d'Urbanisme de Grenoble IUG

Irene Gargiulo, UIC Barcelona:
Urban Streams and Physical Activity Promotion:
Toward an Ecological-Experimental Approach

Manas Marathe, TU Darmstadt:
Learning from the Eighteenth Century
Traditional Water Management Systems of Pune, India

Simon Gehrmann, TU Darmstadt:
reSource Water - working with the nature, instead of conquering it

Manas R. Marathe

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1 'Peshwa' is originally a Persian word meaning foremost leader. Peshwe were the Prime Ministers of the 17th century Maratha Empire. The Peshwe ruled in western India from 1713-1817. Pune was the capital during the Peshwe rule. Balaji Vishwanath (1713-1736), Bajirao I (1736-1740), Balaji Bajirao/Nanasabeh (1740-1761), Madhavrao I (1761-1772), Narayan Rao (1772-1773), Savai Madhavrao (1774-1795) and Bajirao II (1796-1817) were the Peshwe rulers. Nanasabeh Peshwe and Savai Madhavrao Peshwe carried out Most of the water works in Pune (Campbell, James MacNabb, 1885; Mahajan, S.G., 2002)

Abstract

The relation between water supply and human settlements is complex. While the lack of availability of fresh water limits the growth of a settlement, societies have developed means to readjust and manipulate natural water sources to ensure a reliable water supply. This age-old act of readjustment of water sources led to the development of several traditional water management systems in India. Post-independence, India intensified the colonial practice of constructing huge dams and supplying water to its people through a centralised system of networked pipes. With piped water coming to the doorstep, many communities gave up their age-old practices of harvesting water. Still, some of these traditional water management systems have stood the test of time. In face of rapid urbanization, climate change and depleting water sources, constructing another dam or drawing water through deeper tube wells to meet the water requirement of society does not seem to be a sustainable solution. This paper seeks to explore the relevance of existing traditional water management systems in India, taking the case of the eighteenth century water systems developed by the Peshwe¹ Rulers in Pune region. It argues that there is a need to look at the traditional water harvesting systems not merely as a matter of awe and curiosity but as systems, which may have the potential to contribute in the enhancement of the present water supply system. Through a study of secondary data in the form of rare books and documents, the paper extracts the inherent design principles of traditional water management systems. In conclusion, the research proposes a need to link the local knowledge of water management to recent strategies of water sensitive urban design and low impact development for building resilience in developing countries.

Introduction

Societies share an inseparable relationship with water. Sometimes, the availability of fresh water may limit the growth of a settlement. However, at the same time, several communities also manipulate the available fresh water sources to enable growth of their settlements (Mate, 1998). This community act of manipulating the natural sources of fresh water for their own good led to the development of various traditional water-harvesting systems across the world. These water-harvesting systems along with the societal norms for effectively operating and maintaining them together constitute water management systems. These commonly include building of bunds across rivulets and diverting water through canals, capturing rainwater in artificial reservoirs, storing the water in tanks or cisterns, digging wells to extract groundwater, etc. However, there may lack a unanimous agreement on what systems constitute as 'traditional' and what qualify as 'modern'. For the purpose of this research, it seems appropriate to accept the opinion of Nirmal Sengupta on which systems may qualify as traditional. He states that those systems, which attracted engineers in the post-industrial era, could be termed as 'modern' and those that did not as 'traditional'(Sengupta Nirmal, 2007).

Thus, amongst the common ways of water harvesting mentioned above, engineers adopted the canal system widely as it allowed for easy extension, central management and bureaucratic governance. It became a popular practice amongst colonial as well as independent governments to build big dams across rivers and supply water to people through a centralised piped water supply system. All other methods of water management were termed as ‘traditional’ and remained in the hands of indigenous communities. In a developing country like India, these traditional practices of water management have stood the test of time. They have a significant share in the country’s overall irrigation percentage.

The past five decades have witnessed a global change in the approach towards water management. During 1960-80, many countries followed a top-down water management approach. This allowed them to gain sovereignty by having a central control over water distribution. Construction of mega dams was a symbol of progress and modernity to many countries. Water was supplied to people at a subsidized rate through a network of water pipes. This did solve the problem of water scarcity in developing countries to some extent. However, several countries implemented technological solutions of manipulating water sources often at the cost of neglecting the ecological and social damages caused by it. With rapid urbanization and rapid increase in population, expanding water infrastructure and maintaining it needed huge investment. Worldwide, many governments fell short of capital and incapable of meeting the increased water demand of growing population. They transferred the task of water distribution, maintenance and operation in the hands of private players. The private companies saw water as a commodity and charged the people heavily for distributing water to the citizens. This affected the urban poor, as they were incapable to pay for the increased water prices. Thus, by this time it was clear that there are limitations to both public and private water supply. Consequently, experts like Elinor Ostrom advocated for a participatory bottom-up decentralised approach of water management. According to her, many big irrigation projects simply focus on the physical capital of dams, canals, operating gates, etc. and fail to consider the rules in use, beliefs, practices due to which the irrigation projects may succeed (Ostrom, 1992). After 1990, many countries attempted to strengthen local communities to manage their water requirement at the community level with the necessary help and aid by the government. Recently, experts like Peter Gleick argue that the key to efficient water management lies in a soft path approach (Gleick, 2003) of planning centralised water infrastructure systems which are complemented effectively by low-cost community managed decentralised water management systems.

India, too, experienced the above changes in water management. Post-independence, India intensified the colonial practice of constructing huge dams across many rivers. This did lead to an increase in the net area under irrigation and solved the problem of water and food scarcity to some extent. However, simultaneously it also led to the cultivation of water thirsty crops and loss of soil fertility. In the name of Green Revolution (around 1960’s), government forced the farmers to give up the traditional water harvesting practices of crop rotation and growing water prudent crops in water scarce areas (Shiva, 2002, pp. 107–114). In urban India as the cities grew rapidly, dams were located several kilometres away from the city. Water supply has remained more or less under the control of State Government in India, with few attempts like Delhi Jal Board² attempting to undertake a public-private partnership for water operation and maintenance (Vora et al., 2013, pp. 148–184). However, the era of privatization and globalization in India, with the beginning of 1990’s saw the entry of several private companies selling bottled water. Around 300 brands in India sell bottled water (Diwan Vijay, 2016). These huge quantities of plastic bottles pose a serious threat to the environment. Against this background of water being treated as a commodity rather than a valuable resource; experts and activists in India like Vandana Shiva,

2 Delhi Jal Board is the government authority, which provides water supply to the city of Delhi.

Anil Agarwal, Sunita Narain, Anupam Mishra, Rajendra Singh and many others have since then highlighted the harsh effects of big dams, water privatization, which fail to ensure water equity and are non-sustainable. They emphasis on the need to revive back the traditional water management practices that still exist in India and re-establish the broken link between water and society. For this, it is of utmost importance to understand the traditional water systems in totality, not merely as physical entities, but along with the design principles involved behind them.

This paper seeks to explore the relevance of existing traditional water management systems in India. It focuses on the study of the 18th century “Nahar System” of underground conduits built in the Pune city core during the rule of Peshwe (1713 C.E.-1817 C.E.). It also studies the community water systems of building wells, reservoirs and tanks found in the villages around Pune. The study involves gathering information from various data sources like rare books, maps and documents from the archives. Wherever possible, the physical traces of the system are studied through a site visit. The paper is divided into three main parts. The first part establishes the physical and social context in which the traditional water management systems of Pune evolved. The second part classifies the water management systems as urban and rural systems for better understanding and describes the functioning of these systems. Urban water management system primarily comprises of the underground conduit system known as “Nahar”. In rural areas, irrigation management systems consist of ‘Motsthal’ (water supply through wells) and ‘Patsthal’ (water supply through canals). The third part extracts the inherent planning and design principles of the traditional water supply systems. Finally, the author concludes that the traditional water management systems are still relevant today and have the potential to function as decentralised systems simultaneously along with the centralised water supply system of the city. The traditional systems need to be seen in totality, as physical entities along with their inherent planning and design principles.

Physical and Social Context - Pune Region

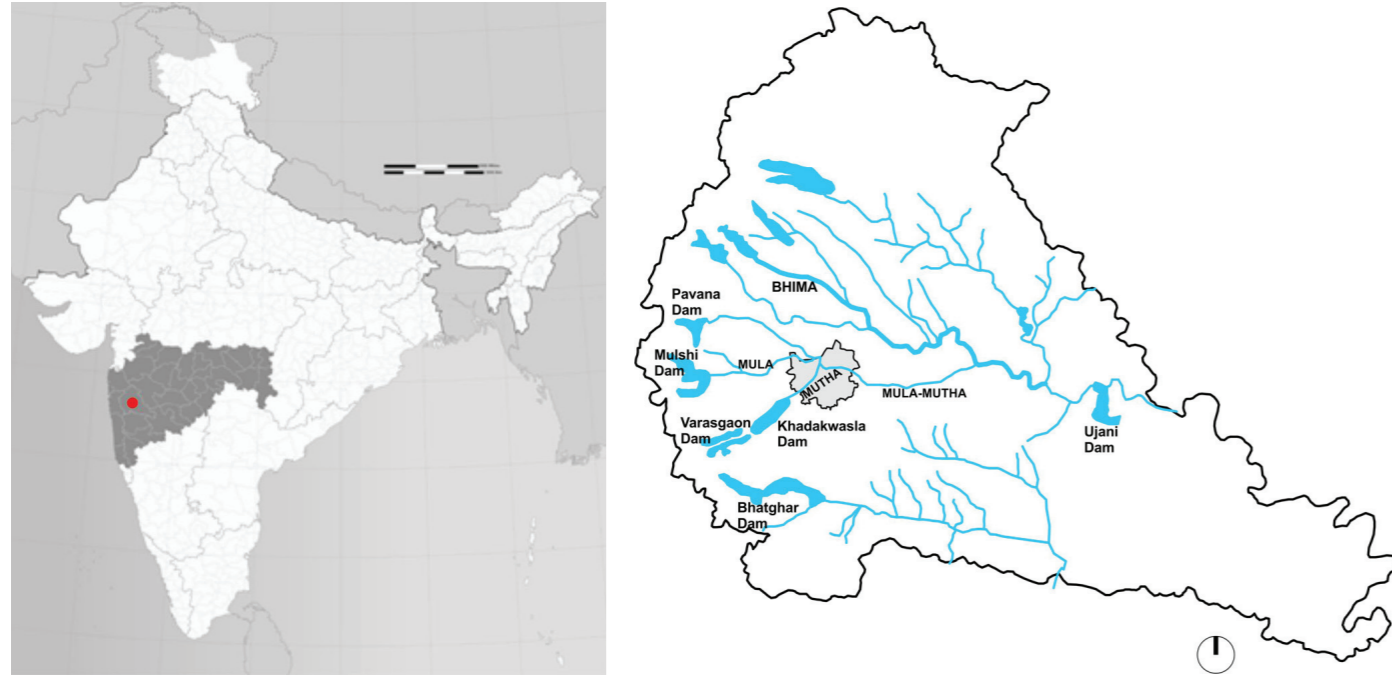
The present Pune City is a part of Pune District. The district lies between 17°54’ and 19°22’ north latitude and 73°24’ and 75°14’ east longitude. In 1881, the district had an area of about 5350 sq. miles and a population of 900,621 (Campbell, James MacNabb, Sir, 1885). As per the 2011 census, the population of Pune district is 9.4 million while that of Pune city is 3.1 million (Census 2011). The Pune city municipal area is 243.9 sq. km. Hydrologically, the region is a part of the Upper Bhima River Basin. Mula and Mutha rivers are the main rivers flowing through Pune city (PMC, 2014). The western part of the district is hilly, central part a plateau, while the eastern part is a flat bare open land. The rivers Mula and Mutha rise in the western hilly region of Sahyadri ranges and flow eastwards across Pune City (Refer Fig 1). The plateau region, where Pune city lies, is made up of hard basalt rock, making it extremely difficult for water to penetrate through it. The average annual rainfall of Pune District is around 1025 mm (Mishra, S.S.P, 2013). This value is close to the national average of 1100 mm annual rainfall. However, Pune receives most of this rain in a short time duration. Therefore, it becomes important to trap the rainwater before it flows away as surface water.

Pune City: Hydrology and drainage

Pune city developed in close proximity to the seasonal rivers Mula and Mutha. Both the rivers originate at different places in the western Sahyadri hilly ranges as mentioned before. They flow separately before entering the city and later on meet towards the North West of the city and flow jointly as Mula Mutha. The southern side of the city is a highland. The hillock with the Parvati³ temple is an important landmark towards the south of the city.

3 The hillock attains its name Parvati due to the ‘Shiv-Parvati’ temple located on it. Nanasabeb Peshwe constructed the temple in 1741 (Mahajan, S.G, 2002).

Four streams namely the Nagzari, Ambil Odha, Manik Nala and Bhairoba Nala⁴ originate in the southern hills and flow northwards through the city before meeting the Mutha. The Nagzari and Ambil Odha were sources of fresh water. Pune developed along the banks of Nagzari. In 1752, Nanasahab Peshwe (1740-1761) built a dam across the Ambil Odha to form an artificial lake near Sarasabag (Sovani Avinash, 1998, p. 26). The old Pune city developed between the Mutha River and the left bank of Manik Stream.



⁴ 'Odha' means a narrow water stream. 'Nala' too is a water stream usually used as a means to drain surface storm water. 'Nagzari', 'Manik', 'Ambil', 'Bhairoba' are names of water streams.

Brief history

During an excavation near the confluence of Mula-Mutha, Sankalia⁵ found vessels dating back to 100,000 years (Mahajan, 2004). He also found traces of a well-worked water management system at Inamgaon, about 50 km away from Pune, dating back to 1400 B.C.E. (Sankalia et al., 1975). In the ancient scriptures of Ramayan and Mahabharat, the region to which Pune belonged to was known as "Dakshinpath"⁶.

Caves belonging to the Buddhist period are found on the Fergusson hill in Pune. However, one finds concrete mention of Pune Region as "Punya Vishay" in a 758 C.E. copper plate inscription of Rashtrakuta dynasty (753 C.E.-982 C.E.), which mentions that King Krishna donated the village of Bhophkel near Pune to Pugdi Bhat on the day of Solar Eclipse. The inscription describes the names of other villages surrounding Bhophkel, which are very much present today.

Pune was also known as "Punypur" which means cleanser, since it was located at the confluence of Mula and Mutha (Gadgil, 1945, pp. 3-7). From 1294 C.E. to 1621 C.E., Pune was under Muslim Rule. In 1621 C.E., Pune came under Maratha Rule. In 1637, Shahji (1602-1664) appointed his loyal minister Dadoji Kondadev to manage Poona. The city of Poona became a habitable place under Dadoji Kondadev.

Later, the renowned Maratha ruler Shivaji Maharaj (1627-1680) took care of Pune province. Since, then one can trace back the evolution of Pune from a being a small village Kasba (artisans community) to becoming a fully developed political military town during the Peshwe rule in the 18th century.

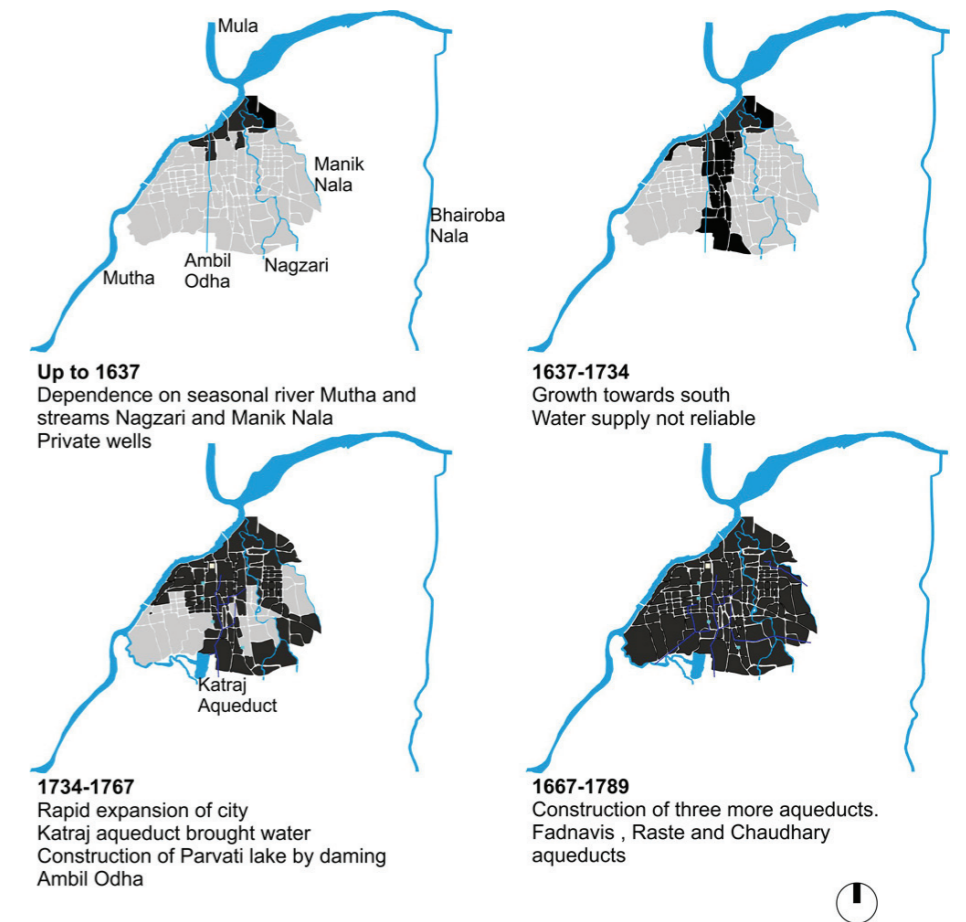
The Peshwe rule began in 1713 with Balaji Vishwanath as the first Peshwa and ended with the rule of Bajirao II in 1817. The British gained control over Pune in 1818.

Fig. 1) Pune Location in state and its hydrological region
Source: <http://www.census2011.co.in/census/city/375-pune.html>, Pune Regional Plan, 1997

⁵ 'Hasmukh Dhirajlal Sankalia (1908-1989) was an eminent archaeologist. His research on Ancient Indian History is significant. He did his doctorate from the University of London.

⁶ Dakshinpath means land to the south.

Fig. 2) Pune old city development - summarises the evolution of Pune city core and the water works undertaken by Peshwe rulers.
Source: Adapted from the maps by Diddee Jaymala, Gupta Samita, 2000



Traditional Water Management Systems:

For a better understanding of the traditional water management systems, one can classify them as urban and rural.

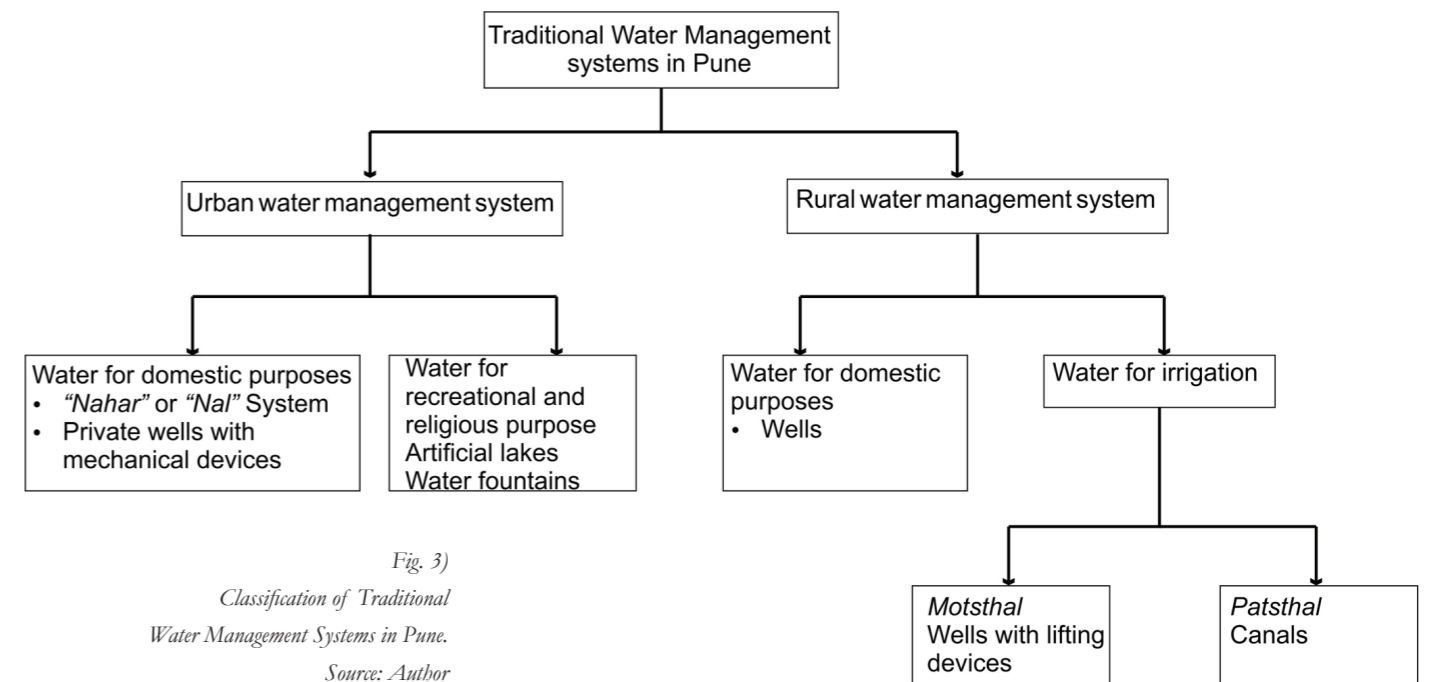


Fig. 3) Classification of Traditional Water Management Systems in Pune.
Source: Author

Urban Water Management Systems

It is significant to note that though the medieval town of Pune up to 1750, depended on the Mutha River for its daily water requirement, the original city core developed at a considerable distance away from the river (Gadgil, 1945, pp. 11-12). People used the Mutha River, Nagzari and Manik Nala mainly for bathing and washing purposes. Wells were the main source of drinking water.

