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MANAGING OF URBAN FLOOD RISK IN COLOMBO WITH SPATIAL PLANNING

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Abstract

Land and water are inseparably linked with each other. External pressures on either water or the land result in chains of impacts on both. Uncontrolled urban growth leads intensive urban growth into natural floodplains. As a result, flood risk and vulnerabilities in many of urban areas are on the rise. The technical measures as well as other planning operations on a continuous basis, which remains unchanged urban flood risk. Presently, it has been recognized that a new approach should be designed to cope up with both flood hazard and vulnerabilities would provide long lasting solution. The importance of spatial planning for an effective flood risk management strategy highlights the multifunctional and integrated benefits of spaces. Currently, many developed countries have already adopted risk based management approach over the traditional flood protection strategies. City of Colombo located adjacent to the downstream of Kelani River is highly vulnerable to floods. It has been regularly flooded in recent decades and brings many hardships to both community and economy despite the available flood protection measures. This present research analyses literature on flood risk management and interface between flood risk management and spatial planning and it discusses the salient characteristics of risk based planning interventions.

Keywords: *spatial planning, urban flood risk, resilience, Colombo*

1. Introduction

1.1 Increasing of flood risk in colombo

City of Colombo located adjacent to the downstream of Kelani River is highly vulnerable to floods during the heavy rainy seasons. Colombo and its suburbs are located in vast low-lying flat lands where there had been many marshlands. A large part of the Colombo region is very low and during Kelani River overflows, most of these low-lying areas are inundated. World Bank Report (2013) highlighted that Colombo is highly vulnerable to flooding, and had experienced regular floods for the past 30 years, affecting over 1.2 million people annually. The flood inundation area are predicted to increase further due to climate change conditions (Niroshinie and Babel, 2011).

The flood risk management strategies in the past aimed at protecting the Colombo urban area by developing protection bunds, pumping stations, etc. Many of the strategies and the action projects emphasized the adoption of structural measures for flood risk management. However, it is quite difficult to have major structural measures due to the value and the scarcity of lands closer to the city of Colombo. Most of the flood risk management strategies are still anchored to the relief-based approach, which mainly concerns allocated funds for rehabilitation of impacted communities, emergency management, recovers the infrastructure systems, post-disaster health services, etc. Each successive government spends capital and attention to manage the flood issue in Colombo.

Nevertheless, the extraordinary flood events cause considerable damage to lives, properties and negatively affect the whole development of the Colombo urban region as well as country. In addition, the rapid urban growth in Colombo stimulated the encroachment of floodplains and wetlands particularly by poor income groups, as they cannot afford more suitable alternatives for housing. The human settlements expanded intensively over the flood prone areas despite the available land use regulations and controlling measures. Extensive reduction of wetlands has recorded during recent decades as a result of rapid urban growth especially after 80s (Hettiarachchi et al, 2014).

The new urban growth on flood prone areas could not controlled through the implementation of spatial planning measures in the past and encroachment of river and canal reservation is a common phenomenon. In 1924, the existing Kelani flood protection scheme was constructed on both the left and right banks of the Kelani River near Colombo. The 5 km south bund protects the Colombo city and suburbs from flooding and is located at a distance of between 300 and 1900 m away from the river. There are two zones designated within the flood bund as protected and unprotected area. The population has increased even in the unprotected zone significantly due to scarce land scarcity in Colombo.

Year	Unprotected area		Protected and under developed area	
	Population	Pop. Density (per ha)	Population	Pop. Density (per ha)
1981	84400	32.90	125863	34.61
2001	134779	52.55	181686	49.95
2012	159613	62.23	210969	58.01

Figure 01- Periodical changes of population and population density in designated "protected" and "unprotected "areas along the Kelani river flood bund

2. Objectives and methodology

This work critically examines the recent literature on flood risk management transformations and interface between flood risk management and spatial planning. Present review demonstrates the limitations and inadequateness of traditional flood management and helps to understand the salient features of the risk-based approach.

3. Literature analysis

3.1 Increasing pressure on urban floodplains and flood risk
Many of the floodplains in developed and developing countries are became sources of livelihood for many communities (Ludy and Kondolf, 2012). Socio economic pressure has increased on many urban floodplains and they had been occupied by rapid uncontrolled urban growth irrespective of their ecological values. Minimization of damage and the social disruption due to floods can be achieved by preventing the floodplain occupancy (Burby and French, 1981). Communities have complex reasons, such as population growth, land scarcity, land tenure, employment, history, community relationships, etc for living with flood risk (Pardoe et al., 2011). Urban growth Floodplain highlights that the habitation choices are based on the trade-offs that exists between the benefits of living in a particular location and the associated hazards (Kates, 1963; Burton et al., 1965; White, 1972 cited in Birkholz et al., 2014).

