

Plan and Design Public Open Spaces Incorporating Disaster Management Strategies with Sustainable Development Strategies: A Literature Synthesis

R.R.J.C Jayakody^{1,*}, Dilanthi Amaratunga¹, and Richard Haigh¹

¹ Global Disaster Resilience Centre, School of Art, Design and Architecture, University of Huddersfield, United Kingdom

Abstract. Current focus of planning and designing public open spaces has been mostly given on creating sustainable cities contributing to its' three pillars; economic, social and environmental. However, the negative implications of rapid urbanization and the implication of climate change has increased disaster risk in cities mounting more pressure on the path of sustainable development. Therefore, it is imperative to incorporate the enhancements of disaster resilience with the sustainable development strategies. Yet, the integration of disaster management strategies with planning and designing public open spaces, remains unrehearsed within the urban planning context. Accordingly, this ongoing research study emphasize the need of incorporating disaster management strategies with sustainable development strategies when planning and designing public open spaces in cities. This paper first analyses the disaster management literature, providing evidences of potential use of public open spaces as an agent of recovery, to provide essential life support, as a primary place to rescue and for shelters and potential for adaptive response. Secondly, the paper cross analyses planning and designing literature with disaster management literature to find out the methods and approaches that can be used to harness the identified potentials. Finally, the paper suggests set of strategies to plan and design public open incorporating disaster management strategies with sustainable development strategies.

1 Introduction

Planning and designing cities towards the sustainability, is evidently a challenging task due to long experiencing environmental, social and economic problems such as poverty, crime, poor sanitation, poor housing, air, water and noise pollution, etc. Moreover, the rapid urbanization causes the concentration of these type of issues in cities in alarming rate. Further, all these negative implications of rapid urbanization increase the disaster risk in cities by pushing more pressure on land and services resulting inadequate resource management, settlements in hazard prone areas, lack of capacities, unclear mandated for DRR at local level and decline of ecosystems and so on [1]. Apart from that, the implications of climate change further increase the risk of natural disasters in cities with an increase of weather-related disasters [2] and accelerated global sea-level rise related coastal hazards [3]. Further, this increase of disaster risks in cities mount more pressure on the path to sustainable cities. Therefore, it is inevitably important to incorporate the enhancement of disaster resilience into cities' sustainable development.

With this understanding of the importance of making cities resilience to disasters, León and March [4] state urban planning and designing can play a vital role through its ability to integrate multi-dimensional aspects

affecting disaster risk reduction. Adding to this, UNISDR [1] states that strategic planning and design of spatial elements and their influence on the natural and built environment are the directives of city's capacity to absorb and recover from the effect of disasters. These spatial elements in cities may vary from buildings, ports, waterbodies to parks, playgrounds and streets. Out of these spatial elements, public open spaces can be considered as one of the key spatial element in modern cities which can play dynamic role effecting to economic, social and environmental life of cities. Public open spaces have the potential to act proactive manner, contributing multi-scale within the entire city to solve the current and future problems and issues [5]. However, this potential of public open spaces has not been fully recognised in enhancing cities' resilience to disasters. Confirming this, Hossain [6] argues that the role of public open space to enhance the city's resilience, especially to encourage the adoptive response following a disaster, has not been fully discovered yet. Contributing to this research need, this paper first analyses the existing literature on potential uses of public open spaces to enhance the cities resilience. Secondly, the initial findings will be cross analysed with the planning and designing literature to find out the strategies that can be used to plan and design public open

* Corresponding author: Chathuranganee.Jayakody@hud.ac.uk

spaces as a strategy for disaster resilience within the sustainable city concept.

2 Research Method

This paper is based on the findings of a literature analysis which was carried out as part of an ongoing PhD research study. Accordingly, comprehensive review of literature was carried out covering journal papers, book chapters, conference papers as well as local and international reports within the subject area. At the same time, this literature review has been presented in different national and international audiences where the literature review has been critically examined and modified according to the feedback received.