Water supply through wells:

Pune had adequate water available to meet the daily domestic water requirement of people. There were few public and private wells in Pune that contained sweet water. Still these were important sources of water supply. The Gazetteer of the Bombay Presidency 1885, Poona mentions the existence of 1290 wells in Pune. However, most of them contained brackish water. The archival record from Pune Nagar Sanshodhan Vrutta mentions the existence of 1511 private wells and 29 public wells in Pune during the Peshwe rule. (Chintaman Ganesh Karve, 1942, p. 13). The wells were narrow in circumference, lined with either stones or bricks. Some of the wells had mechanical devices to extract water. People hired a class of people known as Beldars for the digging wells. Special class of people known as "Kolis" carried water from wells to the houses of persons having special rank. The kolis had a special "baluta" for their work of carrying water (Gokhale Balakrishna Govind, 1988, p. 163)

Types of wells	Sweet/potable water		Total sweet water	Brackish water		Total brackish water	Total
	Year round water	Water for eight months		Year round water	Water for eight months		
Privately owned	22	64	86	665	760	1425	1511
Public	1	0	1	17	11	29	29
Total	23	64	87	682	771	1454	1540

The above table shows that out of the 1540 wells, barely 6% wells had potable water in them. Further, mere 23 wells had a year round supply of fresh water. Thus, it is clear from the above figure, that the wells were not a reliable source of water supply. This prompted the Peshwe rulers to develop a more reliable system of water supply for the growing city. In 1749, Nana Sahib Peshwe started the work of developing a reservoir in the outskirts of the city at Katraj and bringing water to Pune through a system of underground conduits known as "Nahar-e-Katraj".

The Nahar System

The Nahar System has its origin in Iran. Prior to this, there is no evidence of any underground Nahar System in India. This system is seen in Daulatabad and Ahmednagar cities. In this, a reservoir is created by building a bund across a river. Water from such a reservoir or from wells dug on hillocks is brought to the settlement through a network of underground conduits. These conduits empty themselves in cisterns known as 'hauds'. There are settling tanks and airshafts located at regular intervals for the purpose of maintenance.

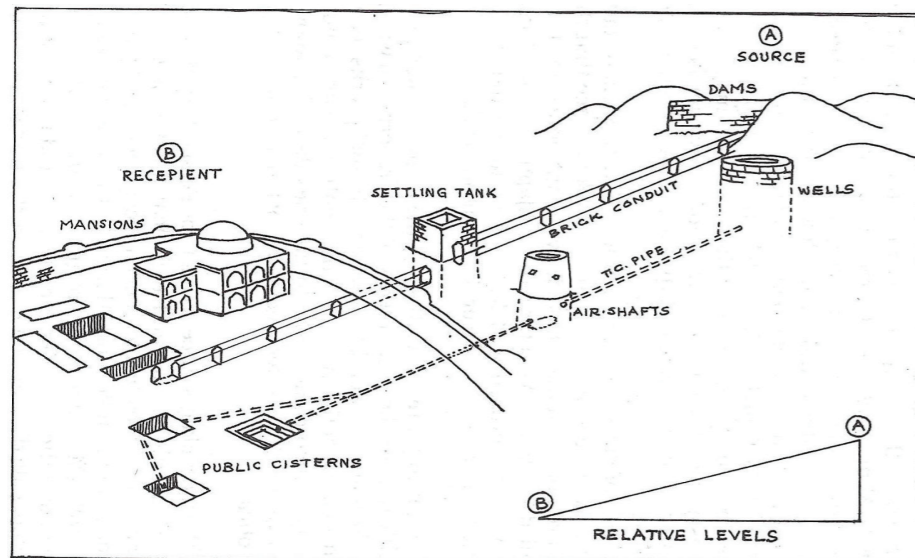
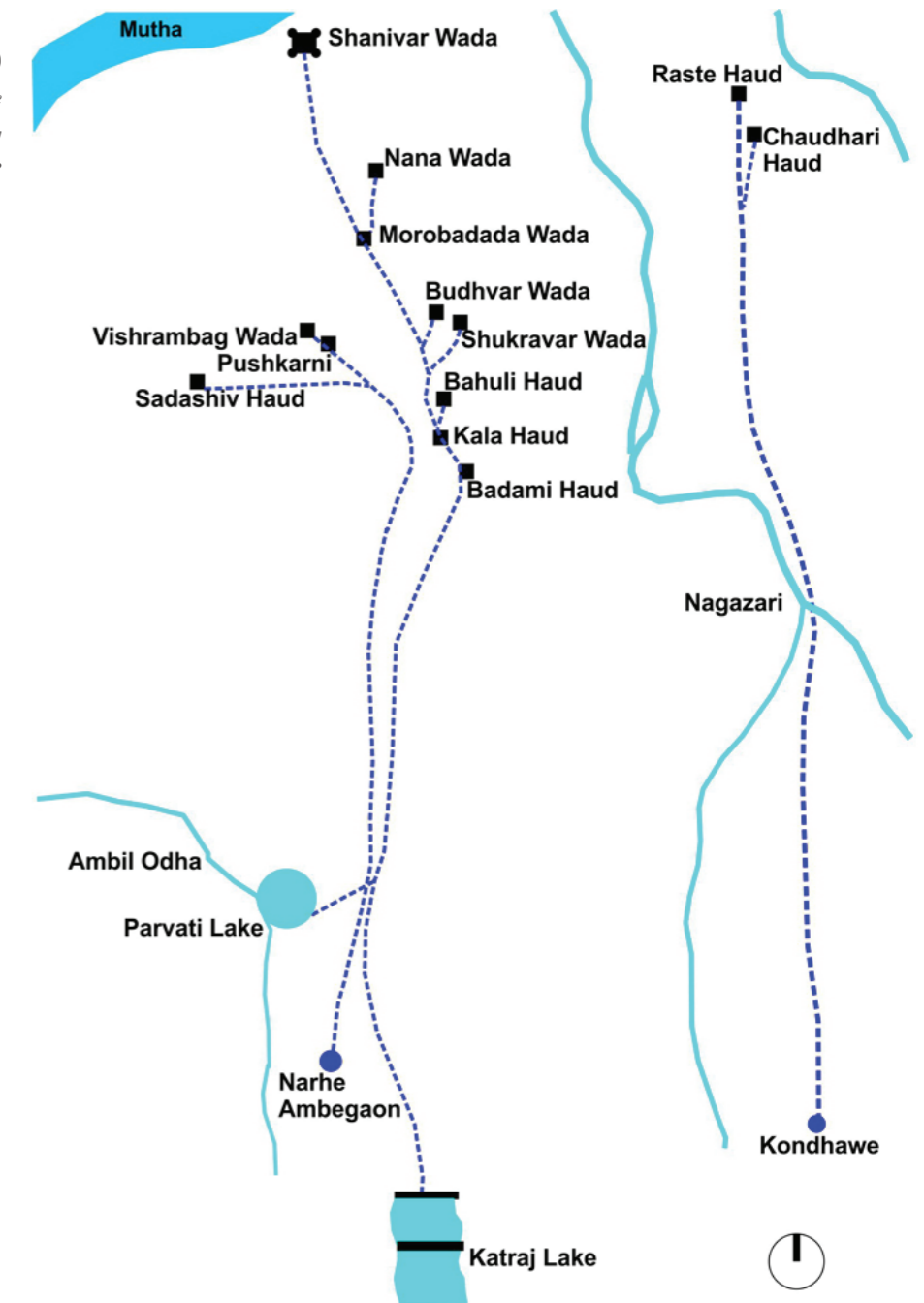


Fig 4)
The Nahar System of conduits
Source: Mate M.S, 1998

The Peshwe rulers were aware of this system. The Mutha River, Ambil Odha, Nagzari and Manik Nala dried up in summer. Nana Sahib Peshwe therefore decided to adopt a similar system of water supply for Pune. This underground conduit system, which started from Katraj, became popular as "Nahar-e-Katraj" or "Katraj Nal" in Marathi. Katraj village is located at a distance of 7 miles towards the south of Pune city. Nana Sahib Peshwe completed the work of building the reservoir and laying of the underground conduits during 1749-1761.

As the population of Pune started increasing in the latter half of 18th century, Nana Fadnavis (1761-1800), Sardar Anandrao Bhikaji Raste and Ruparam Chaudhary laid three more conduits in addition to the existing Katraj Conduit.

Fig. 5)
Conduits and cisterns in Pune during the end of 18th century
Source: Adapted from Mate M.S, 1998



Katraj Reservoir

The reservoir consisted of two dams located at different levels. The first one functioned as a settling tank and was 600 feet long and 8 feet wide. The second dam was 1000 feet long and 15 feet wide. There was a provision to drain out muddy water from the dam into the Ambil Odha. The walls of the first dam had 6 inch round holes with wooden plugs (Gokhale, 1914, pp. 2-5).

Katraj Conduit

The conduit was 8 km long. It was 2 1/2 to 3 feet wide and its depth varied between 5 feet, 7 feet and 12 feet; made out of bricks. The conduit ran along the eastern side of Ambil Odha up to Shanivar Wada and was 5 to 7 feet high. There were air-shafts at a distance of every 300 feet. There were 103 such air-shafts between Katraj to Parvati and 20 to 22 air-shafts between Parvati to Shanivar Wada (Gokhale, 1914). The conduit also had settling tanks at periodic intervals. Residual matter, if any, collected at the bottom of the pit from one side, and clean water flowed from the other side. An 8-10 feet high cylindrical construction was made above the settling tanks, which was open from the top through which a person could enter and clean the dirt. Another use of the construction was air bubbles if any were carried towards the top and did not affect the flow of water. (Mate, 2002, pp. 96–97). The eastern side of Pune received water from this conduit. There were 84 hauds in all, each one of them being 7-8 feet deep (Sovani Avinash, 1998, pp. 68–71, Gokhale, 1914). The complete work of laying the conduit was completed in 1761 with a total cost of Rs 200,000 (Kulkarni A.R., 1998).

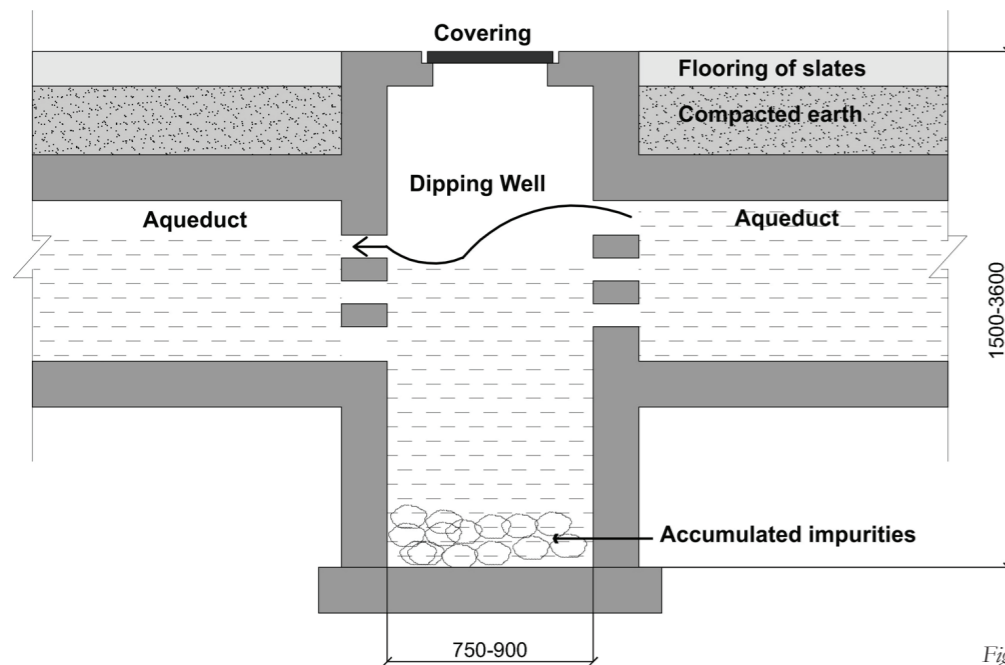


Fig 6: Cross section of Katraj Conduit
Source: Adapted from Sovani Avinash, 1998

Damming of the Ambil Odha and creation of Parvati Lake

Ambil Odha flooded during the peak monsoon. In one such incidence of flooding, several Brahmins were carried away along with the floodwater (Chintaman Ganesh Karve, 1942). In 1752, Nana Saheb Peshwe ordered to build a dam across the Ambil Odha and create a lake at the foothills of Parvati. The lake also served as an alternate water storage provision to supply water to the Katraj Conduit in case its supply reduced. Due to this, the water table rose in the adjacent areas, and people dug many wells and laid gardens to make the precinct beautiful (Kulkarni A.R., 1998). In 1784, Madhavrao Peshwe-I (1761-1772) built a Ganesh Temple on an artificial island created in the centre of the lake. A forest (hunting ground, zoo) surrounded the lake (Sovani Avinash, 1998, pp. 128–129).

Laying of Fadnavis, Raste and Chaudhary Conduits

In 1790, Nana Fadnavis brought water from Narhe Ambegaon village located six miles towards the south of Pune. The water from the conduit was released in four hauds, which included a haud in his own Wada.

Raste spent a lot of money to build temples, schools, water structures in Maharashtra. In 1778, he built his wada in Raste Peth by spending Rs 0.9 million and brought a

conduit at a cost of Rs 0.2 million. The conduit started from the Kondhwe village, which is 7 miles away towards the south of Pune. Six hauds were connected to the conduit. Until 1860, the rights of Raste Peth were with Sardar Raste. The British army used the water from this conduit. Later, The British supplied 5,000 gallons of water to Raste as compensation from the Khadakwasla Reservoir built by them (Karmarkar Vishnu Vinayak, 1925, Chintaman Ganesh Karve, 1942, 23, 221).

Ruparam Chaudhary laid a conduit that brought water from Kondhwe and released it at four places including his own house.

The Nagar Sanshodhan Vrutta mentions the existence of one more conduit laid by Balshashtri Tokekar. However, there is no information present about this conduit. The three conduits mentioned above along with the Katraj conduits mentioned earlier facilitated ample water supply to the newly developed peths of Pune.

Table 2)
Conduits built by Peshwe
Source: Gokhale, 1914

Conduit	Water supply (million gallons) 1 gallon= 3.79 litres
Chaudhary	0,15
Raste	
Nana Fadnavis	
Katraj	0,7
Total	0,85

Water for recreational and religious purposes:

Apart from domestic water supply, the Peshwe rulers created artificial lakes at some places in the city. The Parvati Lake is one such lake mentioned earlier. The Hirabag Lake built by Nana Saheb Peshwe is another such lake near which Nana Saheb built his wada. Various gardens surrounded these lakes. (Chintaman Ganesh Karve, 1942, 51 Khand 4). There were 13 gardens in Pune (Talwalkar, 1936, p. 70). People used water from the lakes or from separate wells to maintain the gardens. D. Boyen, who was a French in the Shinde Army has mentioned Mastani well which watered the Mastani Bag. The gardens contained many residences and temple precincts within them. (Gokhale Balakrishna Govind, 1988, p. 43). Fountains were present in the Wadas of Peshwe rulers. One such fountain being the lotus-shaped Hajari Karanje (Fountain with a 1000 spouts). (Sovani Avinash, 1998, p. 52).

Rural Water Management Systems:

Agriculture was the main source of livelihood for the village people. Prior to the understanding of the rural water management system, it is important to understand very briefly the rural land management and governance system.

During the medieval period, village was a self-sustaining sovereign unit. There existed two village governance types. 1) Rayatvari wherein the villagers owned different land parcels individually and 2) Saamaik (Commons) which worked on the principle of joint ownership of villagers. Land was grouped into two types, 1) Land which was cultivable and 2) Land meant for habitation (Khobrekar, 2006, pp. 547–552). Villagers undertook water works like creating reservoirs for irrigation on the land commonly owned by the villagers. Certain villagers also donated their land to the villagers for carrying out water works. Villagers' extracted water from wells, lakes and rivers for domestic purpose.

Water for irrigation was of two types:

- 1) Motsthal or through wells
 - 2) Patsthal or through canals
- (Campbell, James MacNabb, Sir, 1885).

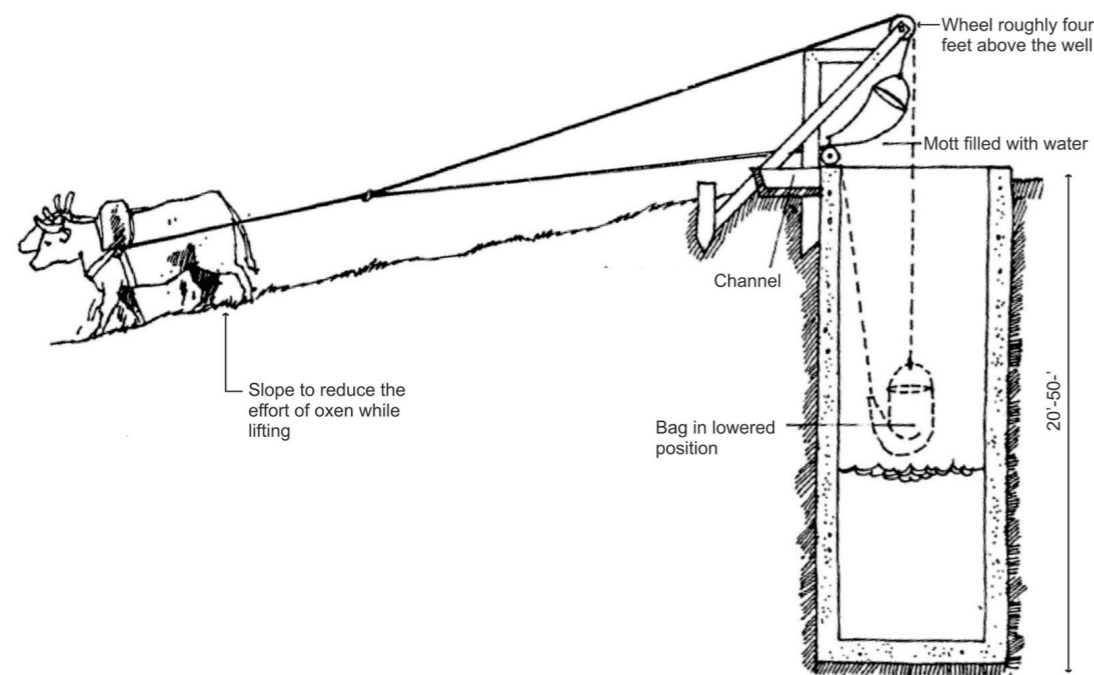
Irrigation systems:

Motsthal

This type of system is an intermittent or discontinuous water supply system with the combined use of animal and men power for drawing water. The name “mot” is derived from the leather bag (even use of metal buckets is common) used for drawing water from a well with the help of a bullock or a pair of bullocks.

The wells were generally circular in shape, eight to ten feet in diameter and twenty to fifty feet deep. Based on the availability of money to build a well, they were either unpitched, or were lined with dry stones, or were lined either with bricks or stones and mortar.

Villagers raised water using a funicular shaped mot with a broad end nearly two feet in diameter and a tapering narrow end. A thick rope tied to the broad end of the mot was passed over a small wheel four feet above the water trough (tharole). An inclined wooden frame secured to the ground supported the wheel. The narrow end of the mot was attached to another rope, which passed over a roller fixed to the ground. Both the free ends of the rope were attached to the yoke pulled by a single bullock or a pair. As the bullocks walked down along the slope away from the well, they lifted the submerged mot filled with water. The lifted mot discharged water through its small end into a connecting channel.



Based on the size of mot, the system worked with a single bullock, a pair, or by four bullocks. This system as mentioned earlier required the application of human labour too. Two operators were usually required for this application, one to conduct the animals properly and the other one to empty the mot water into the channel

This method is less efficient because of two main reasons. Firstly, water flow is discontinuous as the bullocks draw water only when they walk down the slope and secondly, due to the time consumed by them in every operation. Nevertheless, in remote villages, this method still has a high degree of reliability that may be more important to poor farmers than its efficiency. In addition, this method of water extraction also ensures that farmers draw water within the natural replenishment capacity of the well (Kennedy and Rogers, 1985, Srinivasan, 1970)

Fig7)

Mot System of drawing well water

Source: Kennedy and Rogers, 1985

Patsthal

Different village communities built ‘bhandaras’ (check dams) across rivers and channels carried the trapped water to their fields. This system of watering the fields by means of a channel was known as “Patsthal”. The channels were open channels, not bridged, hedged, or sheltered, which sometimes led to their destruction by the village cattle. Such water channel system watered twenty-five, seventy-eight and three hundred and sixty seven acres of garden land respectively.

While the wells were the property of individuals, the channel water was shared between the community who built the bhandaras or who were involved in repair of it every year after the period of monsoon. The share was worked out in time, hours or days and this division by time worked out very smoothly. Men amongst the community known as ‘patkaris’ regulated the entire system of water distribution to ensure fairness and equity in the distribution of water.

Though this system is far more efficient than the mot system, it is found less in Pune region as the number of sites with a sufficient head of water and command of land is limited (Campbell, James MacNabb, 1885).

Mixed method-utilizing water jointly for household and irrigation purpose:

Ranje is a small village located at a distance of about 25 kilometers away from Pune. There is a unique water management system existing in the village temple precinct. There exist three stepped kunds inter-connected to one another.

A natural spring is present in the first kund. Villagers use water from the first kund for drinking purpose.

The overflow of water from the first kund enters into the second kund where the villagers take a bath.