3.2 Traditional approach in flood risk management
This situation specifies that there is a lack of ability, lack of knowledge or inadequacy of traditional management policies and strategies to cope up with flood damage caused due to extreme flood events. Moreover, the recent extreme flood events and severe impacts have challenged the conventional thinking of flood risk management (Thieken et al., 2014). Researchers realized that the limitations of rationalist thinking and cost benefit assessment approaches were insufficient to capture the complexity and uncertainties associated with flood risk (Birkholz et al., 2014;Eiser et al, 2012;Klijn et al, 2014). Thus, scholars argued that the flood risk management could benefit from a more constructivist thinking which advocates more comprehensive exploration of how socio-cultural context shapes wider understanding of risks and influences, which are the outcomes of disastrous events.

The technical approach has been shifted towards a broader integrated management or' risk-based' approach and spatial planning has become a central to this new ‘approach’(Wiering and Immink, 2006; Hutter, 2007). Spatial planning is increasingly regarded as an important instrument for creation of urban flood resilience (Sayers et al., 2013; Merz et al., 2010; Klijn., 2012). However, spatial planning plays only a minor role in flood risk management despite its importance (ARMONIA, 2007). There are many hypotheses can be made; inadequateness of spatial policy and strategy making process, lack of specific policy, strategy or tools, incompatibility between ecosystems and institutional arrangement, ill consideration or involvement of water risk in spatial planning and plan making, lack of communication between ‘technical ‘domains and socio political ‘domains, lack of cooperation between different levels of spatial and water management policy makers, etc.

3.3. Flood risk management

The notion of flood risk as interaction of hazard and vulnerability and as basis for risk-informed decision-making has become widely accepted over recent years (Merz et al, 2010). Flood risk management needs to reduce the probability of flooding and minimize the potential damage. The absolute safety or complete risk reduction through the structural measures is impossible (Sayers et al, 2013). Certain amount of risk has to be retained in the system and such efforts involve the use of flood sensitive land and spatial planning, early warning, flood proofing as well as evacuation and preparation. Hence, the flood risk management strategies need to address all dimensions of flood risk and to increase the capacities to flood prevention, response and recovery. The goal of flood risk management is to minimize flood risk by implementing measures that reduce risk most efficiently and become cost effective. Then it is necessary to seek potential alternative means of flood management measures, which are most effective and within the capacity and opportunities of the particular context to be implemented. Under these situations, the traditional flood management measureswhich consist of (1) traditional engineering strategy (2) Land-use planning strategy have many limitations. The following part analyses the pros and cons of traditional flood risk management, measures.

3.3.1 Flood control infrastructure measures

Flood control infrastructure measures, such as dykes, levees, dams, and drainage channels, etc are has been repeatedly criticized (White 1945; Mount 1995, Philippi 1996; Smits et al. 2006 cited in Liao, 2014). Many of these structural measures can reduce localised flooding in the short term and their effects on hydrological and biological systems, and their role in facilitating inappropriate land use and development of risky areas render them a maladaptive solution (Wenger, 2015). Despite criticism of structural flood protection measures, many countries depend on structural flood protection measures to mitigate flood risk (Kundzewicz, 2001). However, flood control infrastructure measures, are absolutely needed to safeguard existing developments in urban areas.

Wenger (2015) has studied the existing flood protection measures particular levee issue, future flood threats, and national strategies to address them in four flood prone countries; the Netherlands, China, the USA, and Australia. Wenger (2015) has pointed out that levees are becoming increasingly unreliable because flood threats are escalating. As a result, some countries are attempting to restore floodplain storage, thereby reducing their reliance on levees, others are increasing their investment in levee construction. This analysis suggests that federal systems face particular challenges and their capacity to adopt adaptive approaches may be impaired if institutional barriers are not addressed. He further concluded that regardless of the overall approach to manage flood risk, the experiences of all case study countries offer some broadly applicable lessons for improving the use and management of levees, reducing their adverse impacts, and improving the integration of natural flood mitigation.