3 Need of a new focus on public open spaces

The use of public open spaces, was first identified in 19th century in United Kingdom and United States, as a mode to improve the health and quality of life of the working class people who lived in squalid and congested living environment [7]. Further development of the use of public open space in cities, recognized the socio cultural value of it. Accordingly, it was identified that Public open spaces in cities act as a place to celebrate cultural diversity, to engage with natural environment, a place to meet the strangers and one can transcend and the other can be anonymous [8]. Adding to this, Carmona [9] states that the external public open spaces provide life breath to the cities by adding recreational opportunities, venues for special events, wildlife habitats and opportunities for the movement of the people. Then the most popular idea of using public open space was to protect the ecologically sensitive areas and other natural resources while providing a recreational use to it [8]. After the introduction of the recreational use to public open spaces, it was identified that there is also huge economic benefit of adding public open spaces to the city's development. For the reason that, natural and recreational elements increase the property value and therefore the tax revenues of the municipalities [10].

With the consideration on climate change and environmental pollution, the environmental benefits of using public open spaces were also identified, including air and water purification, wind and noise filtering, reduce the surface runoff of rainwater and microclimate stabilization [10], [11]. Apart from these socio cultural, economic and environmental benefits, public open spaces are also identified to improve the mental and physical health of city dwellers. Attractive large public open spaces encourage the walkability and physical activities of the people which can potentially contribute to the health of local residents [7]. Further, urban green parks help to reduce the stress of city dwellers and provide the sense of peacefulness and calmness contributing to the mental health of city dwellers [10].

In summary, the current focus of planning and designing public open spaces has been given on three main areas; social, economic, and environmental which

are considered as three main pillars of sustainability. However, the sustainable development should also incorporate the improvements of disaster resilience [12]. Yet, it is little known in the field 'how to use these public open spaces for disaster resilience'. Accordingly, the following literature synthesis analyses the potential uses of public open spaces for disaster resilience.

4 Public open spaces with a disaster management focus

The analysis of the existing literature revealed that the public open spaces in a city have the potential to be used in three main areas in disaster management: emergency response, recovery and mitigation.

4.1 Emergency response and recovery

Literature related to earthquake and tsunami events, disclose that public open spaces within cities have a significant potential to be used for emergency evacuation and recovery. For instance, Allan and Bryant [13], study the role of public open spaces in an earthquake event in San Francisco, Northern California. This study reveals that, after a major earthquake, open spaces within the city act as a 'second city' using the spaces for simple to complex services such as gathering, building shelters, distribution of goods and service, temporary inhabitation, and commemoration. Therefore, their study highlights the importance of having different typologies of open spaces varying from small squares to parks and playgrounds which can be used for different functions in emergency response and recovery. When using public open spaces for emergency evacuation and recovery, Fuentes and Tastes [14] highlight the importance of consideration on connectivity between these public open spaces. This also confirms the value of Allan and Bryant's discussion as if the open spaces act as a 'second city', these spaces should have a better linkage among them. Further, these studies [14] inform that the connectivity need to be built through the relationship between open space, resilience and urban design as a fundamental way to plan and design resilient cities.

Adding to this, the literature on Tsunami events [14], [4], establish that public open spaces in cities are assets for 'rapid resilience'. For instance, the studies on tsunami prone coastal urban communities demonstrate that public open spaces can be used to provide safe assembly, to distribute emergency services and utilities, such as first aids, fresh water, electricity, and communication [4]. Therefore, public open spaces in coastal cities need to be planned and designed with a focus tsunami resilience considering the factors such as location, capacity and terrain qualities. This confirms that, the factors may differ from one disaster to another varying from accessibility, connectivity, terrain quality and capacity yet, there is a significant potential of using public open spaces for emergency response and recovery after a disaster. Further, it was noted that having different types of public open spaces focusing different

functions in disaster resilience also an added advantage for a disaster resilience city.