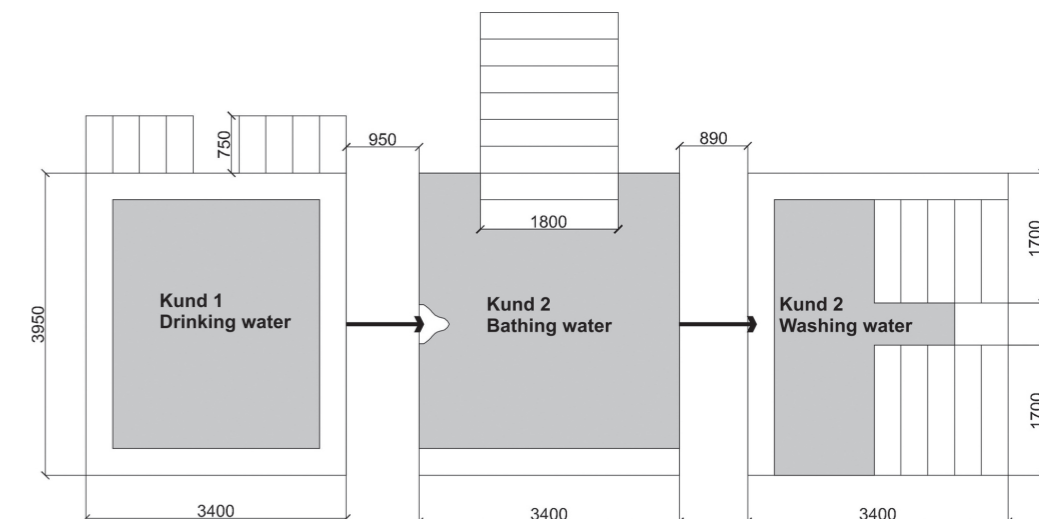
The third kund receives the overflow of second kund, which the villagers utilize for washing purpose.

The water that runs away after washing of clothes and utensils is collected and carried through a channel and is utilized for watering the agricultural fields. Thus, this becomes an efficient system of water management where villagers prioritize water usage. It also keeps a check on water utilization during times of water scarcity.

Fig 8)

Series of kunds at Ranje

Source: Author



Traces of the traditional systems:

Though not fully functional, water continues to flow through the Katraj Nahar and is still available in one or two cisterns present in the old city core. Several parts of the underground conduit have been blocked or cut off during construction of new structures in the old core. A thorough investigation of the quality and quantity of water still available through this age-old system needs to be undertaken. Wells continue to be an important source of water supply in the villages around Pune. However, it is important to realize that these traditional methods of water management are fighting a tough battle for their survival. The government and communities need to take urgent steps to ensure that these systems are adapted translated to suit the present water requirement. More important is that the water wisdom behind the design of these systems is not lost.

Design principles behind water management systems:

Design principles in this context mean what Elinor Ostrom defines as; “a design principle is an element or condition that helps to account for the success of institutions in sustaining the physical works and gaining the compliance of generations of users to the rules-in-use” (Ostrom, 1992). The fact that the above-mentioned water management systems continue to survive generates adequate interest to understand these systems in totality. This necessarily involves on one hand an understanding of the technical components of the system like the check dams, network of conduits, material used for the construction of system, etc. On the other hand, it is also very important to understand the overall city planning, social norms and practices due to which the water management systems thrived. This section describes some of these city design principles, social norms and practices as follows:

1) Utilization of city terrain for water transportation

The Peshwe rulers seem to have had an in depth understanding of the city's terrain. As mentioned earlier, the southern part of the city is a highland and it gently slopes towards the river Mutha in the north. The major roads were laid in the direction of the slope and they acted as carriers of floodwater during the monsoon. The Peshwe rulers laid the conduits in such a manner that they utilized the natural gradient of land to carry water from southern highland to the lower city core towards the north. At places where the natural gradient was inadequate, the technicians created artificial levels within the conduits to ensure an undisturbed water flow.

2) Diverse sources of water supply

Nanasaheb Peshwe laid the Katraj conduit in 1749. Later, with city expansion and population growth, there was a need for an expansion in the water supply also. It is significant to note that the Peshwe rulers and noblemen did not attempt to expand the existing network of hauds served by the Katraj conduit. Instead, the noblemen identified new sources of water supply for the city. This ensured that in case of failure of any one of the conduits, the entire water supply system did not collapse but there were alternate possibilities of water supply to the city. Besides this, the public and private wells also added to the diversity of water sources.

3) Public accessibility to water

Though the Nahar system of water supply may seem a small-scale version of the current centralised system, it is important to note that the water carried through the underground conduits was released majorly in public cisterns. Common people had an easy access to these cisterns.

4) City as water catchment

Artificial lakes like the Parvati Lake and Hirabag Lake allowed for local retention of water. Thus, people were in close contact with the water sources. These artificial lakes increased the water table of wells in the vicinity. The city had many soft landscaped areas in the form of thirteen gardens, which ensured that the flowing rainwater accumulates and percolates into the ground. These soft areas played an important role in water retention and percolation as most of the city terrain is made up of hard impervious Basalt Rock where it takes time for the water to seep into the ground.

5) Priority for water usage.

During years of low rainfall, the Peshwe rulers cut water supply to the private gardens and ensured that adequate drinking water is available for the common people. In 1745, there was a water shortage in Pune during the summer. At this time, the noblemen still used well water for watering their private gardens. At this time, Nanasaheb Peshwe was away from Pune. Therefore, his mother Radhabai passed an order asking the noblemen to stop watering their gardens for few days and instead make this water available to the common people. (Bhave Vasudev Krishna, 1976, p. 39)

6) Patronage to people undertaking water works

The water management systems were a kind of public-public partnerships. The Peshwe encouraged people to undertake construction of bunds and storing water in artificial lakes. They waved off the taxes of those people who undertook water works for the welfare of the community.

7) People's participation in water works.

At village level, every family had to participate in the annual task of maintenance of water storage structures. The village community setup strict punishments to defaulters.

These design principles ensured largely that there was a strong link established between water and the people and people respected a valuable natural resource like water. Most of these principles are in line with the principles of Water Sensitive Urban Design as described by Tony Brown and Rebekah Wong (Wong and Brown, 2008).

Conclusion

Even today, one can still find flowing water of Katraj Conduit at a few locations like the cistern known as Kala Haud. Though at present, the water may not be suitable for drinking purpose, it may be useful for secondary activities like washing, gardening, etc. It is vital to take immediate actions to prevent further deterioration of this traditional water supply system. It is important to look at the traditional water harvesting systems not merely as a matter of awe and curiosity but as systems, which may have the potential to contribute in any manner to enhance the present water supply system. With increased size and expanse of cities like Pune, these systems may function as decentralised systems along with the current centralised water supply system. These systems could add diversity to the entire water infrastructure, which is currently solely dependent on a centralised system of networked pipes. It is vital for planners and designers to understand the inherent planning and design principles of traditional water management systems. One must understand the significance of the social practices, rituals and societal norms that ensured water equity within the community and ensured water usage not more than nature's replenishment capacity. Lastly, the local knowledge of water management when linked to modern theories of water sensitive urban design and low impact development has the potential to tackle the challenges of water scarcity due to climate change and rapid urbanization.

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Lucia Wright, Elizabeth Wamuchiru, Duván López, Andreas Huck

Wednesday, May 24th

Session C: Resilience and Multi-level Governance

Chair: **Nina Gribat**, TU Darmstadt
Discussant: Mbongeni Ngulube, UIC Barcelona

Andreas Huck, TU Darmstadt
Epistemic cultures of urban and critical infrastructure resilience

Lucia Wright, TU Darmstadt
The role of Water Operator Partnerships and water security in Da Nang

Duván López Meneses, UPC Barcelona
Elucidating the principles and practices of risk governance
from applied experiences in Bogotá, Colombia

Elizabeth Wamuchiru, TU Darmstadt
Strengthening community-based approaches and social resilience

Resilient cities and infrastructures: How do we know what we know?

*This essay was written for the purpose of internal use at the workshop
“towards urban resilience 2017”.*

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Abstract

The concept of resilience is said to serve as a ‘boundary object’ allowing for cross-sectoral and interdisciplinary exchange and cooperation. However, the concepts of urban resilience (UR) and critical infrastructure resilience (CIR) seem to develop largely in parallel despite numerous potentials for interlinkage. This paper compares the concepts’ origin, the main actors of knowledge production, the used definitions of resilience, and more generally, their risk perception, objects of protection, and promulgated solutions in order to gain a better understanding of the two epistemic cultures that make up how we know what we know. In this way, it seeks to shed light into the production of knowledge in the fields and aims to draw conclusions on the requirements of an integrated approach of urban and critical infrastructure resilience.

Introduction

The concept of resilience has been used extensively in academic debates over the course of the last decades. Ecologist Crawford Stanley Holling shaped the term and contributed massively to its upturn, differentiating between engineering resilience and ecological resilience (Holling, 1996). Thereby, engineering resilience refers mainly to “the ability of a system to return to an equilibrium or steady-state after a disturbance” (Holling, 1973; Davoudi et al., 2012, p. 300), whereas ecological resilience was defined as “the magnitude of the disturbance that can be absorbed before the system changes its structure” (Holling, 1996, p. 33). Further differentiation of resilience can be made between equilibrium models and evolutionary approaches. While equilibrium models assume a consistent system to bounce back after a shock (cf. engineering resilience), or to adapt another stable state (cf. ecological resilience), evolutionary approaches understand systems as constantly changing over time (with or without external pressure) (Davoudi et al., 2012).

In the field of urban studies, it has been argued that, over the course of the last decade or so, resilience has replaced sustainability as main policy paradigm for urban development highlighting the need for adaptation in changing environments and framing urban areas as complex socio-ecological, and socio-spatial systems (Coaffee and Lee, 2016). In security-driven policy discourses on Critical Infrastructures (CI), resilience currently gains prominence as a concept that stresses the notion of preparedness and acknowledges the character of CIs as complex, adaptive, and socio-technical systems (George Mason University, School of Law, 2007). This paper argues that, despite numerous potentials for interlinkages, the concepts of Urban Resilience (UR) and Critical Infrastructure Resilience (CIR) develop largely in parallel and within two different epistemic cultures. Thereby epistemic cultures are defined as “those amalgams of arrangements and mechanisms-bonded through affinity, necessity, and historical co- incidence-which, in a given field, make up how we know what we know” (Knorr-Cetina, 2003, p. 1). The paper identifies some elementary differences in content- and issue related aspects, actor-related factors,

material and practice-related features as well as in the areas of knowledge production. It concludes that it is not only a matter of governance to close the implementation gaps apparent both in UR and CIR, but also requires cooperation and a better mutual recognition of two epistemic cultures.

Introducing Urban Resilience

Over the last decade or so resilience gains an increasingly prominent role in urban development discourses. Thereby, UR is not a fixed term with an all-encompassing definition (Meerow et al., 2016). There is a diversity of approaches focussing on different risks, using different mechanisms, and concentrating on different objects to be protected. “Each city sees different aspects as important for resilience, and these are context specific.” (Johnson and Blackburn, 2014, p. 43) While UR is often presented as a politically neutral approach (Pizzo, 2015, p. 134), it is increasingly exploited in a normative sense by stating that “enhancing adaptive capacity should be the overall goal of resilience” (Klein et al., 2003, p. 43). Consequently, some authors depict an implementation gap when it comes to UR searching for reasons in the fields of urban governance, planning, and policy making (Coaffee and Lee, 2016).

Introducing Critical Infrastructure Resilience

Critical infrastructures (CI) are essential for modern societies’ well-being as they provide those services that enable modern living in the first place. In the event of breakdown, however, they can pose the social order of a city, region, or country at risk (Graham, 2010, p. 18): „if disrupted or destroyed, [they] would have a serious impact on the health, safety, security or economic well-being of citizens or the effective functioning of governments” (Bouchon, 2006). Those CIs, that are regularly listed are often referred to as lifeline systems (Neuman, 2006) and include large technical infrastructures such as energy, transportation, water supply/disposal, and information/communication. It is important to mention that CIs are interdependent from one another which makes them vulnerable to cascading effects (Rinaldi et al., 2001) and can even lead to “normal accidents” (Perrow, 1999). Therefore, Critical Infrastructure Protection (CIP) and Critical Infrastructure Resilience (CIR) received more and more attention in academic and policy debates. As opposed to CIP, CIR acknowledges the unpredictability of future threats and admits the possibility of infrastructure failure. Whilst CIP focusses more on traditional risk management approaches, CIR includes scenarios of failure in its analysis and asks how to recover as quickly as possible or how to prepare for incidents (Medd and Marvin, 2005). Still, it seems that technical and risk based solutions predominate the field of CIR research and practice.

Towards an integrated approach of urban and critical infrastructure resilience?

Ambitions to build UR will most likely remain incomplete as long as CIs are neglected and ambitions to build CIR will most likely remain more or less abstract concepts as long as the urban level is overlooked. Coaffee and Lee (2016, p. 262) argue that by now it became more important to ask what resilience does instead of what it is. One thing that resilience might be doing is contributing for an integrated governance approach of infrastructure management and urban planning, i.e. to serve as a ‘boundary object’ (Kaufmann, 2012). This hypothesis, however, is thus far barely confirmed empirically and lacks conceptual consideration in academic debates. The remaining paragraphs of this paper should address the issue of academic and expert debates by comparing the way both fields adapt and make use of the concept of resilience.

Comparing UR and CIR

The following paragraphs compare the concepts’ origin, the main actors of knowledge production, the used definitions of resilience, and more generally, their risk perception, objects of protection, and promulgated solutions.

Origin

The study of resilience in urban areas started in the 1990s in response to the environmental threats of adjusting social and institutional frameworks (Mileti, 1999; Lu and Stead, 2013, p. 200) and the vast use of the notion of resilience in public policy debates and urban planning in the 2000s (Coaffee and Clarke, 2015, p. 250). Whilst in the USA, UK, and Japan UR rapidly became a highly politicised policy rhetoric due to a range of natural and man-made disasters such as 9/11, Hurricane Katrina, and the Japanese earthquakes and tsunami in 2011, on mainland Europe the integration of resilience as a concept in planning and policy discourses occurred more slowly and mainly concerned climate change adaptation with a focus on flooding (Coaffee and Clarke, 2015, p. 250).

CIP as a matter of national security in the USA evolved during World War II recognizing the enemy societies’ dependence on these large technical systems (Collier and Lakoff, 2008; Lakoff and Collier, 2010). In recent years, the trend to protect CIs has arguably intensified (Brassett and Vaughan-Williams, 2015, p. 40), especially after the 9/11 terror attacks. Acknowledging CIs interdependencies and potential cascading effects has over time lead to a prioritisation of CIR as opposed to CIP (Coaffee and Clarke, 2016, p. 2) as illustrated by the Critical Infrastructure Task Force’s recommendation to promulgate CIR as top-level strategic objective (Pommerening, 2007, p. 9). Other countries like the UK, Australia, and New Zealand followed the US example and passed CIR strategies pointing to CI interdependencies and their significant role for public safety. In mainland Europe, however, the shift from CIP to CIR at a political level is still to be undertaken, at least when looking at policy rhetoric.

Main actors of knowledge production

More and more cities engage in the dialogue and develop resilience strategies and plans. These actions are often organised by international institutions like UNISDR, ICLEI, C40, or the World Bank. Consequently, knowledge exchange between cities is actively fostered. Moreover, private institutions, consultancies, and companies engage in the growing market of UR developing tools, concepts, frameworks, and strategies to measure resilience levels and to implement the resilience strategies. As a consequence, resilience toolboxes, frameworks, and agendas are shaped by these global institutions, not seldom for commercial gain (Coaffe and Lee 2016, p. 10).

In contrast to that, an international network promulgating CIR does not exist to my knowledge. CI management and protection is mainly organised at national government level (Ritter and Weber, 2010). Although Scalingi (2007) sees the need to better consult regional governments and other stakeholders in this process, she sees the national government of being responsible for CIP/R. At an operational level it is most often the (private) infrastructure providers and network operators who are dealing with issues of protection (and sometimes resilience). Clearly liberalisation, privatisation, and deregulation processes in the vein of the New Public Management have led to an institutional reconfiguration that is not always of benefit for defining and implementing cross-sector resilience strategies, be it at national, regional, or local level.

Definitions of resilience

Resilience, in urban development discourses, acknowledges the imbalance of our world, considering flexibility to be the only practical answer to an uncertain future (Pizzo, 2015, p. 136; Caputo et al., 2015, p. 7; Ahern, 2011). Clearly, different projects and programmes make use of different approaches (engineering, ecological, evolutionary) and the way UR is applied differs among planning cultures (Spaans and Waterhout, 2017, p. 2) as well as from city to city (Johnson and Blackburn, 2014, p. 43) revealing varying ratios of analytical and normative aspects.

Still, the notion of urban resilience is often described by characteristics like awareness, diversity, integration, self-regulation, and adaptability (Rodin, 2014) and it seems fair to state that “[u]rban resilience is ultimately about change” (Coaffee and Lee, 2016, p. 5).

In contrast to UR, CIR often makes use of a rather engineering approach of resilience. As discussed above the concept of CIR mainly emerged out of the political practice of CIP. Hence, a lot of literature on the concept point out the shortcomings of protection as opposed to resilience. Definitions regularly make use of the classical engineering ‘bounce-back’-idea even if they acknowledge the importance of interdependencies between different CIs as well as between the technical and the social dimension of these systems (Pommerening, 2007, p. 14; Scalingi, 2007, p. 51).

Risk perception, objects of protection, and promulgated solutions

UR, at least partly, derived out of the recognition that climate change mitigation will not prevent us from climate change consequences such as flooding and extreme weather events. Müller (2011, p. 4) defines different categories of disturbances to urban areas like natural, economic, biomedical, social, technological, and political. However, at least for Mainland Europe, it seems fair to state that climate change and natural disasters make the biggest share of perceived risks when it comes to UR. While the object of protection, almost always, is the urban population, the city borders most often compound the system boundaries under investigation. In terms of promulgated solutions, most UR approaches make use of an assessment of the current situation in the city. Generally, the rise of resilience in urban planning and development often goes along with governmental encouragement of active citizenship, decentralised responsibility, and self-organisation (Duijnhoven and Neef Martijn, 2016) and includes instruments such as master planning, mapping, and citizen participation.

CIR emerged out of the recognition that protection will sooner or later fail (Scalingi, 2007, p. 50; Boin and McConnell, 2007, p. 55). Developed mainly along the lines of security research the shift from CIP to CIR comes along with a wider perspective on potential threats to CI systems. Therefore, McCarthy (2007, p. 2) calls for a greater role of CIR as governments start focussing on an all-hazards approach in infrastructure security measures. Consequently, one could assume a shift in the object of protection from technical networks to those that are using it. However, there seems still to be a focus on technology as compared to social or institutional aspects (Yumagulova, 2012). In terms of promulgated solutions private actor engagement (infrastructure owners and network providers) is critical but often fails due to diverging interests and overlapping or undefined responsibilities. While strategies at national levels often focus on organisational aspects, European projects mostly focus on technological aspects and the simulation/modelling of interdependencies and cascading effects. Typical instruments that are used in CIR approaches include risk assessments, simulations, and modelling. Approaches that include notions of societal resilience, however, are very rare (see Boin and McConnell 2007 for an exception).

Discussion & Conclusion

The comparison above shows that there are, indeed, two different epistemic cultures which create the meaning of two concepts that are both increasingly shaping political agendas around the world. These communities of knowledge production share a common understanding of resilience, the problem at hand, and potential solutions to tackle the problem. Moreover, the actors that make up these epistemic cultures, act in different areas of knowledge production.

Consequently, integration of the different concepts is, at least partly, a matter of fostering collaboration between the different epistemic cultures, to find a common language, a common problem understanding, mutual trust, and mutual understanding.

An integrated approach of UR and CIR requires coordination and cooperation across different policy domains, different infrastructure sectors, different spatial scales, and different time dimensions. Finding linkages and ways to integrate the two epistemic cultures would be a first step for defining an integrated approach to urban and critical infrastructure resilience. This would involve content-related, actor-related, practice-related, and area-related exchange and understanding. Interdisciplinary research might help to foster integration in the respective areas of knowledge production. In these sort of arrangements, resilience can prove its alleged role as a boundary object.