Flood control infrastructure systems are normally designed based on flood frequencies such as 25-, 50- or 100-year, etc and other previous experience factors. GWP (2012) report pointed that the history may no longer be a reliable guide to future events in the climate change. Liao (2014) and (Kundzewicz et al. (2014) pointed that the flood control infrastructure measures designed with a specific capacity and they do not rapidly adjust with the changes of climate and socio economic systems. Therefore, the technical measures are ill prepared for extreme floods, which are expected to increase whose exact natures are unpredictable.

Kundzewicz et al., (2014) highlights the changing patterns of climate and trends of heavy to extreme hydrological events over the past decades. It has been further alarmed that flood hazard is likely to rise in the future and that plausible climate change scenarios in future will increase both amplitude and frequency of flooding events. However, there has been no conclusive and general proof to show how climate change affects the flood behavior, based on the data observed so far (Kundzewicz, 2002).

Moreover, many researchers have interpreted the causes for increasing of urban flood risk as changes in climate, changes in terrestrial systems (hydrological systems and ecosystems, and changes in socio economic systems and they have further interpreted that relative order of importance is site-specific. The flood control infrastructure measures become increasingly unreliable under these the uncertainties of climate change and socio economic changes. Hence, these infrastructure measures bring incremental benefits with adaptation. Adaptation theorists argue that large-scale engineering solutions are highly localized and bring short-term benefits that are often maladaptive across broader scales and sectors (Adger et al, 2005; Barnett & O'Neill, 2013; Cardona et al, 2012 cited in Wenger, 2015).

Di Baldassarre et al (2015) discussed on levee effect that the non-occurrence of frequent flooding (possibly caused by flood protection structures, e.g. levees) is often associated to increasing vulnerability. Moreover, there are empirical evidences demonstrate that flood control structures tend to promote an increase in the vulnerability (including exposure) of societies. The study conducted in Sacramento-San Joaquin Delta of California had revealed that the residents were unaware of residual flooding threat on levee-protected lands (Ludy and Kondolf, 2012). They have pointed that, the lands behind levees certified as protecting against the 100 – year floods and they officially not recognized 'floodplain' and they are open to residential and commercial development because they are ''protected'' by levees. Moreover, those lands are below sea level and the 70 % of newly settled residents did not understand the risk of being flooded Despite the levels of education and income.This study concluded that climate-change-induced sea-level rise exacerbates the problems posed by increasing urbanization and aging infrastructure, increasing the threat of catastrophic flooding in the California Delta.

Many structural flood management measures are based on defense focused design perspective that seeks to resist, disrupt and dominate the natural hydrological cycle. Thus, many flood control infrastructure measures harm riverine morphological and ecological functions and increasing of long-term flood risk (Smits et al., 2006). Therefore, the structural measures destroy the natural resilience capacity of an urban system (Lennon et al., 2014).When urban areas depend on the flood control infrastructure, they are premised on the artificial environmental stability which has limited tolerationto socio – economic and environmental fluctuations.The flood-control infrastructure subjects a city to contrasting conditions which are either dry, inundated and disastrous. In addition, these structural measures such as levees and channelization transfer the local problem to somewhere else and it may cause displacement of people at another location. However, considering the increasing of flood impact and widespread degradation of riparian ecosystems, it is questionable whether the use of structural measures is truly adaptive in the long term. Liao (2014) pointed that in many cases rural communities often suffer and especially during extreme basin wide flood events, strategically flooded to avoid inundation of economically and politically more important cities. Author further pointed that this could be observed in 2011 floods of Mississippi river in USA and Chao Phraya River in Thailand.

3.3.2 Traditional spatial planning measures

Uncontrolled urban development patterns intervene urban hydrological balance in different ways. It increases the impervious surface areas, which increases the volume of surface runoff and decreases infiltration volumes. Secondly urban areas grow over the spaces naturally occupied and alters the local hydrological patterns, ecological functions while aggravating flood risk. In recent years economic losses from urban floods have greatly increased, principally driven by the expanding exposure of assets to risk. As explained by Miguez and Vero (2016), this issue is strongly linked with land use and with typical urban problems, such as housing deficit leading to illegal occupation of floodplains. The proximity economic growth centers to rivers is a major concern in the context of flood risk. A study conducted in Pordenone province in northern Italy, which has suffered several heavy floods, showed that the main driving force of increased flood risk can be attributed to new urban developments in flood-prone areas (Barredo and Engelen (2010). Third, the unsystematic urban development often disconnects the natural drainage flows and makes it difficult for authorities to effectively manage flooding in an integrated, cost-efficient way that combines the use of water bodies such as wetlands, rivers and streams, for their flood regulatory functions.