4.2 Disaster Mitigation

Apart from emergency management and recovery, the disaster mitigation focused literature reveals that the Public open spaces can also be used to mitigate the disaster risk. Most commonly, flood mitigation strategies first identify the flood prone areas and to protect these areas from unauthorized encroachments and future development, authorities propose to allocate these spaces for open space uses [15], [16]. Conversely, National Tsunami Hazard Mitigation Program [17], also emphasizes the use of open spaces as an element to mitigate the Tsunami Risk. They introduce seven basic principles of planning and designing for Tsunami events. Out of these 7 principles, the second principle describes, that Tsunami hazard areas need to be allocated for open-space uses [17]. However, most of these discussions, emphasize the need of keeping tsunami hazard areas as open-spaces and confine the uses in conservation and preservation perspective rather than using it as an asset in city development.

Identifying this need, researchers alike Kubal, Haase et al. [18] promote the idea of using these spaces not merely for preservation and conservation, but for the publicly used spaces such as wildlife habitat areas and nature related recreational activities. In supporting this view, Ardekani and Hosseini [19] state that tsunami setback areas can be potentially used for agriculture, open-space or scenic amenity. However, this does not mean to promote an additional development in vulnerable areas, but it should be planned and designed to make the use of hazard-prone areas safer to the community and to get the highest and best use of the urban spaces in cities.

5 Discussion

Above literature synthesis revealed that the public open spaces have the potential to be used for emergency response, recovery and mitigation with a focus on making cities resilience to disasters. However, to harness these potentials, public open spaces need to be planned and designed with focus on disaster resilience use of it. Then the question is 'how to plan and design public open spaces in cities with a focus on disaster resilience' and 'what are the strategies that can be used to plan and design public open spaces for disaster resilience'. Enquiring this, the identified potential uses were cross analysed with the sustainability focused planning and designing literature as follows.

5.1 Strategies to plan public open spaces for emergency response and recovery

In cities, land is a scarce resource. Therefore, it is imperative to get the highest and best use from whatever the available land. At the same time, allocating open

spaces for the sole use of disaster emergency or recovery is not a practical solution as disasters may occur sometimes seasonally (seasonal flooding, winds and storms) and some are unpredictable (floods, hurricanes, tornadoes, volcanic eruptions, earthquakes, tsunamis). Therefore, planning open spaces for the sole purpose of emergency planning or recovery without having any connection with everyday life of the city can lead to extra set of problems such as unsafe isolated places, unstructured open spaces, maintenance cost to municipalities, etc. Further, this is not only a threat to sustainable city concept, in the long run these places will not be physically prepared and will not be identified by the public for disaster emergency or recovery [20]. Therefore, these open spaces for disaster resilience need to be planned aligned with everyday life of the city. In supporting this view, Allan and Bryant [20] state that when emergency management plans and recovery plans are aligned with everyday life of the city through urban planning and designing strategies, it becomes more effective. The studies on tsunami rapid resilience [4], further confirm that public open spaces need to be planned to function well in both emergency and non-emergency situations. Accordingly, it can be understood that, for the effective use of public open space as a strategy for emergency response and recovery, it needs to be planned and designed, aligned with everyday life of the cities.

However, planning and designing public open spaces for both emergency response, recovery having connection with day today life of cities, is not a simple task. Planning for everyday use of the city may include recreational facilities, promote walkability, cycling, green spaces and so on. If the same space need to be used to emergency response and recovery. It may include, assembly points, sheltering, space to distribute goods and services. Then the place should be planned in a flexible manner allowing variety of uses. Having connection with this need, planning and design literature suggest a method call 'loose space'. According to Franck and Stevens [21], 'Loose-fit' spaces are not planned or designed for a specific use. When the place is not planned for a specific use, that spaces is loose, unregulated and open-ended, where the user will decide the use of it rather than following planner's decisions. In supporting this view, Thompson [8] states, unlike the designed space, "Found" spaces often serve people's wide range of needs. Applying the same theory, if the public open spaces can be planned and designed as a loose-fit space with minimal designed features, it has a significant potential to serve the everyday life of the city as well as for a disaster emergency and recovery. For the reason that, the user has the freedom to choose the use of the space, in day today life the user will be the city dwellers who want to relax, play, walk and cycle. In an event of disaster, the user will be evacuees who were evacuated from a hazard prone area or who need further inhabitation due to loss of houses. Accordingly, designing selected public open spaces as loose space can be a potential strategy to plan public open spaces for emergency response and recovery.