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Attribution and distribution of climate risks: a critical analysis of policies for resettlement in Bogota, Colombia, to elucidate new practices of risk governance

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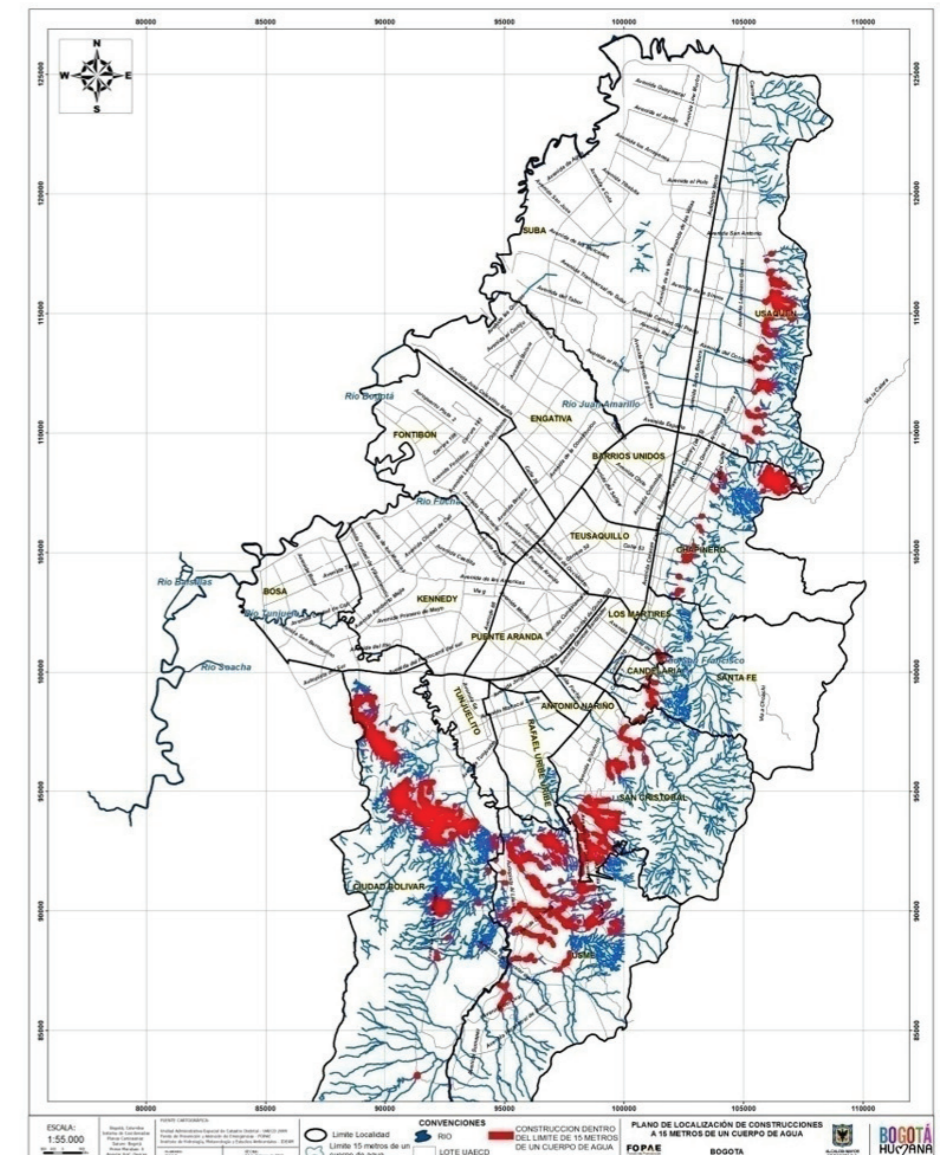
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Introduction

Bogota is a huge urban concentration with a large number of informal human settlements, particularly along its eastern and southern borders.

More than 40 percent of the near 10 million of inhabitants occupied, informally, in less than 30 years, extensive mountainous terrains, over a really complex physiographic background, in a context of absence of governance, configuring intensive climate risks .

Fig 1)
Distribution of natural runoff water drainage and critical areas of climate risk in Bogota (taken and modified from López, 2013)
The figure permits to associate the preexisting frame of natural drainage and the risk conditions identified along them. The risk expresses the conflict produced by the occupation processes displayed.



Much of the current conditions in the city of Bogota could be comprehended as the “natural” consequence of the historic evolution of the nation. Under the genesis of risks in Colombia resides a violent conflict, but such violence was built along the history, with the retrace of socio-economic development in relation to the political one and with the congenital weakness of the Colombian State (BushnellWWctures configured unstable urban systems that continue challenging and bursting such structures in a vicious circle, determining the constitution of many tangible conflicts including among others climate risks.

Julio Carrizosa Umaña, a famous Colombian environmentalist, explains how over the time were produced the social spaces in the middle of lacking of governance. In his words, some characteristics of our situation, like the historical difficulties to apply State authority throughout the territory, the permanence of the misery and the low accumulation of public and private capital, could be explained, because of the conflictive interaction between an extremely complex territory with many variables and interrelations and a simplified society unable to adapt to this complexity (Carrizosa, 2014: 213).

A prime hypothesis is that society in Colombia has been burst in many senses by the complexity of his territory and the denominated risk conditions are just collateral consequences of such bursting. The strong and prolonged armed conflict, the massive displacement of population, the uncontrolled settlement of more than 4 million people in the capital city of the country, the exclusion and exploitation once into the city suffered by miles, for example in urban mining zones; all evidences the difficulties of a society to agency her own situations. Everything finally is somatised in situations like the constitution of risk zones.

If the increasing of social risks and uncertainties are consequence of the difficulty for the exercise of governance, understand the manners, how certain models of simplified governance are imposed, causing des-adaptation in specific territorial contexts, is fundamental to sustain the proposal of risk governance pretended. Three questions are formulated in the following sense to move forward in the research being carried: How are attributed and distributed the climate risk conditions for the case analyzed in the urban space of Bogota? How are being governed the territories affected by risk? And how can be deconstructed those risk conditions or recreated the affected territories without risk?

The first question, that would be more extensively covered in the present paper, concerns to the necessity of a critical approach to the usual risk management practices, focusing particularly in the resettlement of population affected by risk.

The second and third questions, that will be only briefly approached, look for elucidate alternative perspectives, to understand and treat the constitution of climate risk’s conditions and to permit enhanced visions beyond the physicalist perspectives, that use to focus mainly on the treatment of the natural processes to manage climate risks.

Attribution and distribution of climate risks for resettlement in Bogota

The ciphers of the program for resettlement in Bogota are revealing. After 15 years, the populations effectively evacuated by this measure don’t reach one third of the expectations initially programmed to be finished in 10 years (López, Buriticá & Vanegas 2016; López, 2016a; Alcaldía Mayor de Bogotá, 2016a). Additionally, the total amount of reoccupation, in the areas declared for resettlement, currently exceeds the initial quantity of inhabitants included in the measure (Alcaldía Mayor de Bogotá, 2016b).

Two problematic aspects of such policies for resettlement are analyzed. At first the composition of the climate risk assessments or <<the mechanisms for attribution of the climate risks>>; at second, a particular attribution, used to support resettlements, the not mitigable risk - NMR, will take us to discuss the <<distribution of climate risks>>.

Is very usual to encounter, in the references made to climate risks, the association established for the risk as an intrinsic condition of certain physical spaces. Expressions like “inhabitants of risk zones” or “people occupation of risk zones”, regularly appearing on public media, institutional and even academic papers, giving account for a very ingrained association to treat risk as a preexistent condition of the space, where people come to inhabit.

In general terms is conceptually resolved that risk depend over exposed elements, that at the end, turn around the presence of human groups or the interest for them displayed (Lavell, 1993: 111; Wijkman & Timberlake, 1985: 31; Wilches, 1993; Cardona, 1993; Maskrey, 1993: 96). But a common intuition tends to assume that risk preexist, whatever the interests playing on the space before, during or after the establishment of human settlements or interests.

It would hardly be denied that in the case of a volcano crater, for example, the mere projection of some kind of human interest would automatically become on risk, for the natural conditions of the space. But that intuitive prescription doesn’t accounts generally with the similar evidence on physical conditions; and the margin of subjectivity, in front to “predetermined risks”, increases with the complexity and the uncertainty of the phenomenon confronted.

To advance in the designing of adequate responses to deal with climate risks, is advised to deconstruct the model for comprehension of the risk. Because if risk is seen as a property of certain “risky spaces”, doesn’t matter what to do the spaces will remain such attribute, so not another chance remains but to restrict the land use. What needs to be sustained is that risk is not that intrinsic property of the space. Does not exist somehow like empty risk spaces, but the space, by definition, should be better understood as a social production where risk results configured and could become intensified or positively addressed by built-in adaptive mechanisms.

By the other hand, the interests and projections over the space mentioned as determining to configure risk are hardly conceived into the used models for assessment. For the case of Bogota, the risk models employed to assess landslide risk conditions were evaluated by a multidisciplinary commission with some relevant findings.

In particular, in terms of vulnerability, the support for the decision-making in Bogota and for example to define the resettlement of population or the NMR, results very restricted to a physical vulnerability index for housing units, according with a model of structural engineering, conceived in 1996 (López et. al., 2015). The risk assessment converts this index into levels and crosses it with categories of hazard to obtain categories of risk (High, Medium and Low).

The commission mentioned, recognizes, that the risk of landslides in Bogota results from social transformations of the territory rather than from mere factors inherent of the physical context. In this sense was observed an inconsistency with the vision of the risk expressed by the technical concepts used for assessment, where the physical factors predominate and therefore the management measures divert in the same sense (Lopez et al., 2015).

According with the same analysis (Lopez et al, 2015), the reality of the territories today differs from the original postulates when the formulation of the policies for risk assessment was initially conceived. The responsiveness of populations, changes and pressure for land use of the city, substantial reduction of poverty levels in the last decades and thus, access of people to living conditions, education, culture and interaction with the State; all this elements are decisive to assess vulnerability, but are not part of any of the models used to support the decision making to treat risks.

Moving forward to the distribution of the climate risks, must be told, at first, that risk resettlement policies in Bogota are applicable for the called “non-mitigable risk areas - NMRA”; an enigmatic category permanently cited into the local or

national legislation (Alcaldía Mayor de Bogota, 2013; UNGRD, 2016), but not precisely defined there in any term.

One definition of <<mitigability>>, valid to understand the application of NMR in Bogota, comes from a very influential guide to incorporate the risk analysis in the planning processes in Latin America (Ramírez & Rubiano, 2009). It mentions that the possibilities for mitigation rely on aspects like the magnitude of the works required, the restrictions of governments and the social and cultural dynamics of population. The concept of mitigability is then proposed as a condition in which it is feasible technically, economically, socially and politically intervene a territory, to reduce the risk and guarantee the population, the infrastructure and the economic activities to remain, within reasonable and socially acceptable margins of safety (Ramírez & Rubiano, 2009, p. 36). “Therefore, is very common that in a land management processes, in areas affected by landslides, governments have to make the decision whether risk can be or not mitigated” (Ramírez & Rubiano, 2009, p. 36).

A guide for resettlement of populations in risk, presented by the World Bank (Correa, 2011), analyses the pertinence of mitigability depending on the characteristics and the types of natural phenomena considered. For the case of landslides, in coincidence with Ramirez & Rubiano, is reaffirmed that the notion of “Mitigability” varies widely according to the economic, social and political context (Correa, 2011, p. 43). It is clarified that it implies a political decision and certain agreement with the population under risk, but as a conclusion is specified that resettlement “results from technical analysis to identify the most appropriate mitigation alternatives and define whether this is or not the only option” (Correa, 2011, p. 46).

For the case of hazards related to flooding events is supported than for river basin management purposes, “it is necessary to define a limit to the sides of channels, lagoons and buffer areas considered part of the hydric structure and therefore there should be no human settlements, since the risk of flood could be considered as non-mitigable” (Correa, 2011, p. 42). Once declared this statement is clarified that areas of the natural water structure could be intervened and modified according to the development needs.

In the documents cited, it appears to be a technical criterion that determines mitigability objectively, but always, some note appended remits to political decisions whose criteria beyond technical arguments are not explicit.

In Bogota, the NMRA result being zones affected by high level of a natural hazard, occupied with families with low socio-economical indexes on informal settlements. This type of populations and settlements are “focused” by the policies of resettlement for not mitigable risks (Alcaldía Mayor de Bogota, 2013). The relationship between NMRA and informality and poverty is practically explicit and that is certainly problematic.

Being analyzed, the authority displayed by the State to attribute risk and distribute mitigability on informal settlements results disturbingly discretionary. The climate risk policies are capable even to suspend the validity of certain civil rights, resembling to the status of <<State of Exception>>. In fact, not in few situations the declaratory of NMRA is pronounced in the context of an “emergency declaration”, a figure whose similarity with the State of exception merely to be as well analyzed. Indeed, from the World Bank’s perspective, in its resettlement guide above mentioned, it is suggested that the best scope for the establishment of “non-mitigability” is the occurrence of a disaster (Correa, 2011, p. 38).

In front to the emergency or the disaster or in behalf of them, the State counts with an authority to designate the <<mitigability>> of risks and by this way to distribute such risks across the space. The decisions made, behind the declaration of NMRA, designate where is going to be the risk assumed by the State, or the private sector, or where it is dispensed to the market or to the citizens and in this last case, the State also decides if such citizens are capable or not to cope with risk.

Another perspective for this issue of risk’s distribution becomes from the proposed concept of <<society of risk>>. It nominates a “civilizational behavior” on the configuration of postindustrial societies, where the distribution of wealth as a fundamental transaction takes a back seat and welfare or poverty are determined according to the distribution of risks, defined as destructive forces emerging from the social relations of production or modernization (Beck, 1986; Beck 1988, Montenegro, 2005).

In the global society of risks, risks have become one of the main forces of political mobilization. In the first place, because there is a basic structure of power within the global risk society, which divides those who produce and benefit from the risks and the many who are affected by those risks. On the other hand, as risks refer to more potential than visible events, their interpretation can be oversized, denied, reduced or minimized, as long as they are open to “processes Defining social conflicts “in which the struggle of visions of various actors and interest groups manifests itself (Beck, 1986: 28).

Beck takes into account the political dimension of the categorization of risks, disdaining the idea of objective scientific appreciation of them and introducing the concept of “risk heterodetermination”, to refer to the competition between the pretensions of rationality with ethical, political and economic content (Montenegro, 2005). The reasoning provided, pointing on the conflictive attribution and distribution of risks, connects with the stated by Ulrich Beck.

Governance in territories affected by climate risks

In the previous stage was described the authority displayed by the State, in the domain for attribution and distribution of the climate risks, and insinuated a parallel for such discretionary property with the State of exception, in particular easily visible in the emergency declaration.

The State of exception is considered the cornerstone in the edifice of the modern regimes of governance that attribute the sovereign decision to a centralized state (García, 2016). The State governs over an idealistic closed homogeneous community and is capable to interpret the willingness and convenience for such. Also is authorized to detect the internal and external enemies and apply the violence for elimination or control.

This model for governance is criticized for being antagonist against the human plurality and the possibility of existence for heterogeneous communities. The manipulation addressed to induce and validate the idea of a common danger or a public enemy attacks the community dimension in the human society (García, 2016).

For the case of complex informal urban settlements addressed to be administered with climate risk policies of resettlement, the literature is quite extensive detailing the fragmentation suffered by the communitarian structures and the rupture induced at human, social and territorial scales. There is recognition even from those who defend or support the implementation of such policies, with respect to the enormous impact caused on the population (World Bank, 2011, p., 367; IDIGER, 2015, page 17; Oliver-smith and Sherbinin, 2014, p.24).

López (2016b, p. 56) reflects about the contradiction activated by the resettlement procedures in Bogota, in terms of <<arraigo>> (rooting), composed of heterogeneous human projections and social forces territorially engaged and <<desgarro>> (tearing), alluding to the impulse mobilized by the State to codificate and homogenize the urban landscape. This confrontation is revealed to explain, for such areas intervened, the structural failures and weakness of the systems for governance, that difficult the orientation and consolidation of development processes at local scale, much in the line with what postulates Carrizosa, when making reference to the challenge to administrate complexity.

But from another point of view, the induction of territorial conflicts could be seen as an intentional scope (Moral, 2012). The entire disruption caused by operations like resettlement, could be seen as successful applying of certain manner of governance. López (2016, p. 88) refers to factual coincidence, between the effects of resettlement by risk and the phenomena of organized daily life, creative destruction and accumulation by dispossession, widely denounced by the social sciences and the critical urban theory.

The resettlement policies cause strong social and spatial disturbances in Bogota (Figure 2), which can be certainly seen as failures on the governance systems or intentional processes of creative destruction operated by the State.

Pelea entre clan familiar deja cinco muertos en el norte de Bogotá



Fig. 2) A headline from one of the most consulted news webs in Colombia, reports a gang's reckoning resulted in five people killed. But the image, beyond the scene of crime, shows a landslide affected risk zone, patched resettled and inhabited Source: Archivo Semana

The notion of governance is not politically neutral. Is proposed as desirable, for the case of risk management, a modality of governance capable to involve an increasing range of stakeholders as decision makers at the local level, instead of a governance limited as the response from the political system to social demands, that at the end could tend to authoritarianism, in detrimental of the human dignity and development into a space socially produced, adaptive and sustainable

In this sense the risk is comprehended as a result of misgovernment, a condition where the autonomous performance of the agents at local scale and the social mechanisms of control and legitimacy are revealed or turned into insufficiency (López et al., 2016b).

Risk is then associated as a problem of mismanagement of difference and local governance, a challenge for creative social and spatial transformation (López, 2016b, Lopez et al., 2016).

Deconstructing risk conditions, recreating territories affected by risk

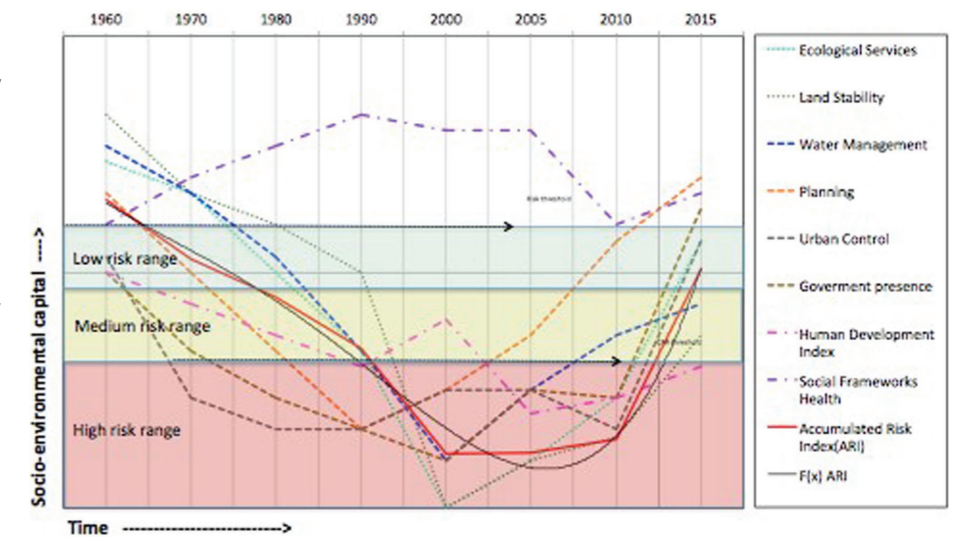
One of the first tasks identified, to advance in the designing of adequate responses to risk conditions was to deconstruct the model for comprehension of the risk. The models for understand risk determine the measures designed to resolve it and a positive transformation of the risk conditions demands a comprehensive understanding of the reality that causes it. The reasoning discussed along the present paper justifies to include into the analysis aspects that include the social, economic and politic compounds that underlie the risk conditions; also the sufficient information to support the political decisions determining the attribution and distribution of risks.

The Figure 3 pretends to illustrate a lecture of the process of risk constitution and deconstruction base on the experience of a particular case of risk management in Bogota called Altos de la Estancia. The draw represents several territorial components that became progressively degraded to configure an increasing condition of risk. Considering this graph as an assessment, it represents the route of that territory that became degraded progressively to an increasing condition of climate risk.

Fig. 3) Illustrative scheme for territorial concentration and social construction of risk, for the specific local context of Altos de la Estancia, Bogotá Colombia, in terms of an hypothetical Accumulated Risk Index (ARI), based on variables of urban resilience (Alliance, 2007) and several researches and practical experiences from that zone documented (López, 2013; IDIGER, 2014; IDIGER et al., 2014; IDIGER & RECNET, 2015; Fraser, 2014; López et al., 2016; López 2016a)

Unregulated mining, gradual and sudden waves of occupation, agency of illegal actors for exercise territorial control, human rights exploitation or inoperative behavior of public institutions, those whole aspects during the time could have into this graph some manner of representation.

The risk conditions once understood in this sense, demand a program that consists in the many tasks required to upgrade each of those lines degraded to take them above the limit of accepted risk, into increasing levels of accumulated social capital and resilience.



Understanding with this perspective the risk constitution, allows beyond the traditional technical assessments, the lecture of territorial dynamics that call for assuming responsibilities in terms of spatial justice, transforming the oppositional logics in relationship between the State and the citizenship claims, and dismissing the usual perspective from technocracy that situates the State as a benefactor that concedes wisdom solutions, in a top down vertical relationship.

The approach of risk governance pretended, is focused on organizational arrangements, social structures and cultural drivers that provide the energy and sense required for the transformation of the risk conditions in a creative process for producing social spaces.

Four cases of territories intervened in Bogota are being analyzed, where the whole intervention of the institutions, the injection of public investments, the reconstitution of the social fabric and the crystallization of cultural and territorial transformations, could be seen as emerging risk governance.

One of the cases, the project Altos de la Estancia, was recognized worldwide into the top 20 disaster risk reduction – people centered, sustainable and innovative initiatives, with the Risk Award 2015, granted during the third United Nations global conference on disaster risk reduction on Sendai, by the Global Risk Forum, the United Nations Office for Disaster Reduction and the Munich Re Foundation. The social and spatial transformations for this case were so rapid and effective. The entire project designing reposed over the comprehension of the risk conditions of the zone as previously explained and the lines of intervention resulted being successful, in the same way, in which they attend the main topics that determine the risk constitution.

These types of projects are demonstrative of social qualification resulted or projected in Bogotá under the excuse of configuring systems for risk governance. Strengthened social arrangements, with renovated channels of linkage, are shown with many advantages as long-term risk governance mechanisms, beyond the limited political and institutional periods and beyond the functionality and temporality of solely physical interventions.