3.4 Spatial planning in the face of flood risk

Recent years many scholars emphasized limitations of traditional planning practices in the face of urban flood risk. Filatova (2014) showed that in the past, flood risk management is dominated by planned adaptation, which is primarily command-and- control in nature, e.g. spatial planning and engineered flood defenses. Hutter (2007) also pointed that the spatial planning is often narrowed down to a regulatory instrument within flood risk management. It has been showed that the conventional flood risk management measures such as structural flood defenses and zoning developments in high-risk areas set fixed homogeneous rules for all actors. These homogeneity does not consider the possible differences in positive or negative impacts they incur on various actors and they also do not pay attention to alternatives migratory measures.

Many scholars highlighted that the centralized planning together with investment in technical defense measures, and governmental disaster relief programs impede stakeholders from taking individual risk mitigation efforts. Specifically, current government responses to floods and flood risks are characterized by regulatory restrictions on floodplain land use, structural protections, and flood insurance or disaster relief - transfers to property owners. Such government interventions dramatically increase the value of coastal properties and continue to promote or maintain unwise and unsustainable coastal floodplain development (Barnhizer, 2003).

Walega (2013) described that there are three reasons for increase of urban growth along floodplains.

- There are, lack of local development plans that regulate the land development ensuring flood protection.
- Failure to comply with restrictions contained in land use planning leading to decisions on land development in areas threatened by flooding.
- Location of settlements in areas with medium flood risk in which floods are relatively rare.

This had made it necessary to understand the drivers and mechanisms, which lead to increasing of urban flood risk and vulnerability.

Sudmeier-Rieux et al (2014) carried out a study in Vietnam Spain and Nepal, in areas which are prone to natural hazards and illustrated that weak public policies, urbanization, economic liberalization are the main drivers of exposure and to some extent vulnerability. In all three cases, risk is rooted in individual and collective decisions about investments in risky development based on differing and often conflicting interests, needs, and perceptions about risk when compared with public concerns about safety. It has been pointed that the main problem with reducing risk is that it either ends up getting paid by tax payers or by marginalized populations. Therefore, one important way to reduce risks is to better analyze and reduce such transfer of risks, and then to transfer the responsibility those who identify risks.

Accordingly the authors demonstrated the challenges, which could emerge when the planning framework is not capable to convert these potentials in a coherent manner and thus forcing greater reliance on engineered infrastructure, which require additional financial investment. They have described inter linkages between land use planning and risk management and also how a coherent and stringently implemented urban land-use planning process could contribute to long-term disaster risk management. Finally, their study had concluded the need of comprehensive, coordinated planning at all scales, from national to local, aiming at an efficient and balanced territorial development, a combination of both regulatory and financial or market based incentives and public participation.

3.5 Urban Flood resilience

Smit & Wandel (2006), conceptualized that exposure and sensitivity are almost inseparable properties of a system (or community) and are dependent on the interaction between the system characteristics and attributes of the climate stimulus. The characteristics of the human settlement influence its sensitivity to such exposure. This work further pointed that human settlement characteristics such as settlement location and types, livelihoods, land uses, etc., reflect broader social, economic, cultural, political and environmental conditions, which are sometimes called ‘‘drivers’’ or ‘‘sources’’ or ‘‘determinants’’ of exposure and sensitivity. Thus, many of the determinants of occupancy or sensitivity are similar to those that influence or constrain a system’s adaptive capacity.

Secondly, drivers that directly impinge upon water stress and sustainability are the ecosystem, agriculture, infrastructure, technology, demographics and economy. The ultimate drivers which are governance, politics, ethics and society (values and equity), climate change and security exert their effect mostly through their impacts upon the proximate drivers (UN water, 2012). Therefore the primary factors that directly impinge upon urban flood risk are increasing of, socio economic development and climate change etc and the ultimate it decided by the decision making process.

Thirdly there are inherent uncertainties due to uanabilities in (stream flow, precipitation, water quality) and uncertainty in decision making due to lack of knowledge. Akter and Simonovic (2005) conducted a study in a Red River Basin, Manitoba, and Canada and showed that the Flood management decision-making problems are often associated with multiple objectives multiple stakeholders and the uncertainty in decision-making is more profound in flood risk management.