The analysis of literature further identified the potential use of different types of open spaces for different functions in emergency response and recovery such as shelter, first aid, distribution of goods and services. In relation to this need, planning and designing literature informs that mixing various types of public open spaces to the city layout can address variety of need of a city. Further, diversity of public open spaces with their individual characters invite different uses contributing the city's functionality, vitality and sustainability [8]. These places can be any type of external public open spaces providing leisure opportunities, places for special events, wildlife habitats and even a place just for the movement of the people [9]. In combination of this notion with the above identified potential use, mixing diversity of public open spaces to the city layout focusing both city's vitality and functionality in disaster emergency is a potential strategy to be used in future cities.

It was also identified that city's open spaces can act as a 'second city' after a major disaster contributing simple to multifaceted services such as gathering, sheltering, and temporary inhabitation. Adding to this, studied [13] demonstrate that, when the recovery plans are successfully integrated with urban design, it facilitates to see the city's open spaces as a 'second city' with network of open spaces. Conversely, Fuentes and Tastes [14] emphasise the need of designing an open space network contributing to urban resilience based on the studies on 2010 earthquake and tsunami in Chile; case study on San Pedro de La Paz. In a similar vein, urban planning strategies value the notion of open space network under the sustainable built environment concept. Confirming this, Rogers and Sukolratnametee [22] emphasize that integrated network of parks and open space can bring multiple benefits such as encourage the walkability, facilitate the sense of community, beneficial for neighbourhood designs and promote the interlinked recreational facilities. Adding to this, Carmona [9] states, network of open spaces connected with green corridors integrate the natural and the built environment which is a key to create sustainable cities. Accordingly, it can be identified that, designing a network of Public open spaces have a significant potential to facilitate both disaster resilience, urban resilience and sustainable cities.

5.2 Strategies to plan public open spaces for mitigation

Disaster resilience literature identified that disaster risk and exposure can be reduced by preserving hazard prone areas as open space uses and possibly can be used as publicly used spaces. Further, as it was mentioned, land is a scarce resource in cities. Therefore, getting the highest and best use from available space can be considered as a vital solution. At the same time, it was identified that public open space can bring many economic benefits to the municipality contributing to economic sustainability. Crompton [23] demonstrate that market driven factors demand for public parks and open spaces as it delivers the highest and best use of public

land. Accordingly, open spaces which are preserved and conserved for mitigation purposes can be possibly used for Public open space uses with minimal intervention to the land and with proper safety measures.

Further, this potential conversion of hazard prone areas to public open spaces should not be an additional development in vulnerable areas, rather it should be a benefit for both mitigation, community resilience and wise use of the space in cities. For instance, Drake and Kim [24] introduce the notion of urban sponge park where they converted a marshy wet land in to a residential area and public parks were used as working landscape to divert excess storm water run-off for use in the public park along the canal. Likewise, the urban sponge park achieves multiple objectives including liveable cities, environmentally sustainable and flood resilience built environments. Accordingly, it can be understood that public open spaces need to be planned and designed in a manner addressing multiple objectives incorporating sustainability, disaster mitigation, liveable community, protecting hazard prone areas, protecting wildlife habitat, and enhancing economic vitality.