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Venkat Aekbote, Raquel Colacios, Nasr Chamma, Chen Siqi, Carmen Mendoza Arroyo, Kathrin Golda-Pongratz

Wednesday, May 24th

Session D: Post-Crisis Emergency Reconstruction and Upgrading

Chair: **Carmen Mendoza Arroyo**, UIC Barcelona
 Discussant: **Kathrin Golda-Pongratz**, UIC Barcelona

Chen Siqi, TU Darmstadt
 Socio-spatial Interaction (SSI):
 Design Strategies to promote Integration
 of Elementary school-aged Refugees in Berlin

Nasr Chamma, UIC Barcelona:
 Beirut the Refuge[e] City:
 Syrian and Palestinian Refugees in informal Settlements
 and forgotten Refugee Camps

Venkat Aekbote, TU Darmstadt:
 Lessons from the post-disaster resettlement
 in Dar es Salaam, Tanzania

Raquel Colacios, UIC Barcelona:
 Social Recovery through built Environment Reconstruction

Socio-spatial Interaction (SSI): Design Strategies on promoting Integration of Elementary school-aged Refugees in Berlin

Chen Siqi

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Social Context

The fact that over 40%¹ of all refugees in Germany are children or adolescents has already made the country one of most teenage refugees accepting countries globally. According to the report of BAMF (The Federal Office for Migration and Refugees), more than 230,000 refugee children in Germany are living in rather unacceptable housing conditions. With rarely connections to administration services, media and other significant parts of social or political life, future development of refugee children has been neglected by both the public and themselves. Instead of being treated as independent persons, they would be perceived as annexes to their parents or even being forgotten. The supportive measures to fulfill their unique, child-specific needs are missing².

Motivation

As a country taking a lead role in the world, Germany government formulated asylum apply procedures for children. Nowadays, unaccompanied minors, taking children specific aspects into accounts, have been thoroughly considered by the BAMF when handling their asylum applications. On the other hand, the foreigners' authorities provide them a long-term residence permit for the efforts they paid to integrate into Germany reality³. On this purpose, a full range of possible supportive services and infrastructure based on children's welfare and the rights of abode should be provided to them. As for architects and urban planners, the main focus should be the efficient use of limited existing space for these refugee children.

¹ BAMF. (2017). *Aktuelle Zahlen zu Asyl-04.2017*. Berlin: BAMF, www.bamf.de.

² Berthold, T. (2014). *In erster Linie Kinder: Flüchtlingskinder in Deutschland*. UNICEF

³ Müller, A. (2014). *Unbegleitete Minderjährige in Deutschland*. EMN.

⁴ *Act on the Reorganization of Refugees, on the reimbursement of benefits under the Asylum Seekers' Benefits Act and on the amendment of other provisions on 19.11.2013, more information: http://www9.laundtag-bw.de/WP15/Drucksachen/4000/15_4352_d.pdf (22.5.2014)*

The UNICEF report of refugee children in Germany considers elementary school-aged (6 to 10 years old) as the main focus of child-specific care. Various infrastructures, basic care facilities, children' rooms, and children's medicine care should be available. Unfortunately, the specific needs of children are not addressed in many institutions. For instance, the being built Tempelhof Feld, one of the biggest refugee centers in Europe, also owns the same deficiencies as spatial limitations (Fig 1). The existing living and public scales are far more below suggested standards⁴. Another example is the inner-city refugee center in Berlin Reinickendorf, the original residents are against the construction of playgrounds for refugee children and forbid them playing in the existing parks or playgrounds in that neighborhood by standing the warning board there (Fig 2). Additionally, the interviews with refugee children revealed that current community-accommodation is unfriendly to them, sometimes scary. It is also shameful for them to bring school friends back "home". As one NGO's officer, Katharina Müller's original words: "How do you want to integrate the young people there who have no way of interacting with others?" And how could we as architects or urban planners re-understand and reform the refugee campus, effectively active the refugee children's perception to space, and upgrade "urban resilience" from this perspective, eventually improve their integration, is the main aim of this project.

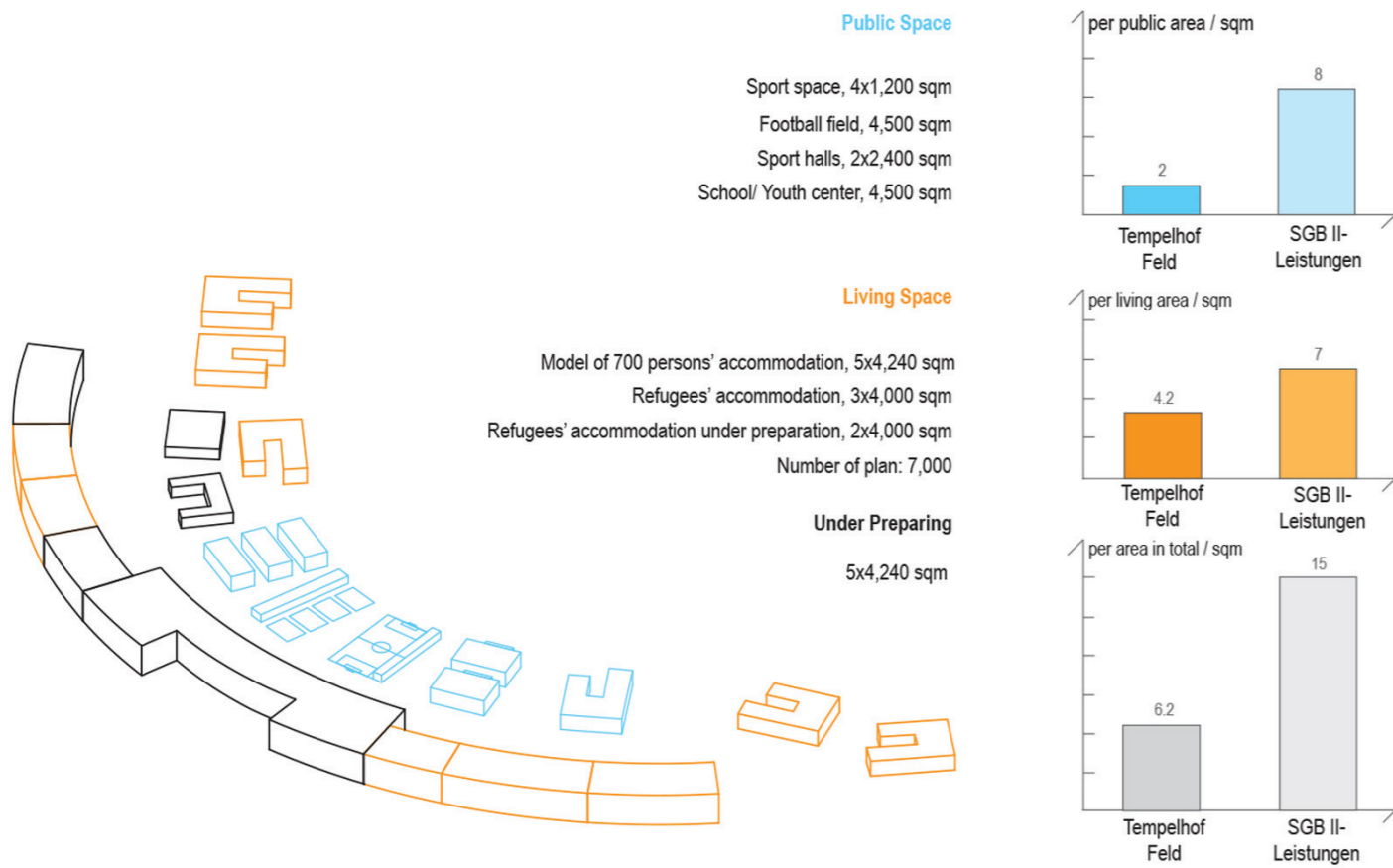


Fig.1)
by the author



Fig. 2)
Photo: AKUD/Lars Reimann

The interactive physical activities would greatly improve outcomes of children's well-being⁵. As examples listed above, the opportunities for refugee children's physical activities have been affected by motorized transportation, recreational programs, and public facilities. In addition, they have limited opportunities for moderate and vigorous physical activity due to the lack of safely playing sports or games in the neighborhood, and their exposure to criminal activity when traveling to or from recreational activities within or outside of the neighborhood⁶, going even further, the housing form - Modulare Flüchtlingsunterkünfte (MUF) - itself has already been stigmatized to them. Given the fact that their participations and accessibilities are being found significantly low at present, research is needed to examine the effectiveness of innovative interventions that provide the motivating physical activity opportunities for them.

5 Ginsburg, K. R. (2007). *The importance of play in promoting healthy child development and maintaining strong parent-child bonds*. *Pediatrics*, 119, 182-191.

6 Bhimji, F. (2016). *Visibilities and the Politics of Space: Refugee Activism in Berlin*. *Journal of Immigrant & Refugee Studies*, 1-19.

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Socio-spatial Interaction (SSI)

Knowing the influences of interventions on children's physical activity correlates is an important first step in designing intervention programs to promote physical activity participation among children. The fast growth interactive games have led to the development of new interactive communication strategies, which in turn has a great impact on urban-based physical activity programs⁷. Like the successful augmented reality-game Pokémon GO (Fig 3) has already shown us a possibility on how playful games could highly improve the social circulation between young people and the cities. In the other hand, Ai Weiwei's refugee project (Fig 4) has indicated that "social media" and "social tools" already became the interactive instruments for young refugees to organize and act out their movement, as results of their powerful abilities to distribute information. Considering cases previously mentioned, socio-spatial interaction (SSI) as a better space perception optimization method would be introduced into this project.

7 Biddiss, E., & Irwin, J. (2010). *Active video games to promote physical activity in children and youth: a systematic review*. *Archives of pediatrics & adolescent* 164(7), 664-672.

Guy, S., Ratzki-Leewing, A., & Gwady-Sridhar, F. (2011). *Moving beyond the stigma: systematic review of video games and their potential to combat obesity*. *International journal of hypertension*, 2011.

Fig.3)
by the author

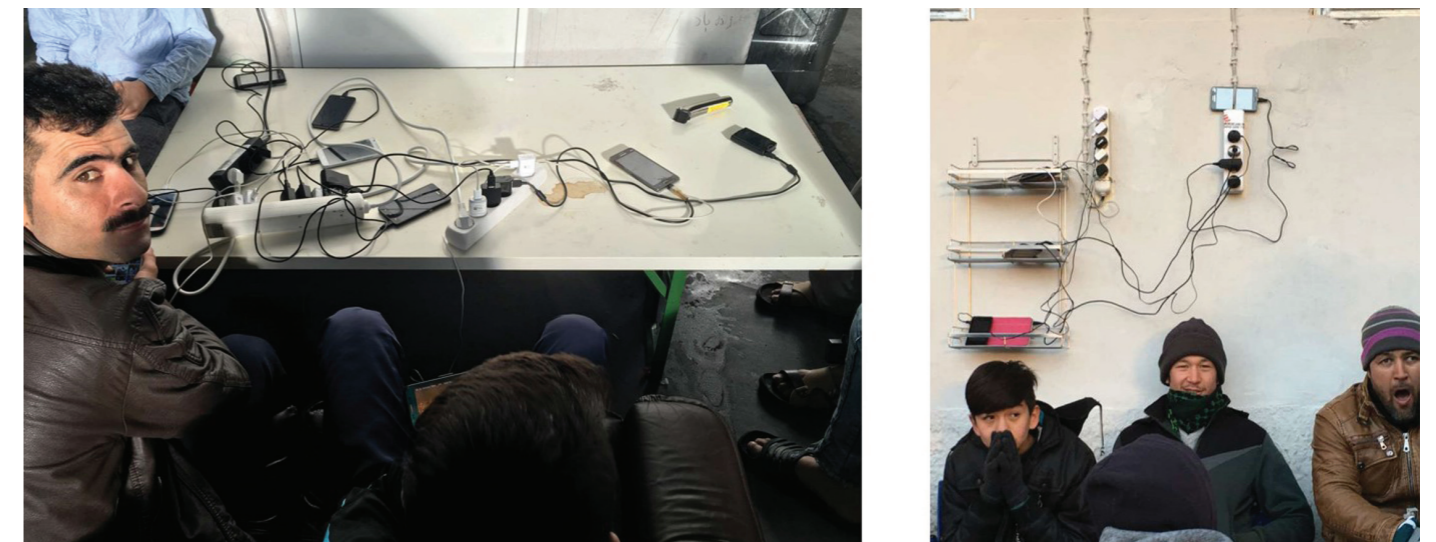


Fig. 4)
Photo: Ai Weiwei, Berlin Tempelhof Feld)

Interaction is already a proved method that could improve users' opportunities for physical activity, socio-built environment design strategy would also be proposed on this context basis, denominated as socio-spatial interaction (SSI), which combines augmented reality as well as virtual reality. SSI could tap into the processes of social and spatial cognition, at the same build its functional interaction. The properties abstracts from SSI can be described as the social and spatial character of users' perceptions, how social cues influence perceived space and environments, and whether users feedback on social aspect as well. SSI could not only contribute to augmented efficient infrastructures but also improve the virtualization of related space. With the aid of SSI, elementary school-aged refugees could be able to take more advantage of the existing space. The process of their integration into the city would be more efficiently and successfully by

means of an in-depth understanding of the mechanical and psychological effects of SSI. As depicted prospective vision of this project, SSI would provide an operational link between elementary school-aged refugees and the cities they need to integrate into. It is vital to the sustainable and resilience of urban development, which aims to enhance the inclusivity for cities spatially and socially. With such new vision, more attractive urban designs for improving user experience and potential would be offered.

Research Questions

The focus of this research is on city-related scale, as a supplement, individual differences will also be taken into consideration. All research questions will be divided into three areas, which also intend to illuminate the concepts of “Socio-Spatial Interaction (SSI)”:

1. the specific emotional, physical and social requirements of elementary school-aged refugees in their built environment;
2. the social and spatial space perceptions deficiencies from elementary school-aged refugees’ and relevant remedies;
3. the fields of design and actions for architects and urban planners.

State of the Art/Related Works

The emphasis of the study is to engage children’s participation in urban processes and to optimize their interactive relationships within cities. By bringing children’s voices back to the adult-centric arena of urban development, urban conditions will be improved at the same time⁸. Kevin Lynch’s “Growing up in Cities”, Schugurensky’s “Pedagogy of the city”, Pink and Noblit’s “Urban Education” all share a view of urban spaces as a background assisted formal, informal and nonformal learning processes, where development and socialization takes place. While the particular approaches differ, a common core through how children interact and perceive the environment and give their feedback is a significant research area: recent studies (e.g. project GDMC⁹) on developmental and technical psychology shows that perception and interaction can also be actively augmented with the support of VR&AR devices.

Methodology

The literature analysis and the empirical studies in Berlin Tempelhof field refugee center will be conducted on this basis. Additionally, the researcher plans to investigate related public and shared spaces, which is indispensable to the constitution of “Ideal Urban” for these refugee children. The starting point is the challenge for all participants actively in a short time and to create spaces with a limited budget, not only in the optimization of accommodate, but also offering safe shelters for learning, playing and exploring with other companions. In this research, the researcher focus on the topic of movement promotion, urban perception and the potential for the usage of digital technology, with the aims of accompanying a social exchange and involving those affections more closely to push the design of their living environment. Meanwhile, the elementary school-aged (6-10 years) will be considered as the target group. In the following data collection and analysis, the researcher will work on expert interviews, related object interviews, and mental maps. Workshops with focus groups will also be done during this process. At the end, an app will be applied to evaluate the qualities of their built environment and document important elements from their perceptions. In the past few months, the researcher has already built connecting networks with local NGOs and experts from related fields. They will also support the researcher in next steps.

Expected Outcomes

The first expected result is an available model in terms of social interaction and movement for the needs of elementary school-aged refugees to adapt and augment their built environment. The updated of this model will be tested and refined from exploratory studies with the assistant of digital applications. Secondly, the feedback from this model would provide an important first basis for further research on refugee shelters from the perspective of this vulnerable target group. And the empiric data can be validated for related objects in different urban contexts. Thirdly, the digital method as a co-design tool of socio-spatial interaction (SSI) that helps the kids to express their needs will be the ideal outcome. Meanwhile, the researcher also aims to develop the results as guidelines which are available to those architects and urban planners. Abovementioned corresponds to the previously research questions.

⁸ Nallari, A. (2011). *Growing up in an urbanizing world, Paris, Londres, Unesco. Carnets de géographes, n3.*

⁹ Clark, K., & Sheridan, K. (2010). *Game design through mentoring and collaboration. Journal of Educational Multimedia and Hypermedia, 19(2), 125.*

Syrian Refugees in Palestinian Refugee Camps and Informal Settlements in Beirut, Lebanon

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Abstract

Informal spaces often develop on the periphery of cities as a result of the arrival of rural migrants, national and international workers, refugees and others. In Lebanon during the 1950s, Palestinian refugees arrived and settled in tent camps, which were originally created in 1948 for temporary use. 69 years later, they are still considered refugees and still in these “temporary camps”, which have transformed into informal concrete slums. The number of Palestinians exceeds 500,000 in a Lebanese population of less than 4.5 million. The Syrian conflict has added a further one million Syrian refugees who, for security, as well as political and economic reasons, found themselves searching for shelter; they had no choice but to go to the existing overcrowded Palestinian camps or other dense poor neighborhoods, mostly in Beirut City, the capital city of Lebanon.

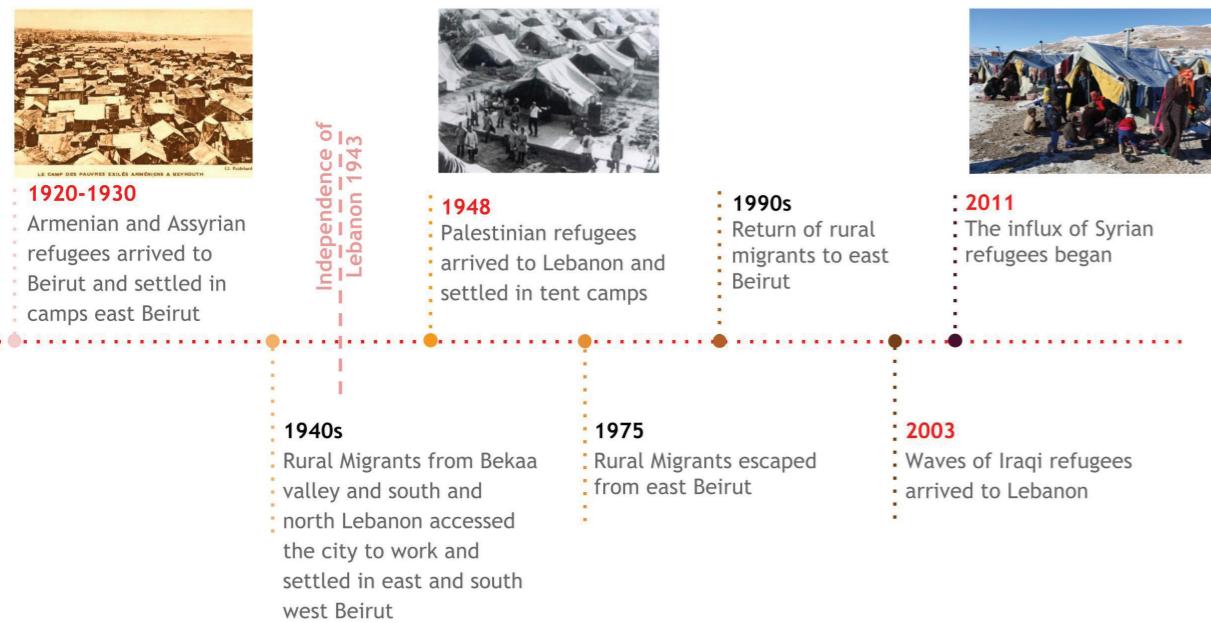
This paper analyzes the transitional settlement of Syrian refugees in Lebanon, examining two distinct elements in the Beirut urban fabric: the Burj El-Barajne Palestinian refugee camp and Naba Neighborhood, one of the informal urban areas. The cross comparison highlights the typology of housing, the use of space, the health situation and the challenges faced by new arrivals. It also evaluates the population transformation, the integration of refugees in the wider social structure of the host community and their incorporation in the labor market and local economy.

Based on existing studies and first-hand materials gathered through interviewing residents while visiting both case-studies, this paper highlights current living conditions and provides recommendations for healthier and more sustainable urban environments. We also consider urban integration strategies to ensure refugee social and economic participation. The paper contributes towards improving outcomes for refugees and providing practical knowledge for humanitarian organizations, in Beirut or in similar urban refugee contexts.

Introduction

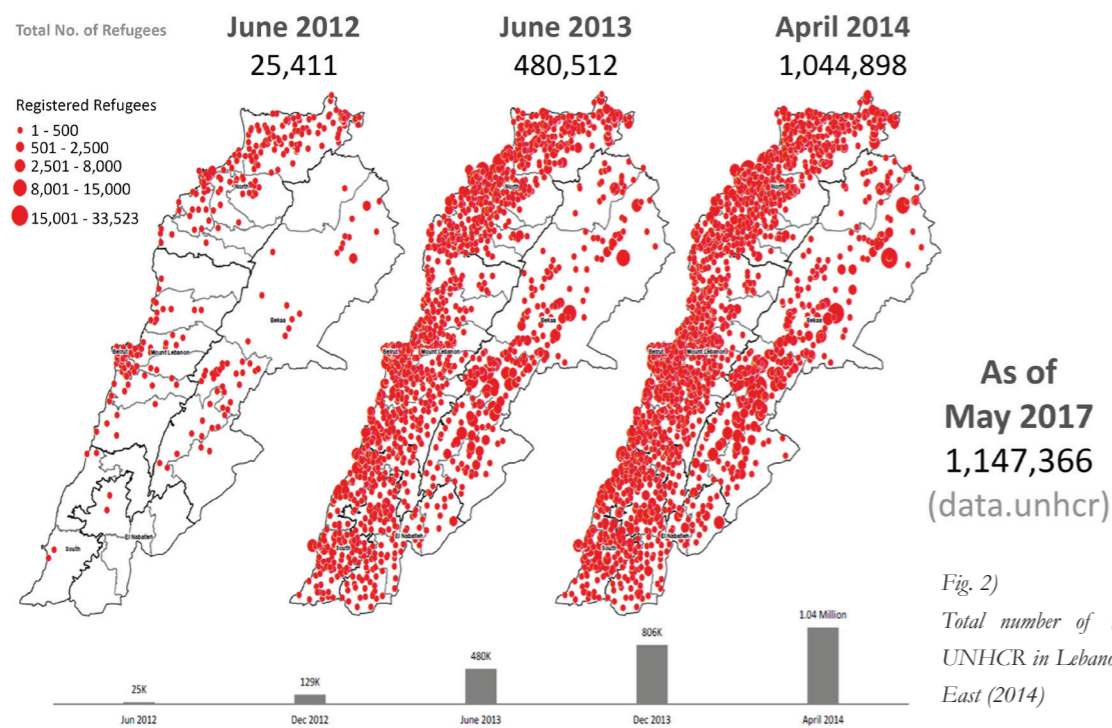
In recent decades, many countries around the world, developed and developing ones alike, have been facing a major challenge. The issue of mass migration is a key feature of contemporary global society; the various movements of rural migrants, national and international workers and of course, refugees, presents a fundamental political challenge for many countries.