Flood management strategies could cope up with extreme events as well as uncertainties in decision-making. Review of the flood risk management system in Germany Thieken et al (2016) pointed that the risk drivers, such as climate change, land-use changes, economic developments, or demographic change together with resultant risks must be investigated at regular intervals while risk reduction strategies and processes must be reassessed as and implemented with a dialogue stakeholders.

The recent shift of urban flood risk management towards resilience concedes that it helps to reduce the impacts on flood risk prone communities can be reduced (Schelfaut et al, 2011). Urban flood resilience means the ability of a system to potentially exposed to hazard and to resist, respond, recover and reflect up to a stage, which is enough to preserve its level of functioning and structure (Scott, 2013). Vanneuville et al., (2011) emphasized that an increase of the resilience can be also referred to as ‘adaptive capacity’ or ‘coping capacity’ ‘before the event’ and actions to minimize or decrease the negative consequences after the flood event.

As highlighted by Kellagher et al (2008), the benefit of a risk-based approach distinguishes from other approaches of decision-making because it deals with outcomes. Thus in the context of flooding it enables intervention options to be compared on the basis of the impact that they are expected to have on the frequency and severity of flooding in a specified area. Therefore, a risk based approach enables informed choices to be made based on comparison of the expected outcomes and costs of alternative courses of action. Moreover, this is distinct from, for example, a standards-based approach that focuses on the severity of the load that a particular asset has been designed. Risk-based options appraisal and design involves modifying the variables describing the flooding system in order to estimate the effect that proposed flood risk management options will have on flood risk. They have pointed that the risk calculation therefore requires probability distributions for the loadings (that include spatial, temporal and inter-variable dependencies), physics-based models of fluid flows from source to receptor and a mechanism for integrating loading. As highlighted above the translation of the integration in achieving flood resilience into the practice has been pursued in two ways (1) being integrated with the technical infrastructure level and (2) the social political level (Bruijn et al., 2015).

From a political perspective a systems, approach results in very complex decision-making processes with the involvement of many actors, their interests, many uncertainties and disputable choices (system boundaries, data, methods etc). Thus, the resilient strategies highlights the integration of variety of dimensions of flood risk such as social, socio-cultural-historical, legal-institutional, political and economic differing with the flood type. Therefore, the risk-based approach depends on comprehensive and integrative concepts, encompassing many stakeholders and asking for collaboration at various levels. Schelfaut et al., (2011) reviewed the flood risk management in three case studies in Europe: Flanders (Belgium), Niedersachsen (Germany) and Calabria (Italy) and revealed that participation of all stakeholders and bottom-up involvement are considered important factors to bring flood resilience into practice.

Accordingly, they concluded that the increasing the strength of a community is also about increasing the strength and scope of the internal connections between its individuals, organizations and the physical environment that form that community. It is creating stewardship of lay people and consequently hand over responsibility from the authorities to the lay people is considered to be a challenge. Smit and Wandel (2011) also conclude that the adaptations can be considered as local or community-based adjustments to deal with changing conditions within the constraints of the broader economic–social–political arrangements. However, Su (2016) has pointed that resilience policies also need a top-down method as well as mandates and support from higher levels of government.

Many scholars have highlighted the limitations of traditional planning practices in management of flood risk. Klijn et al (2015) highlighted that the multi-layered safety approach or rather a multiple-tiered approach to flood risk management. This includes flood protection as keystone and the second layer of sustainable spatial development as supplement aiming to prevent a further rise of flood risks through demographic and economic developments in the future, and the third layer is meant to reduce the effects of any undesired flooding event. At present, many countries especially, Germany, Netherlands, UK, Australia, USA etc have already recognized the need to adopt risk based management approach over the traditional flood protection strategies (Moel et al., 2009). The spatial policies such as 'space for nature', 'space for water', 'green-blue network', 'climate-proof city', etc are the evidences.

3.6 Spatial planning and urban flood resilience

Spatial planning is a regulatory instrument, which decides the physical landscape pattern, and hence it regulates the implementation of socio economic development. Recent experiences of many of urban issues indicate the lack of feasibility of existing approach of planning to address the urban complex and uncertainty. Many of urban areas are facing increasing of flood risk and they are the evidences for the existing urban fabric in many of our towns, and cities were built without consideration of flood risk (White, 2008). Second, in the past, many of the planning measures for flood risk management were often developed in the domain of water management and from a water-management perspective. As a result, policy makers encounter strong local opposition, sometimes results in major project delays, inadequate solutions or even in the cancellation of projects aimed at providing more space for water. With the experiences in the Netherlands Neuvel (2010) argued that spatial planning should not only be regarded as an instrument for regulating the land required for flood reduction, but also as an important substantive perspective through which participation can be facilitated and through which water management objectives can be balanced with other spatial claims on the landscape. Accordingly, scholars argued the inseparably link between spatial planning and water management and the limitations of existing problem framing and approach of decision-making (Lu, 2014).