In summary, the points which were discussed in the discussion section can be graphically presented as shown in Fig. 1. Accordingly, this figure (Fig.1) presents the literature proposed strategies to plan and design public open spaces incorporating disaster management strategies with sustainable development strategies

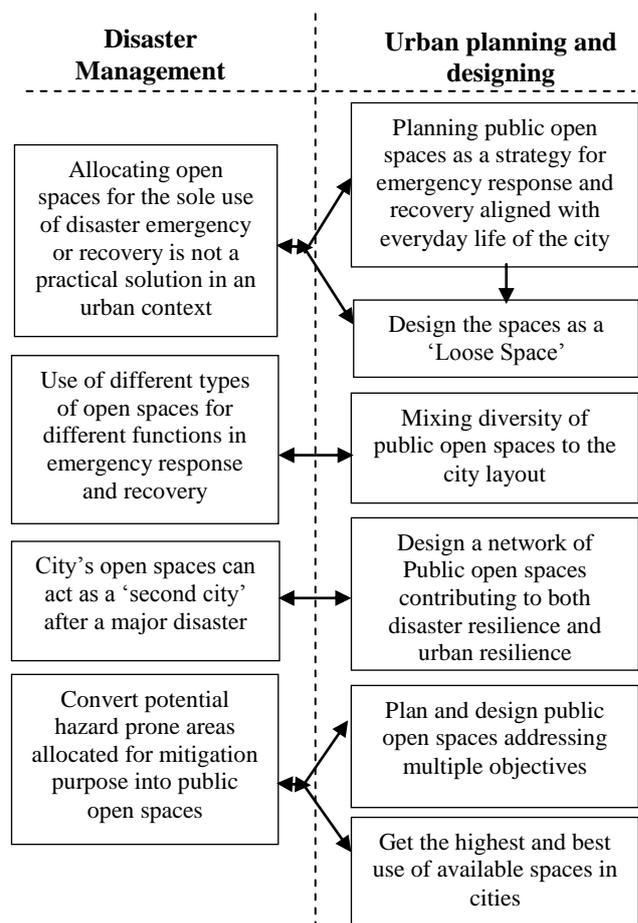


Fig. 1. Literature Proposed strategies

6 Conclusions

This paper has provided an overview to expand the current focus of planning and designing public open spaces towards enhancing disaster resilience in cities. Accordingly, it was first discussed the need of a new focus informing that the current focus is given on socio-cultural, environmental and economic benefit and there is a significant need to focus on disaster resilience. Then, the paper analysed the literature evidences which discusses the potential uses of Public open spaces for disaster resilience and summarized that public open spaces have the potential to act as a facilitator for emergency evacuation, as an agent of recovery and as a strategy for mitigation.

Then the identified uses were cross analysed with the sustainability focused planning and designing literature inquiring the strategies that can be used to plan and design public open spaces with a disaster focus. Finally, the cross analysis suggested six main strategies. Addressing the limitation of allocating open spaces for the sole use of disaster emergency or recovery two strategies were identified; 1. Planning public open spaces as a strategy for emergency response and recovery aligned with everyday life of the city and 2. Design the spaces as a 'Loose Space'.

To harness the potential use of different types of open spaces for different functions in emergency response and recovery, the strategy of 3. Mixing diversity of public open spaces to the city layout was identified. Then 4. Design a network of Public open spaces contributing to both disaster resilience and urban resilience, was identified to facilitate the City's open spaces system to act as a 'second city' after a major disaster. Finally, for the potential conversion of hazard prone areas which allocated for mitigation purpose into public open spaces, two more strategies were identified; 5. Plan and design public open spaces addressing multiple objectives (incorporating sustainability, disaster mitigation, liveable community, and enhancing economic vitality). and 6. Get the highest and best use of available spaces in cities. Furthermore, these literature-based findings can be evaluated and tested with a disaster specific focus or context specific focus from further researches.