Lebanon is a developing country with a long history of immigration. It is one of the countries facing the issue of internal and international migration and mass influxes of refugees. Even though its geographical area is small (10,452 km²), Lebanon has attracted temporary workers and refugees of different nationalities for almost a century (MPC, 2013). The influx of economic migrants and refugees caused the creation of many of the ‘informal settlements’ found within the suburbs of Lebanese cities.



Lebanon hosts large numbers of refugees and asylum seekers, especially Syrian, Palestinian and Iraqi people, who today form a big part of the Lebanese population. Lebanon is one of three countries, together with Turkey and Jordan, which has been heavily affected by the arrival of forced migrants fleeing Syria (MPC, 2013). It is the second biggest refugee-hosting country of Syrians after Turkey (UNHCR, 2017).

Fig. 1) History of migration to and within Lebanon. Developed by authors



Within the total Lebanese population of 6 million, there are over 1 million Syrians, around half a million Palestinians and over 0.1 million other Arabs and Asians (UNRWA; MPC, 2013). Today, one in four people in Lebanon is a refugee and/or international migrant, with the majority of them located in the suburbs of the main cities of Lebanon: Tripoli, Saida and the capital Beirut, the most populated of all.

The modern urban history of Beirut was marked by high population density in informal areas, totalling about 53% of the city (World Bank, 2015). During the 1940s and 1950s, the growth of informal settlements in Beirut spread into the

eastern and southwestern parts to form new suburbs such as Nabaa, Rouweyssat, Az-Zaaytriyeh, Hay Sellom, Raml, and Ouzai (Fawaz & Peillen, 2003). These informal settlements were also accompanied by the creation of four refugee camps for Palestinians post-1948, Mar Elias, Shatila, Sabra and Burj El-Barajneh. These camps all started as tent camps before being gradually transformed into the informal concrete slums found today (MPC, 2013).

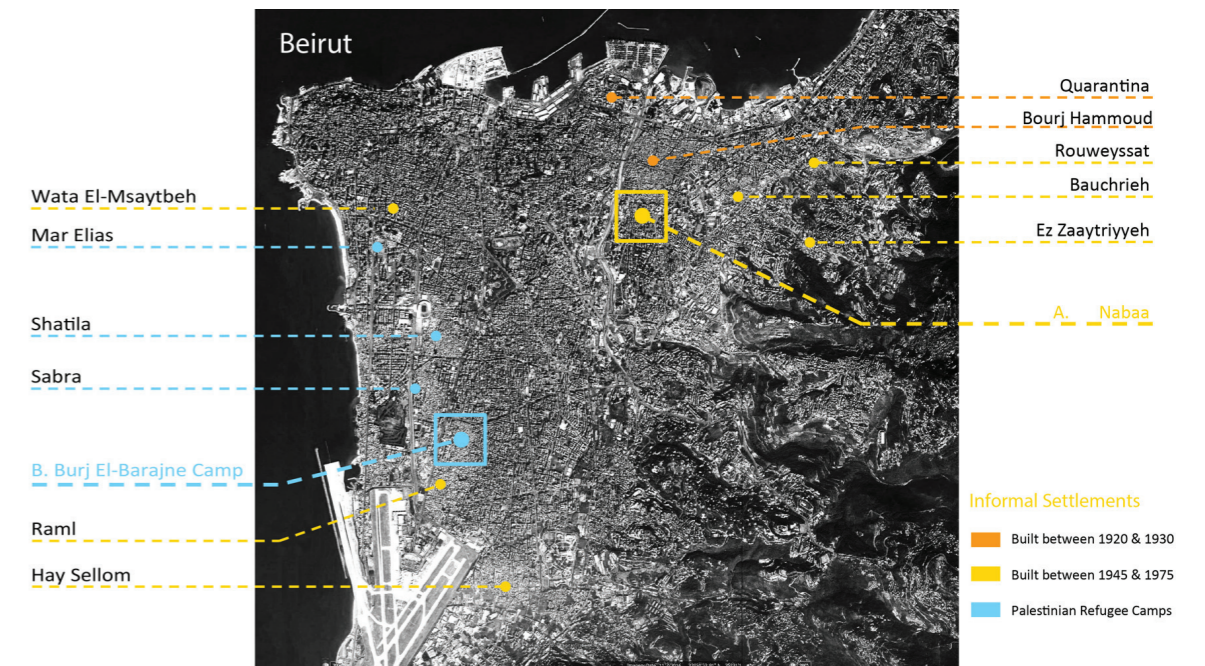


Fig. 3) Informal settlements and refugee camps in Greater Beirut. Based on report by Fawaz & Peillen, 2003

Today, Beirut hosts around 280,000 Syrian refugees (UNHCR, 2017) who are mostly living in poor areas where rent prices are affordable; they found refuge in informal settlements and already existing Palestinian refugee camps. This paper analyzes the transformation phases of two neighborhoods in the Beirut urban fabric: the Nabaa neighborhood, one of the oldest informal urban areas; and the Burj El-Barajneh Palestinian refugee camp. The choice of case studies is based on the concentration of Syrian refugees, which is high in contrast with other similar neighborhoods. The paper compares the current situation of each case following the transitional settlement of Syrian refugees in Lebanon. Moreover, the cross comparison highlights the typology of housing, the use of space, the health situation and the challenges faced by new arrivals. It also evaluates the population transformation, the urban integration of refugees in the wider social structure of the host community and their incorporation in the labor market and local economy. Based on existing studies and first-hand materials, this paper highlights the living conditions in each of the two cases and provides recommendations for integration and healthier, more sustainable urban environments. At the same time, it explains how the 'bad' political decisions of the Lebanese government have resulted in the creation of the informal settlements and camps as well as resulting in worsening the living conditions within them.

According to Al-Husban and Adams in their 2016 article 'Sustainable Refugee Migration: A Rethink towards a Positive Capability Approach', the refugee migrant "issue" is often heavily political, while the mass migration by refugee migrants is invariably seen as a short-term "problem" that will consume resources and generally have a negative impact on the hosting communities. In the case of Lebanon, the continuous ignorance about the migrant/refugee "issue" is a core problem which, even still, impacts Lebanese infrastructure, society and economy, particularly in Beirut. Instead of viewing the refugee population as a burden, perhaps, the government could think of the large numbers of refugees as a valuable, productive part of the population, who could be a benefit to the country and economy.

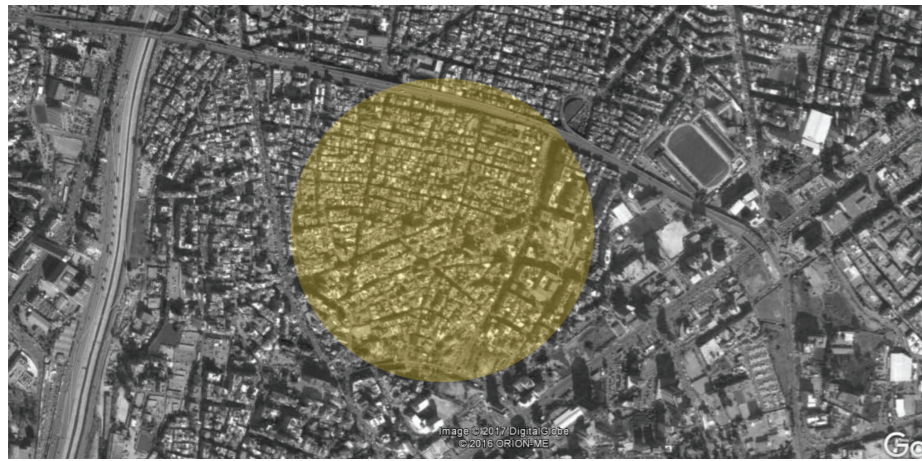


Fig. 4)
The area of Nabaa neighborhood

Nabaa Neighborhood

Nabaa is a small neighborhood with an approximate surface of 0.19 km² (UN-Habitat, 2017). It is located east of Beirut, in the region of Bourj Hammoud, which has been the shelter for Armenian refugees since 1920. In the 1940s, the city observed rapid economic development due to industrialization. Impoverished rural migrants from the Bekaa valley and southern and northern Lebanon chose the eastern suburbs of Beirut due to the many employment opportunities in factories and workshops there (Fawaz, 2009). In addition, since the beginning of the Syrian conflict in 2011, Nabaa has become one of the most accessible refuges for the Syrian refugees that arrived in waves to Beirut. During the Lebanese civil war phase (1975-1990), after an increase in religious discrimination in Beirut, most of the residents were evicted to other parts of the country. They were then replaced by displaced people who escaped from other Lebanese cities due to conflict; after the end of the war, original residents were able to recover and move back into their properties in Nabaa (Fawaz & Peillen, 2003). The proximity to main neighborhoods, the easy access to Beirut, and the affordability of rentals made the neighborhood a focal point for Lebanese citizens, and foreigners, who came to the city to work in construction and infrastructure projects implemented after the war. The congestion of the neighborhood and the needs of the residents have resulted in the transformation of the majority of ground floor apartments to small sized shops and workshops.

Fig. 5)
One of the streets in Nabaa



Since 1993, the neighborhood has presented a unique diversity of demographic mixture. Until the arrival of Syrian refugees in 2011, the population was distributed between low-income Lebanese families (including Armenian people who today are Lebanese citizens), and migrant workers from Syria, Iraq, and Africa (UN-Habitat, 2017).

The average population before 2011 can be estimated at 11,000 and the density at 58,000 people/km², and recently the population increased to 14,760 persons living at a very high density of 78,000 people/km² (UN-Habitat, 2017). Today, the number of Syrian refugees is 9374 persons living in 1624 apartments in Nabaa at a residential count of 5.3 people/residential unit. Otherwise, Lebanese people are living at an average density of 3.5 people/residential unit (UN-Habitat, 2017). If we look deeper into these numbers, it appears that a minimum of 5684 people, mainly Lebanese, left the neighborhood during the last 6 years. Those people were replaced by 9374 new arrivals (3690 more people).

Social Issues

The different nationalities and religions in the neighborhood have enriched the population diversity and added new churches and mosques (Mar Doumit Church, Farhat Mosque, etc.) Otherwise, the available social services in the district are not able to fulfill the needs of the residents. Only 5 health-care centers are present but are under pressure due to the high population density; people basically rely on private hospitals out of the neighborhood as well as Beirut Governmental Hospital in Jnah due to their affordability (ACTED, 2015).

During fieldwork undertaken in Nabaa, we observed high levels of educational absenteeism. The majority of Syrian children are not registered in schools (Assaad, 2016). This high rate is because of the difficulty in finding a vacancy in public schools (there are only 3 in Bourj Hammoud), the unaffordable prices at private schools (5 in Bourj Hammoud), and the involvement of children in work in order to help support their families (UN-Habitat, 2017). The need for education encouraged some social development centers to give free lessons and courses for illiterate children. The programs also include resettlement courses for students coming from Syrian schools in order to integrate them into the Lebanese education program.

Fig. 6)
In Nabaa, children play in streets due to the lack of public space and formal playgrounds.



Physical-Spatial Issues

With reference to UN-Habitat's report which was published in 2017, Nabaa contains 765 multi-level buildings that have 3 to 4 floors each. It is composed of nearly 3,000 residential units.

The year 1961 was the first time when building permits became mandatory (Verdeil, 2002). Until the civil war in 1975, in various locations the building code

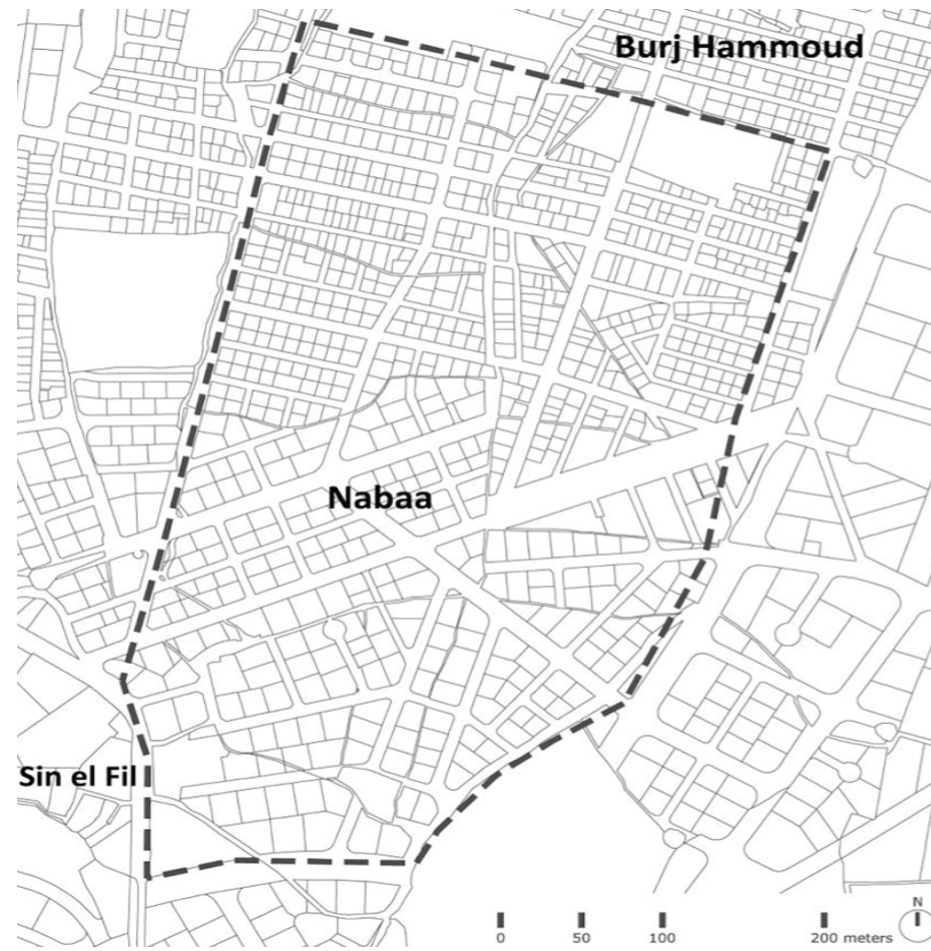


Fig. 7)
The outline of Nabaa neighborhood.
Map developed by authors

and urban regulations were bypassed to provide dwellings for newly arriving migrants. The footprints of buildings reveal the chaotic planning and disregard for the building code and urban regulations. Buildings generally follow the shape of the lot, sometimes with a small inner patio for lighting, usually with no setback between buildings, or are away from roads, which is affecting the natural lighting and ventilation inside buildings. Also, because of the building density, there is a huge lack of open public space, gardens and playgrounds.

Apartment typology

Nabaa today mostly contains one to two bedroom apartments, with some exceptions of three-bedroom apartments. After the return of rural migrants to Nabaa in the early 1990s, the high demand on housing encouraged landlords to add floors and subdivide the majority of the 2 and 3 room apartments to multiple single-room units and to add kitchens and bathrooms (UNHCR; UN-Habitat, 2014). The most common prototypes are:

- The one-room apartment which contains, other than the multifunctional room, a small bathroom and a kitchen. It's usually occupied by 4-5 persons and its average area is 20 m².
- The two-room apartment which contains 2 rooms and the service area. The first room is a bedroom, usually connected to a kitchen and serviced by a bathroom and the second is a family room. This type is mostly occupied by a family with 4 to 6 kids.

Basic urban services

After the end of the Lebanese civil war in 1990, the general situation of Nabaa neighborhood has deteriorated due to its marginalization by the municipality of Bourj Hammoud and the Lebanese government, with no attempt made to improve infrastructure or provide basic services. The situation has been exacerbated by the additional Syrian refugees who have arrived to the neighborhood since 2011, whose numbers continue to grow.



Figure 8: The current conditions of streets, sidewalks and buildings in Nabaa.

The existing wastewater network has become overloaded by the population growth. Potable water and electricity (which are provided by the government) experience extended shortages, residents must therefore rely on private suppliers, who provide water and electricity at unreasonable prices. Moreover, a stormwater network is not available in Nabaa. Bins are not provided for the city's garbage collection, thus garbage is placed at street corners and in vacant plots (UN-Habitat, 2017). Additionally, almost all the narrow streets are in a bad condition, with lots of potholes and permanent accumulation of water. In addition, most sidewalks are inaccessible as they are often blocked by cars due to the lack of formal parking spaces.

Conclusion

Syrian refugees are living in poor conditions due to the high rental prices in the neighborhood and the unavailability of job vacancies. Most large families are living in one-bedroom apartments, single men are sharing small apartments (in groups of up to ten people), and often two small families (usually relatives) live together in the same apartment. As for the physical situation of the neighborhood, currently 35% of the buildings (where 38% of the population live) need urgent intervention to fix serious structural problems and severe wall and balcony leaks, in order to protect the homes and lives of dwellers (UN-Habitat, 2017). Since 2011, the waves of Syrian refugees arriving to Beirut in general and Nabaa specifically have added huge pressure on existing infrastructure, public services and facilities, as well as on available employment opportunities. This has caused many Lebanese families to leave Nabaa in the last 6 years while the government has provided nothing but inaction and neglect. In the following case of Burj El-Barajne Refugee Camp, we will see a similar situation of transformation caused by the thousands of Syrian refugees who resettled in the camp and created additional pressure on the basic public services and infrastructure, residential units and job opportunities.

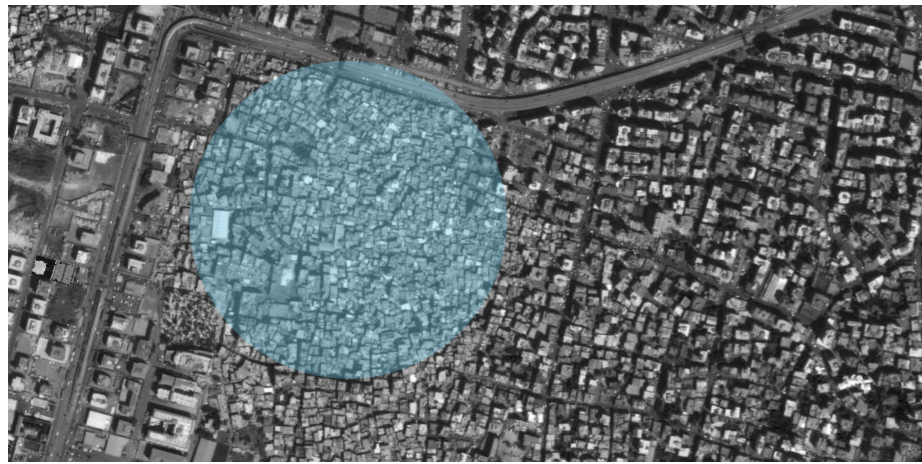


Fig. 9)
The area of Burj El-Barajne Refugee Camp.

Burj El-Barajne Refugee Camp

As with Nabaa, Burj El-Barajne was another main point of attraction for Syrian refugees due to the low living costs within the camp. As it is still considered a ‘temporary’ refugee camp for the Lebanese government, the inhabitants do not pay tax, nor for water or electricity and rental prices are affordable. These conditions attracted thousands of Syrian refugees to settle there, says Mohamad Daher, General Coordinator of Al-Nakab Center for Youth Activities at the camp (2016).

Burj El-Barajne refugee camp was established in 1948 to accommodate the large influx of Palestinian refugees who arrived to Lebanon after the Palestinian-Israeli conflict. The majority of these refugees and their families still reside there today. The camp was constructed on 0.23km² of land in the southern suburbs of Beirut. As mentioned earlier, Burj El-Barajne was initially envisaged as a temporary part of the city; however, decades of neglect of the area and inaction by the Lebanese authorities led to the informal permanent settlement that is chaotic and problematic, as it exists today. Burj El-Barajne has grown organically with time, without structural planning, producing a maze-like web of dense alleys and informal buildings.

Following analysis completed with visits to the settlement (April, 2016), interviews with humanitarian workers, meetings with inhabitants, and site assessments of buildings, Burj El-Barajne’s main issues can be summarized in the following three categories.

Social and Political Issues

Even though the camp has no surrounding wall or fence, since its establishment, it has been isolated from the Beirut society and neighborhoods, and the situation has deteriorated following the arrival of the Syrian refugees. The camp exists effectively as an island shut off from the social and administrative life of the city. Inhabitants are treated as second-class citizens, without the right to vote or to work in many professions (Woodrow, 2016).

According to Daher, until 2011 the settlement housed around 28,000 Palestinian inhabitants, including around 3,000 Syrian workers who brought their families to the camp once the Syrian conflict started. Today the camp’s population has rapidly increased to around 40,000, due to the influx of Syrian families (Daher; Abu-Diwan, 2016).

Despite many families having lived there and being on personal terms with one another, the social fabric of the camp is torn. Its growth and flourishing are negatively affected by the physical limitations and informality of the settlement: mainly the low quality of individual buildings, the population density (particularly after the Syrian refugees arrived), the compressed and chaotic layout of the buildings and the lack of public spaces as explained in detail in the following section.

Physical-Spatial Issues

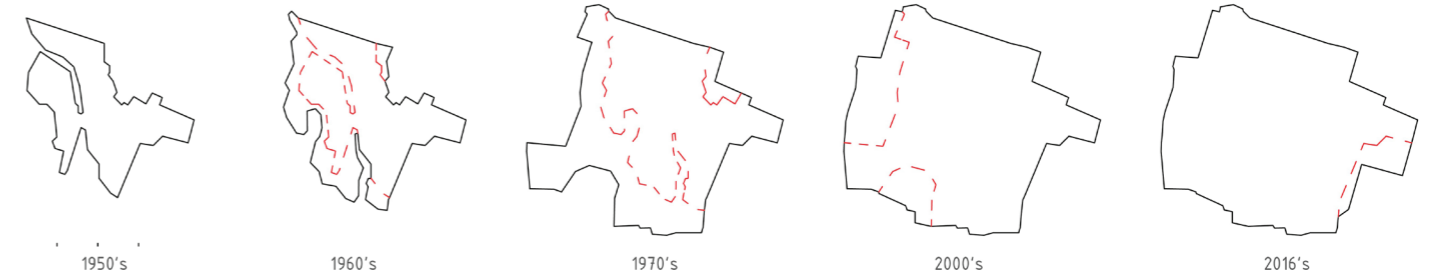


Fig.10)
The growth of the Burj El-Barajne camp since 1960's until today.
Figure was adapted from Woodrow, 2016

In 1948, the camp started with tents which were gradually replaced by mud huts. Zinc roofs were installed on the huts, later to be replaced by concrete houses. This transitional process was developed by Palestinian refugees themselves. When the possibilities for horizontal expansion of the settlement were exhausted, the inhabitants began to build vertically in order to cater for the growing needs of the population. This process led to the dense informal settlement that exists today with no clear identity, formal infrastructure or housing typology.



Fig.11)
Transformation of Palestinian Refugee Camps since 1948 until now, from tents to permanent concrete houses.
Source: Ismail and Ciravoglu 2016.

The organic and internal demographic population increase, coupled with the continued influx of new Palestinian refugees and the neglect of the settlement by Lebanese authorities, has led to Burj El-Barajne becoming an underdeveloped sprawling urban slum.

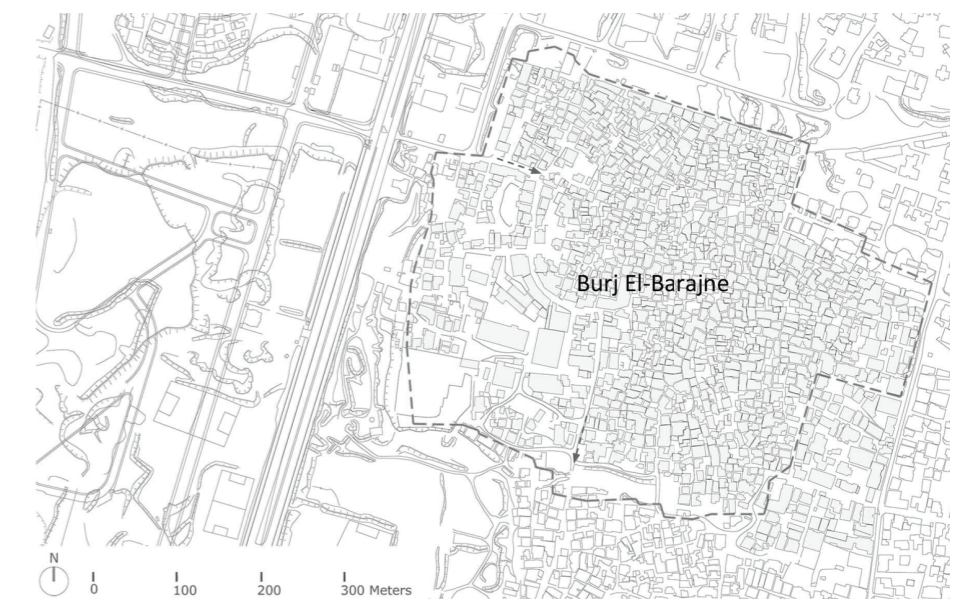


Fig.11)
The outline of Burj El-Barajne refugee camp.
Map developed by authors.

Today, the area is a dense urban fabric composed of around 1,000 concrete buildings, constructed on foundations capable of supporting two stories, despite most buildings having four or more stories and lacking formal structure and architectural efficiency (Daher, 2016).

Through the site visits, the interviews conducted on site and the spatial assessments, the major spatial issues which both Palestinians and Syrians are facing can be demonstrated as follows:

- Similarly to Nabaa, the residents of Burj El-Barajneh camp do not follow any building code or urban regulations. The setback between buildings does not exist in the camp.



Fig. 13)
The building typology. Buildings grow vertically in order to cater for the needs of inhabitants.

- Most newly constructed buildings lack formal foundation and the architectural efficiency as they start from above ground. It is not possible to dig and implement structural foundations due to the small size of available lots in between existing buildings and the financial challenges which the residents face today. Moreover, there's an average of 1 floor being built every 5 years, which is creating a higher pressure on existing structure and a further risk for the inhabitants.



Fig.14)
The chaotic structural systems (left). Foundation of new buildings start from above ground (right).

Referring to the Bhanes Center for Seismic and Scientific Research, in 1956, an earthquake measuring 6 degrees on the Richter scale struck Lebanon, killing 136 people and destroying 6,000 houses (Naharnet, 2013).

Around this time, the camp still consisted of tents and shack structures so the damage was negligible. It is predicted an earthquake of similar scale will hit in the next 50 years (Abdo et al, 1998), and if it does, it will cause a mass death and destruction to all these un-engineered concrete structures of the camp.

- Due to the high density of buildings, the streets are narrow, damp and dark, giving the feeling of being underground. Only a slight amount of natural light reaches street level and even less reaches the ground floor apartments/rooms.

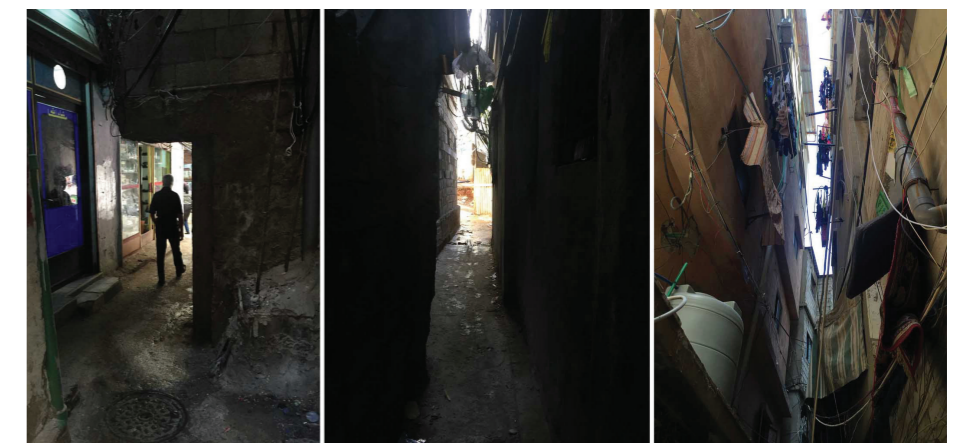


Fig. 15)
The inner alleyways in the camp.

- Residential units are extremely small. Regarding space in individual structures, rooms are shared by 3 people or more. Most apartments have privacy issues due to the small distances between buildings.
- There is an extreme lack of public space within the camp. The only spaces in which people can gather are the residual spaces, around shops and between buildings. The camp also lacks trees, green spaces, playgrounds, open squares and recreational facilities.

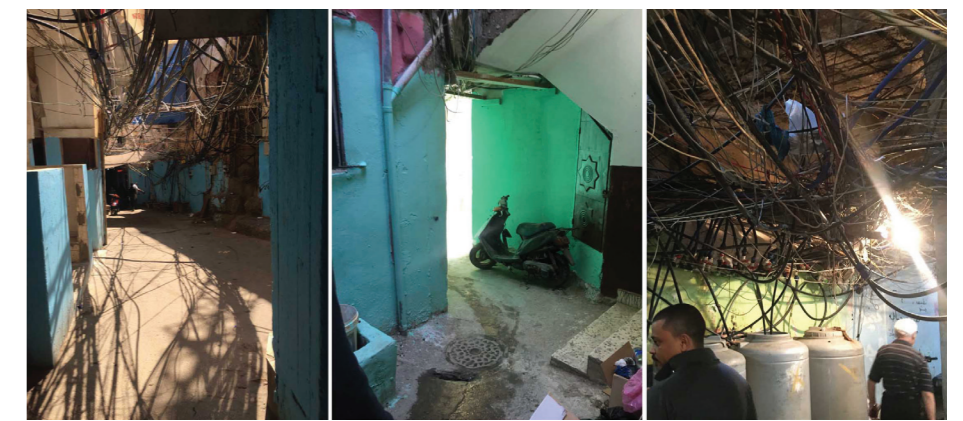


Fig. 16)
The existing infrastructure systems (from left to right: electrical, sewage and water networks)

- There is a complete lack of formal public infrastructure in the area (sewage and drainage). Moreover, many die annually from electrocution whenever it rains, caused by the tangled overhead wires and electrical cable connections which inhabitants created. That is creating a continuous threats to the lives of inhabitants.

- As the camp only has one main road, cars/vehicles cannot access it, except in a small part of the camp. In case of emergency, it is almost impossible to reach inner areas. Thus, motorcycles and bicycles are the common transportation systems as the average width of alleys is 1.5m.

Economic Issues and Challenges

Palestinians and Syrians have to adapt to these physical limitations to find the most beneficial and profitable use of space. Ground floor spaces are constantly reconfigured to maximize profitability either for personal commercial use or for leasing to newcomers. The main source of income for many inhabitants is these small shops, found in every street and alley.



Fig. 17)

The commercial activity within the camp.

As our analysis shows, the Burj El-Barajne is no longer a refugee camp and must be considered as a permanent settlement and an integral part of Beirut. Over the span of 69 years, the settlement (since 1948) has undergone a long transitional process, with many difficulties along the way. There is a need for urgent change and as a first step the acceptance of the Palestinian and Syrian inhabitants, who deserve no less than a decent quality, as long as they are seeking refuge in Lebanon.

Recommended Strategies for Nabaa and Burj El-Barajne

It is necessary to recognize and accept Palestinian and Syrian refugees, who deserve better living conditions, and an increased social interaction from wider Lebanese society. In the long run, the quality of life inside both settlements can be improved by a general urban strategy from the Lebanese government and the UN agencies (UNRWA, UNHCR and UNICEF). This strategy should be based on a multi-sectoral approach combining social, cultural, physical, and economic plans, and specify short-term and long-term action plans to solve the problems detailed above. In addition, some immediate interventions should be undertaken especially with regards to the safety of buildings, health improvements, and relocation of vulnerable people who reside in unsafe settlements. It is important to consider that the lifespan of Nabaa and Burj El-Barajne and other informal settlements in Beirut, including camps, extends beyond the presence of Syrian refugees in Lebanon.

Furthermore, other important improvements should be made for both neighborhoods as soon as possible, including: upgrading of apartments through architectural interventions in order to provide the necessary ventilation and natural lighting, provision of social services especially for women and children by involving them in social activities, upgrading the quality and capacity of existing schools or building new ones, integrating children through resettlement courses, provision of healthcare services for all residents, creating recreational facilities, provision of basic urban services (potable water, electricity, etc.), and finally upgrading of existing waste management system as well as the stormwater and drainage networks.

Conclusion and Discussion

Despite some economic and political issues in Lebanon, no refugee should be abandoned, whether in a slum or elsewhere. Now is the time to safeguard the rights of the inhabitants of Nabaa and Burj El-Barajne and to provide a brighter future for them.

After 69 years of inaction and ignorance towards Palestinian refugees and refugee camps, today the Lebanese government is repeating the same mistake with Syrian refugees who currently form a large part of the Lebanese society.

As a substantial part of the population (1 out of 4 people is a refugee in Lebanon), refugees must definitely be a 'part of the solution'. The Lebanese government could consider refugees a skilled workforce and benefit from their presence, to provide employment in support of weak sectors in Lebanon, e.g. agriculture which used to be an important productive sector in the 1990s. This way refugees can be more involved, generate income, have autonomy in their lives, feel they belong to the society and have a higher quality of life, until repatriation one day.

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Abstract

Post-disaster resettlement issues are becoming more and more important worldwide with the increasing number of hazards and disasters. This paper is based on a fieldwork carried out in 2016 by the author in Dar es Salaam (Tanzania), one of the fastest urbanising cities in Sub-Saharan Africa. The paper presents the case study of resettled flood victims in Dar es Salaam after the 2011 floods and using narratives from the resettled population, discusses their impoverishment risks using the framework of Impoverishment Risks and Reconstruction Model (IRR Model) proposed by Micheal Cernea.

On 20 December 2011, Dar es Salaam was subjected to massive flooding following unprecedented rains. The official death toll was 43 and over 50,000 persons were affected, among which about 10,000 people were displaced. As part of disaster recovery, the flood victims were accommodated in temporary camps and subsequently provided plots and resettled in Mabwepande, about 40 Kilometres from the Central Business District (CBD). However, this affected the livelihood opportunities of the flood victims, besides resulting in various grievances, leading to various impoverishment risks among the resettled population. However, the local government that managed the process with limited financial resources considers it as a commendable accomplishment, despite the challenges in the process. The qualitative study brings out the reasons behind such diverse perceptions through narratives, concluding with valuable lessons that can be learnt from the case.

Introduction

Over the years, in the wake of several frequent disasters, both in the developing and developed countries, there has been increasing importance attributed to disaster risk reduction and related components. Internationally, their importance was recognized towards the end of last century, where the period from 1990 to 1999 was declared by the United Nations as the International Decade for Natural Disaster Reduction (IDNDR). According to the United Nations, more than 230 million people suffer every year from various disasters such as floods, earthquakes, droughts and destructive storms. Despite the numerous efforts taken by various international organizations to counter the challenge of disaster risk, more and more costly and deadly disasters continue to occur.

There are four phases that commonly represent disaster management and form parts of the disaster management cycle: mitigation, preparedness, response and recovery (Rubin, 1991). The resources and government efforts in developed countries are directed extensively towards mitigation and preparedness, which is ideal, but in most developing countries and particularly in African countries, due to financial and technical constraints, the efforts are towards response and

recovery phases, after the disaster event. In most cases, the resources are so scarce that the efforts are limited just to the response stage. However, several authors have stated that despite a number of post-disaster reconstruction experiences, response and recovery still remains inefficient and poorly managed (Lloyd-Jones, 2006; Halvorson and Hamilton, 2010; Sawyer et al., 2010). Not only that, it is also under-researched and needs further studies for improved understanding. There is considerable literature on the development-related displacement and resettlement, but not much on disaster-related displacement and resettlement to a new location.

In 2015 alone, conflict, violence and rapid-onset disasters caused 3.5 million new displacements in the African continent. Of this, 1.1 million displacements were caused by rapid-onset disasters, a million caused by flooding alone (IDMC Africa Report on Internal Displacement, 2016). Moreover, the approach to the more frequent disasters in African cities is still predominantly reactive rather than being proactive and preventive. Consequently, the case of Dar es Salaam is an interesting and useful example to study.

At the same time, rapid urbanization is taking place mostly in developing countries and it is estimated by United Nations that by 2020, more than half the population of the world is projected to be urban. African cities are amongst the fastest growing in terms of population and their growth is concentrated in the urban areas. Besides, African coastal cities are situated in vulnerable region and as Kebede et al. (2010) have noted, global assessments (Hoozemans et al., 1993; Nicholls, 2004; Nicholls and Tol, 2006) and regional assessments (Boko et al., 2007; Brown et al., 2009) have identified East Africa as one of the most threatened coastal regions globally. They are undergoing rapid and unplanned growth, urbanization, and coastward migration, and have high population densities and overburdened infrastructure. Facing such challenges is Dar es Salaam in Tanzania, the largest coastal city in Africa, which, having a population growth rate of about eight percent per year, is identified as one of the fastest growing cities in Sub-Saharan Africa (UN-HABITAT, 2008).

The study issue

The issue at hand is that, in Dar es Salaam, people have continued to reside in the informal settlements which are mostly in flood plains and low lying areas despite being affected by flooding each year and experiencing negative effects such as destruction of properties, economic losses and disease outbreaks (Lerise and Malele, 2005). However, the flooding of 2011 was of unprecedented magnitude claiming the lives of at least 43 persons besides heavy destruction of properties, causing mass displacement of victims. In response to the situation, the government, decided to resettle the victims from flood-prone areas to a flood-free area by providing them with surveyed government plots in Mabwepande, located in the outskirts of the City. This Although it was explicitly stated by the government that similar action of providing free plots for those living in flood-prone areas would not be repeated again, it is likely that relocation of population from flood-prone areas to safer upland areas of the City (without provision of free plots) may be considered as a possible long-term planning option, to prevent loss of lives to future floods. In view of this, the aim of the present study is to understand the response and recovery stages after the 2011 floods in Dar es Salaam and assess the impoverishment risks of the resettled population using Michael Cernea's Impoverishment Risks and Reconstruction (IRR) Model as a framework, such that, in the likelihood of future relocation and resettlement in Dar es Salaam, valuable lessons can be learnt to minimise the risks.

Conceptual framework: Michael Cernea's Impoverishment Risks and Reconstruction Model for Resettling Displaced Populations (IRR Model)

A widely used conceptual model dealing with displacement and resettlement is Michael Cernea's Impoverishment Risks and Reconstruction Model (IRR Model) for resettling displaced populations (Cernea, 2000). The IRR Model focuses primarily on forced relocation of communities as a result of development projects, but is also applicable to displacement and resettlement due to disasters. In this Model, it is argued that displaced people have a risk of economic, social and cultural impoverishment when they settle in new locations. If adequate measures are not taken by the authorities and agencies to counter the risks, then it will inevitably lead to a negative outcome of resettlement. That is to say, the majority of the resettled population would suffer from impoverishment and as a result be dependent more on the government (Muggah, 2003). However, Cernea also acknowledges that it may be impossible to prevent every single adverse effect arising from resettlement.

According to Cernea, the Model captures the socioeconomic content of both displacement and resettlement. It identifies the eight key risks and impoverishment processes in displacement that resettled population have to cope with and they are as follows:

- (a) landlessness
- (b) joblessness
- (c) homelessness
- (d) marginalization
- (e) food insecurity
- (f) loss of access to common property resources
- (g) increased morbidity
- (h) community disarticulation

These are not the only ones that result in processes of economic and social deprivation, but are considered the most important ones. Depending on local conditions, these risks have variable intensities. Conversely, the Model also suggests that reconstructing and improving the livelihood of those displaced require risk reversals through explicit strategies backed up by adequate financing (Cernea, 1997). The risks have overlaps and are closely related to each other.

According to Cernea (1998), the key economic risks to affected people are from the loss of livelihood and income sources. The loss of economic power with the breakdown of complex livelihood systems results in temporary or permanent, often irreversible, decline in living standards leading to marginalisation. Higher risks and uncertainties are introduced when diversified livelihood sources are lost. Loss of livelihood can adversely affect household food security, leading to under-nourishment.

As Cernea notes (1998), forced displacement tears apart the existing social fabric, leading to socio-cultural disarticulation. According to Cernea, the internal logic of the IRR Model as a planning tool suggests that in order to defeat its impoverishment prediction, it is necessary to attack the looming risks early on during the preparation for resettlement. Cernea asserts that, despite the many challenges, redressing the inequities caused by displacement is not only possible but is also necessary, on both economic and moral ground (Cernea, 2000).

Methodology

Qualitative research methods were used to collect the information in the study area. The selection of resettlement area for the study was straight forward as Mji Mpya Sub-Ward in Mabwepande Ward (under Kinondoni Municipality) was the only location where the population had been resettled. The data collection tools included face to face interviews and informal discussions with government officials (at national, regional and local levels) and key informants at non-governmental organisations, and household interviews and narratives from the resettled population. Since the author did not know Kiswahili, the local language of Tanzania, the interviews and discussions were conducted with the help of an Interpreter. Field observations and photo documentation were used to support the information collected through other methods. The fieldwork was carried out in Dar es Salaam between April and August 2016.

The information regarding the situation during 2011 floods and subsequent response and process of relocation and resettlement as part of recovery were obtained from both primary (face to face interviews and discussions) and secondary (official and non-official reports and documents) sources. The leading questions put forth to the officials were:

- (a) Following the floods, what was the sequence of events that followed leading to the resettlement of victims to Mabwepande?
- (b) What is the perception on the resettlement exercise?

To understand and explore the risks and stresses that the resettled population was coping with in the new settlement, household interviews were conducted and recorded as narratives. The narratives were used as a data collection method to formulate individual stories from the respondents representing their household. Subsequently narrative analysis was employed as an approach for qualitative data analysis as it emphasizes the stories that people recount (Bryman, 2004). As mentioned earlier, IRR model was later used as a framework for analysis.

The questions for the household interviews and narratives were framed as follows:

- (a) What have been the risks and stresses that they have been dealing with since resettlement?
- (b) What are their major grievances?

Respondents representing eight households, who were above 18 years of age, were selected for in-depth interviews. The respondents were selected based on purposeful and snow ball sampling from different streets in the resettlement area.