References

1. UNISDR, How To Make Cities More Resilient- A Handbook For Local Government Leaders-A contribution to the Global Campaign 2010-2015-Making Cities Resilient – My City is Getting Ready! , The United Nations Office for Disaster Risk Reduction Geneva2012, Available: http://www.unisdr.org/files/26462_handbookfinalonlinerevision.pdf (2012)
2. L. Schipper and M. Pelling, Disaster risk, climate change and international development: scope for, and challenges to, integration, *Disasters*, vol. 30, no. 1, pp. 19-38 (2006)
3. R. J. Nicholls, Planning for the impacts of sea level rise, *Oceanography* (2011)
4. J. León and A. March, Urban morphology as a tool for supporting tsunami rapid resilience: A case study of Talcahuano, Chile, *Habitat International*, vol. 43, pp. 250-262 (2014)
5. J. Vargas-Moreno, B. Meece, and S. Emperador, A framework for using open green spaces for climate change adaptation and resilience in Barranquilla, Colombia (2014)
6. N. Hossain, 'Street' as Accessible Open Space Network in Earthquake Recovery Planning in Unplanned Urban Areas, *Asian Journal of Humanities and Social Sciences (AJHSS)*, vol. 2, no. 4 (2014)
7. B. Giles-Corti et al., Increasing walking: how important is distance to, attractiveness, and size of public open space?, *American journal of preventive medicine*, vol. 28, no. 2, pp. 169-176 (2005)
8. C. W. Thompson, Urban open space in the 21st century, *Landscape and urban planning*, vol. 60, no. 2, pp. 59-72 (2002)
9. [9] M. Carmona, *Public places, urban spaces: the dimensions of urban design*. Routledge (2010)
10. A. Chiesura, The role of urban parks for the sustainable city, *Landscape and urban planning*, vol. 68, no. 1, pp. 129-138 (2004)
11. S. E. Gill, J. F. Handley, A. R. Ennos, and S. Pauleit, Adapting cities for climate change: the role of the green infrastructure, *Built environment*, vol. 33, no. 1, pp. 115-133 (2007)
12. D. Paton and D. M. Johnston, *Disaster resilience: an integrated approach*. Charles C Thomas Publisher (2006)
13. P. Allan and M. Bryant, The critical role of open space in earthquake recovery: a case study, in *EN: Proceedings of the 2010 NZSEE Conference* (2010, Nueva Zelandia), pp. 1-10 (2010)
14. C. W. Fuentes and M. T. R. Tastes, The role of open space for urban resilience: A case study of San Pedro de la Paz under the context of the 2010 earthquake in Chile, *7th i-Rec Conference 2015: Reconstruction and Recovery in Urban Contexts* (2015)
15. R. J. Burby and S. P. French, Coping with floods: the land use management paradox, *Journal of the American Planning Association*, vol. 47, no. 3, pp. 289-300 (1981)
16. I. White and J. Richards, Planning policy and flood risk: The translation of national guidance into local policy, *Planning, practice & research*, vol. 22, no. 4, pp. 513-534 (2007)
17. National Tsunami Hazard Mitigation Program. *Designing for Tsunami: Seven Principles for Planning and Designing for Tsunami Hazards* [Online]. Available: https://nws.weather.gov/nthmp/documents/designingfor_tsunamis.pdf (2001)

18. C. Kubal, D. Haase, V. Meyer, and S. Scheuer, Integrated urban flood risk assessment—adapting a multicriteria approach to a city, *Natural Hazards and Earth System Science*, vol. 9, no. 6, pp. 1881-1895 (2009)
19. A. Ardekani and M. Hosseini, Urban and Architectural Approaches to Design against Tsunami, *Proceedings of the 15WCEE, Lisbon, Portugal*, pp. 24-28 (2012)
20. P. Allan and M. Brytan, The critical role of open space in earthquake recovery: a case study, in *EN: Proceedings of the 2010 NZSEE Conference (2010, Nueva Zelandia)*, pp. 1-10 (2010)
21. K. Franck and Q. Stevens, *Loose space: possibility and diversity in urban life*. Routledge (2013)
22. G. O. Rogers and S. Sukolratanamete, Neighborhood design and sense of community: Comparing suburban neighborhoods in Houston Texas, *Landscape and urban Planning*, vol. 92, no. 3, pp. 325-334 (2009)
23. J. L. Crompton, Parks and Open Space: The Highest and Best Use of Public Land?, *Journal of Park & Recreation Administration*, vol. 19, no. 3 (2001)
24. S. C. Drake and Y. Kim, Gowanus Canal Sponge Park™, *Ecological Restoration*, vol. 29, no. 4, pp. 392-400 (2011)