Brief on Dar es Salaam

Dar es Salaam is the largest and most-populous city in Tanzania. It is the national centre for industry, education, and culture, and is full of diversity. Hosting eight percent of the national population and generating over 70 percent of the national gross domestic product (GDP), it has a land area of 565 Square Kilometres (UN-HABITAT, 2008). Administratively, Dar es Salaam falls under the jurisdiction of one administrative body, the Dar es Salaam City Council but is divided into five Municipalities: Ilala, Kinondoni, Temeke, Ubungo and Kigamboni. It is estimated to have a population of 4.3 million, of which nearly 70% (three million) live in about 43 unplanned, informal settlements of different sizes and over half of them survive on roughly a dollar per day (UN-HABITAT, 2012). These settlements lack adequate infrastructure and services, and are highly prone to adverse impacts of frequent flooding.

Some of the settlements are regularly affected by devastating floods whenever it rains (see Fig.1). Majority of urban dwellers are vulnerable because of the

conditions in which they live and the inadequate coping strategies (knowledge, resources and life skills available to them). The City and Municipal authorities face significant challenges with respect to providing new or even maintaining existing infrastructure and services in these areas. The increased development in the coastal zone coupled with sea-level increase due to climate change has exacerbated the issues (PMO, 2004).

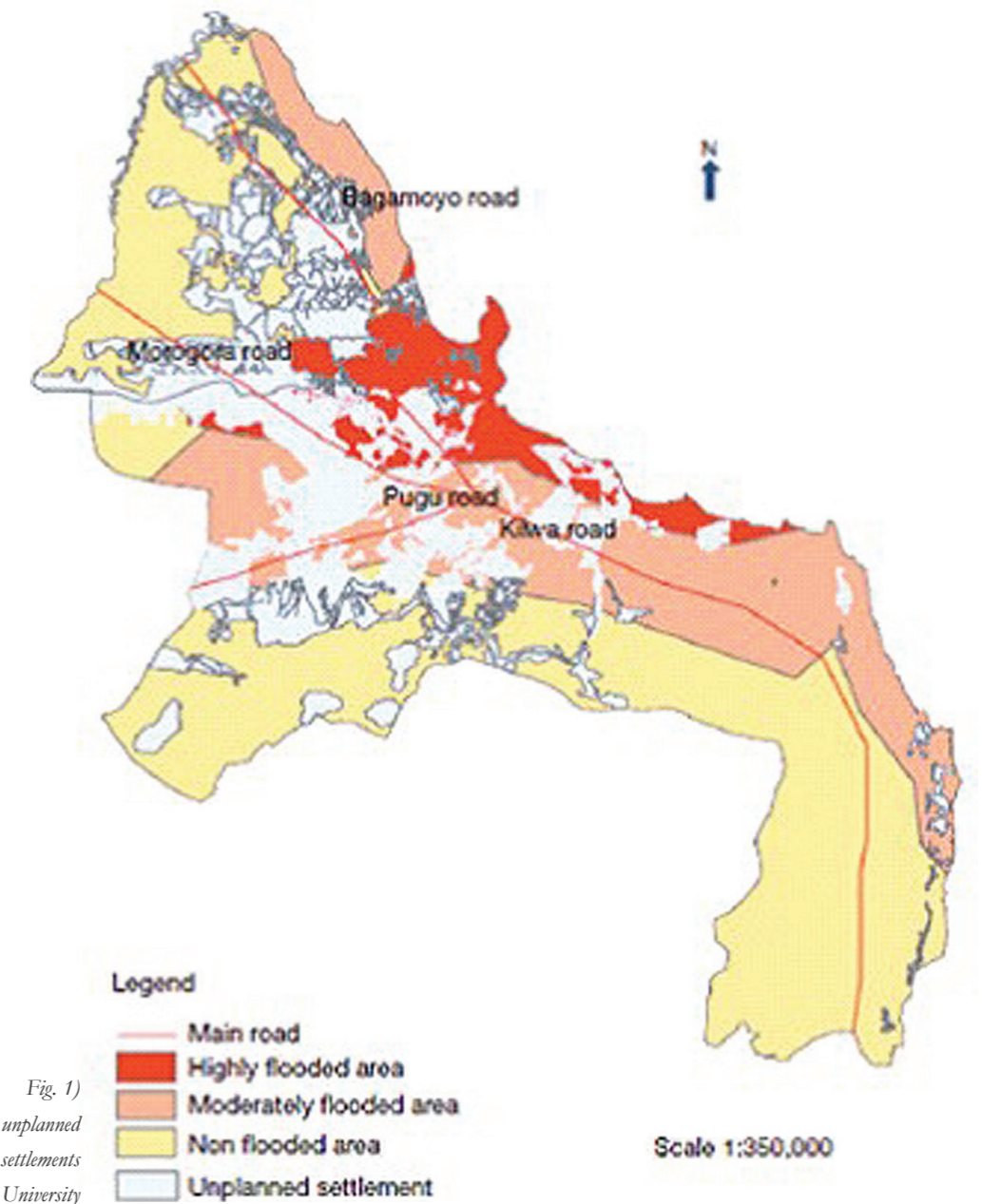


Fig. 1)

Map of Flood Hazard Zone overlaid on unplanned settlements

Source: Ardbi University

Situation during 2011 Floods

Dar es Salaam city was subjected to massive flooding following unprecedented downpours which started on 20 December 2011. The flood waters overwhelmed the city's drainage systems, resulting in mass displacement of the city residents, particularly those residing around the Msimbazi River basin and other the low-lying areas in the city. According to the Tanzania Meteorological Agency, the rains were the heaviest in Tanzania since its independence in 1961. A rapid assessment of the disaster by the Tanzania Red Cross Society (TRCS, 2012) indicated that over 200 people were injured, with approximately 2,500 people missing, mostly children. The official death toll due to the floods was 43. The total number of people affected by the floods was over 50,000 (approximately 10,000 families) among which about 10,000 people (approximately 2,000 families) were displaced. Damage to property and infrastructure was massive.



Response and recovery phase following the 2011 Floods

The massive flooding had brought the city to a standstill. The Government authorities, the TRCS, the police force, and the fire brigade led the search and rescue operation supported by various international NGOs including UNICEF, UNHCR, USAID, Save the Children, the media, the private sector and the general public.

It was an emergency situation and the then Regional Commissioner of Dar es Salaam was chairing the Disaster Relief Committee, with support from the Disaster Management Department of the Prime Minister's Office, TRCS, the Tanzania People's Defence Forces, National Service wing and the Administrative and Senior Officers of the Local Government Authorities. The decision was taken to accommodate the flood victims in temporary shelters, mainly the primary and secondary school buildings nearest to the affected areas. Since it was vacation period for the schools, this was a possibility. Subsequently, three temporary holding and transit centres were identified, that had adequate area to host the population as a temporary shelter and about 2500 families were moved to this place for a short period.

Meanwhile, the then President of Tanzania visited the victims in the temporary shelters and considering the gravity of the situation, directed that the population be resettled to safer locations such that they would not be affected in the future. Accordingly, the Disaster Relief Committee discussed the possible options for relocation and resettlement. During this discussion it emerged that there were surveyed plots available, which were part of 20,000 plots housing project of the government. As this was already government property, it was decided that those victims who owned plots in their original settlement would be provided plots in Mabwepande by the government so that they could resettle. As per official statistics, 1004 families were provided plots in Mabwepande, and the process of moving the victims from the temporary centres was started in February 2012.

The Red Cross, military and government agencies were involved in clearing the plots and setting up temporary shelters in each of the plots for the households. When the population arrived, they were provided with food and essential supplies for the first few months of their stay. Meanwhile, the resettled population was trying to explore the possibilities of livelihood activities in the area and trying to adjust with the limitations and challenges posed in the new settlement.

Fig. 2)
Floods in a section of Dar es Salaam following heavy rains in the City in December 2011
Source: The Citizen

In August 2012, considering the slow wearing out of the temporary shelters, the government announced that it would provide building materials comprising of 100 bags of cement, 30 iron sheets and few wooden sticks such that it could help them get started in building their permanent houses.



Fig. 3a)
Location of Mabwepande resettlement area from the City centre Kariakoo, approximately 40 Km
source: Google Maps

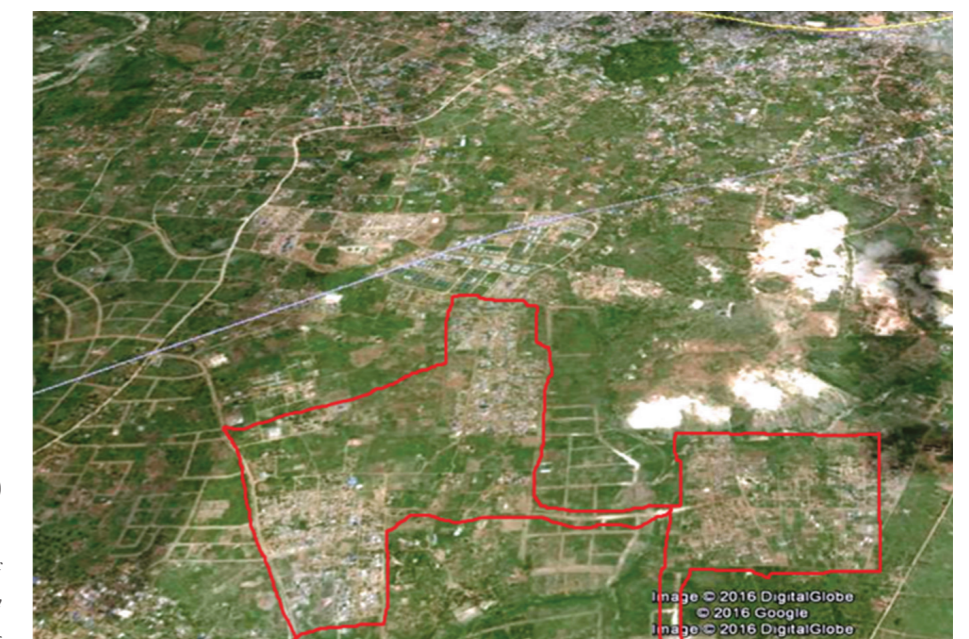


Fig. 3b)
Boundary showing Mabwepande resettlement area. The distance from Bunju bus stop, the nearest public transport, is approximately 5 Km
source: Google Maps

Present situation

In the four years since the resettlement, there have been many challenges facing the resettled population, some of which have been overcome and some others still persisting. The access roads leading to and within the settlement are poor and become much worse and dangerous during rains (see Fig. 4 (a), (b)). The nearest public transportation is Bunju bus stop, which is about 5 to 6 Kilometres away from the settlement (see Fig. 3 (b)). In terms of housing, of the official 1004 households who had been provided plots, only 604 families received the building materials promised by the government. As a result, there is a pronounced difference in the housing situation of those who have received building materials and those who have not, as it is observed that most of those who had received the materials, and adding their own resources due to their own capacities and capabilities have either managed to complete building their permanent houses (see Fig. 4 (g),(h)) or at least have semi-complete houses (see Fig. 4 (e), (f)) whereas those who have not received any building material are still living in shacks, known as fulusuti in their local language (see Fig. 4 (c), (d)). As the nearest access to daily provisions is Bunju, a few of them have constructed a shop in front of their house to sell some provisions and daily needs (see Fig. 4 (h)). Pertaining to health facilities, there is a health centre that is built closer to the settlement, but it is not fully completed (see Fig. 4 (i)) and has limited facilities besides not being open round the clock. A new primary school has been built close to the settlement and has been in operation (see Fig. 4 (j)). However, the nearest secondary school is far from the settlement. The other persistent challenges faced by the resettled households are described as part of the narratives.

Fig. 4a):
Access road to Mabwepande resettlement area
source: author



Fig. 4b):
Access road within Mabwepande resettlement area
source: author



Fig. 4c):
Fulusuti house type
source: author



Fig. 4d):
Fulusuti house type
source: author



Fig. 4e):
Semi-built house type
source: author



Fig. 4f):
Semi-built house type
source: author



Fig. 4g):
Fully built house
source: author



Fig. 4h):
Fully built house with shop-front
source: author



Fig. 4i):
Health centre
source: author



Fig. 4j):
Primary school class room
source: author



Perception of local government officials involved in the process of resettlement

From the discussion with government officials, it was evident that the process of resettlement is widely perceived as a positive endeavour and favourable to the resettled population, as otherwise, they would continue to be at locations frequented by floods. Moreover, the provision of surveyed plots at Mabwepande is an incomparable bonus, considering that they were previously located in unplanned and informal settlements. The authorities had a sense of accomplishment and pride on how the victims were taken care of during the response stage and subsequently resettled as part of the recovery efforts. The officials believe that the government has done much beyond their capacity, especially when the victims were living in violation of rules by residing in flood-prone areas. One Municipality official mentioned that some of the development projects had to be stalled to divert the funds for resettling the population.

Narratives from resettled population in Mabwepande

The following narratives constitute the empirical evidence from selected household members who were resettled in Mabwepande after the 2011 floods in Dar es Salaam. As mentioned earlier, they were selected based on purposeful and snowball sampling. The narratives are categorized in accordance with five of the eight impoverishment risks of the IRR Model postulated by Michael Cernea. They are selected based on their relevance and importance with regards to the resettled population.

Joblessness

One of the biggest challenges to deal with at the household level for most of the resettled population was joblessness. Except for those who were employed in the government or private sector, all others who were dependent on informal sector in the City centre were badly affected. As one of respondents mentioned:

“Many people were employed in the previous settlement. Since it was close to Kariakoo, at least one person in every household had a job. As for me, I never had trouble finding work. There was employment all year round. I was never dependent on the government for anything. I and my family used to manage with what we had, but here, it is a different story. The government and other Good Samaritans provided food for us for about two months after we moved here, but after that we were left on our own... without jobs and without food. It was hard for us. We felt helpless, as there were no jobs immediately available for me in this area.”

Homelessness

Although plots were provided and temporary shelters were built for the population to start living in Mabwepande, the cost of building a new house was too much for many of them to afford. Those who received building materials to start building had the possibility to build at least one room, but for many others, it was impossible to build their house and have continued to live in fulusuti. As a result, those who have been living in such shelters consider themselves to have been rendered homeless, as compared to their situation in the previous settlement. One of the respondents living in fulusuti mentioned the following:

“We lost all our belongings and house in the floods...in fact we were left with nothing. Everything in the house had been lost including television set and refrigerator. When the government promised plots and building materials for us, I was thankful, but although I have this plot, until today I have not received any building material from the government. All I could manage was this fulusuti. I feel like a homeless person among those who have built their houses using building materials from the government. I am not happy as my family is also suffering...it is like the government has forgotten us and doesn't care about us anymore”

Food insecurity

For those who had moved in early 2012, they were provided with food and basic needs for about two to three months, but those who moved after this period had to fend for themselves from day one of their resettlement. In other words, they had to start all over in the new location. The various stresses associated with joblessness, homelessness and that added with the task of looking for food caused undue stress on the households.

“The government was not fair to us. We were asked to go back to retrieve our things and so we left the camp. They recorded our names and promised that we will have plots in Mabwepande. After coming here, we came to know that those who had moved before had received building materials and also food in the initial months. But for my family, I had to start looking for job to feed my family. I had to borrow some money from my relatives, because I could not find a job here. I lost many things in the floods. Finding a job here for me was not easy. Before, I was working in Kariakoo (city centre) in a shop, but after relocating here, the transportation cost is high compared to the money I receive, so I gave up the job there and was looking for something here. After about one year, I could have some money to feed my family without borrowing. I have had a struggle a lot in these years.”

Loss of access to common property resources

Common property resources include markets, schools, hospitals, transportation nodes, play grounds, cultural and entertainment facilities, etc. With regards to loss of access to common property sources, most of the respondents had suffered most with regards to markets, hospital facilities and secondary school.

“For me and my family, it was not an easy decision to move here because there is no market for me and my wife to work. My two little children are small and we used to have relatives nearby who took care of them before, but now it is not possible here.”

Another resident who had an old mother staying with her explained her precarious situation:

“My mother is about 80 years old and I am a widow. Many times she used to fall sick and the government hospital was so close to where we lived and I could take her there. But here, there is only a small health centre and it also closes by 6pm. With no hospital nearby and no public transportation, it is very risky for me to live here with my old mother, but I don't have any choice.”

Community disarticulation

Family and community disintegration has been common in many of the households in Mabwepande. The distance from the City centre and lack of job opportunities in Mabwepande are the common reasons that the family is disintegrated. Pertaining to her family one mother said the following:

“I have three children, one of whom is in the Secondary school near our old settlement and so living in the City with his Uncle. He likes the school there and does not want to move here as it is not easy for him to go every day from here. I have not seen him for two months now as it is expensive to come and go. I just hope he is doing well. I miss him here as he is the eldest.”

Another resident, who works in the government sector and lives alone in Mabwepande had the following to say:

“We are four in our family, but I am the only one living here. My wife is living with our sons in the City as one is studying in College and another is working in a shop in Kariakoo and so cannot move so far. I stay here during the week to keep an eye on our belongings and the plot here. I go to my wife and children only in the weekends. My life is hard here without my family. I hope someday they can move here and we can all live together again.”

Discussions

The case of Dar es Salaam reveals that even humanitarian-based resettlement measure fail to prevent widespread impoverishment and suffering among resettled population. Although the study leans heavily on the household narratives and official interviews and there might well be several different views one can take of each of the narratives presented here, the main objective has been to focus on the lessons to learn from this case, when relocation and resettlement are considered as a viable option.

The first and most important lesson from this study is that any relocation and resettlement measure must ensure basic infrastructure provision as required, before the population is resettled. There should be a careful assessment of needs of the population through participatory methods. Any neglect of the population or forgetting after a period of time invariably results in challenges, impoverishment and other risks, which is counterproductive to the purpose of resettlement in the first instance. There are complexities involved in the relocation and resettlement, but care should be taken to counter them through careful planning and consideration of various components.

Secondly, it is important to have a clear communication and clarity on the expectations as any communication gap between the government and the resettled population leads to mistrust and unfulfilled expectations. As can be seen from the narratives of the respondents in this study, the government made promises to the communities to the effect that they would be provided free surveyed plots, building materials for construction of their houses, access to markets would be in place, and a few others pertaining to basic infrastructure facilities. Typically these promises were made before the move, when government agents and others were doing their best to persuade the community that it was in their best interests to move. Once the relocation occurred, however, and the bargain was not kept, the resettled population had no way to compel the authorities to deliver on their promises and no recourse if they failed to do so.

It is established in literature, that in many cases the focus of resettlement measures is simply to get people to move “out of the danger way” to the resettlement sites as quickly and smoothly as possible. Once people are relocated, the resettlement programme usually fizzles out or loses momentum, with the displaced people now at their most vulnerable. The resettled population is most vulnerable to be forgotten once the physical relocation is complete (Argentina Report, 1999).

With due regards to the fact that the government relocated the 2011 flood victims from flood-prone area to a flood-free area by providing them plots at its own expense, the case of the resettled population in Mabwepande presents itself as a sorry tale of how a largely self-reliant people, have undergone radical disorder and disintegration due to relocation, resulting in detrimental effects to both the households themselves and the larger community around it. The relocation had created a dependence on government that did not exist before. Having moved from close proximity to City centre, where the majority had access to jobs, since resettlement, they have become either jobless or involved in menial labour, as their previous skills are of little value in making a living in the new environment. One study observed that even governments with the best of intentions often implement moves before preparing an adequate economic support base for population to be resettled and that “almost universally, governments fail to pay attention to how the resettled population are going to make a living after removal” (Scudder and Colson, 1982).

The study of Mabwepande illustrates this shortcoming dramatically. Even when the difficulty of making a living was anticipated, little or nothing was done by the government or other agencies to deal with the problem.

Discussions with the respondents revealed that for a vast majority of the resettled population, the experience has been extremely negative in economic, and health

terms. They include loss of asset, unemployment, health-risks, hunger, and family disintegration. Communities of displaced people have been fragmented, tearing asunder kinship and social networks and traditional support systems. Communities and often even large family households have been broken up and settled in city centre and Mabwepande. The disruption and anxiety of relocation alone are enough to require very careful planning and serious consideration of all potential outcomes before a relocation is carried out.

Resettlement of displaced population is a process that is acknowledged as entailing several risks, and certainly those identified by Cernea. These risks render resettlement inherently problematic, and indeed impoverishment and disempowerment have been the rule than the exception with regards to resettled population in the case of Mabwepande.

Conclusion

The objectives of this paper has been to present the case study of resettlement of flood victims in Dar es salaam after the 2011 floods and from the narratives of the resettled population, discuss their impoverishment risks using the framework of IRR Model proposed by Cernea and bring out the lessons that can be learnt from the case. This study has confirmed what other studies have pointed out, that relocation measures, although often suggested as a solution to disaster risk, involve serious problems associated with them. Relocation to less hazardous areas is highly effective in reducing physical risks, but overlooks the centrality of livelihood security to vulnerable people and the intensity of the socioeconomic pressures that drive them to occupy hazardous land. Relocation schemes, as in the case of Dar es Salaam, tend to involve sites on the edges of cities. Land may be more readily available and affordable there, but jobs and many other facilities are not and invariably expose the resettled population to more than one impoverishment risks and stress. More often than not, the policy of resettlement has always overlooked the economic and other reasons that make people settle in unsafe areas in the first place (Twigg, 2004), and this needs to be carefully considered.

The main conclusion from this study is that, any effort towards even a mild success of disaster relocation and resettlement is dependent largely on the access to livelihood opportunities and provision and functioning of the basic infrastructure before the population is resettled, as otherwise there is a greater certainty that the population would go through various risks and stresses as according to the IRR Model and eventually, they may either sell their land and return to their old hazardous areas or succumb to the intensity of the risks, thereby defeating the whole purpose of resettlement. Identifying, prioritising and addressing the many challenges is not going to happen overnight and the risks cannot be eliminated completely, but its negative effects can be substantially reduced. Considering the unfortunate situation of the resettled population after four years, it is implied that in keeping with its humanitarian and morally responsible action in 2011, the government should invest time and money into a planned approach to address the risks and grievances so strongly expressed by the respondents and better the life of the population that it strived to protect in the first place.

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