Meantime, as water sector, spatial planning domain has also experienced transformation because number of planning concepts, such as coherent, convenient, etc could not be achieved through the existing planning process or through the physical hard planning (see Hart, 1976 cited in Albrechts, 2004). Thus, spatial planning strategies are evolved from the integrated perspectives that transcend traditional sectoral policy divisions through a specific focus on the spatial impacts of sectoral policies (Albrechts et al., 2003). Second, the new approach encompasses comprehensive coordination of all scales from national level, regional level to local level aiming at an efficient balanced territorial development.

Accordingly, the spatial planning tries to coordinate different spatial sector claims and tries to balance spatial claims to achieve sustainable territorial development or serves as a bridge between different spatial levels and policy fields. With an interdisciplinary and comprehensive approach, spatial planning strives for a physical organization of space, which is coherent and desirable from both sector and multi-sector points of view. Therefore, the new approaches of spatial planning evolved with more concerning of open dialogue, accountability, collaboration, and consensus building and they have become key concepts. Then spatial planning provides benefit as a substantive focus in interactive policy and strategy-making processes. Moreover, the spatial planning has become a process of policy-making that guides spatial development or frames the activities of stakeholders to help achieve shared concerns about spatial changes (Albrechts, 2004). Therefore, the spatial strategies are not framed and operate in a rather autonomous, isolated and technocratic way as in the past. Besides, spatial planning leads towards the development and implementation of spatial measures can have a benefit in dealing with current and potential conflicts (Neuvel, 2010).

In this context, it is highly emphasized that the urban development should be carried out “with the water”, “with the river”, and not ‘against the water’. New spatial strategic capacities have developed focusing on water and water as a vehicle for attractive living and working conditions and water concerns. It has further highlighted that water concern become stronger in spatial planning, and using strategic water management as a vehicle for integrating economic and environmental interests. (Woltjer and Al, 2007). Van Leeuwen et al., (2007) highlights spatial planning can be perceived as a policy-making process through which the actors involved try to define and create desired spatial situations while defining and preventing undesired ones. Under these circumstances, is capable to direct people and properties into less hazardous areas and thereby reduce hazard risks by controlling the timing, location, type, intensity and other characteristics of development (Godschalk, Brower, and Beatley, 1989 cited in Burby, 2000). In this context, spatial planning is perhaps the most effective approach to preventing the increase in flood risk, through active controls on (re)development of land and property in these areas (Sayers et al,. 2013).

Deyle and Butler (2013) highlighted the functions of spatial strategies, which need to create flood resilience in urban areas through protesting, accommodating and avoiding/retreating. Su (2016) has divided the spatial planning strategies in the face of urban flood resilience as (1) prevention (2) accommodation (3) fortification (4) protection (5) retreat and (6) green infrastructure. Moreover, planning more space for the river, wetland planning, polder and retention areas, and permeable surface design to increase urban flood resilience do matter in reducing flood risks. Accordingly, spatial strategies emphasize allowing more space for water, highlight the natural landscape, and create more water adaptive space.

The recognition of flood risk management is growing but the practices are still not widely used or understood at strategic and local levels (Burby and May, 1997; Richards et al., 2008). Nevertheless, many of the countries are facing challenges in implementing risk sensitive planning measures in flood management. The main question is how to frame process perspective spatial strategies on flood risk management, which is owned different understandings of cause effect relationships and diverging interests. Because risk-based planning explains integrating the risk-based land use planning approach into urban governance (Jha et al. 2013).

Many scholars have been argued about this challenge. Moss, (2004) highlighted that the integration of flood risk management and spatial planning highly depends on the framings and institutional processes. Dawson et al., (2011) and Vinke-de Kruijf et al., (2015) also pointed that the effectiveness of planning strategies is sensitive to socio-economic pressures, institutional capacities and governance arrangements. Lyles et al., (2013) also pointed that the development of integrated strategies in flood risk management is determined by three generic factors; (1) planning process (2) planning context and (3) planning outputs. Hutter (2006) also explained that the strategy formulation determine mainly by three factors such as context, content and the process.

4. Discussion and conclusion

Flood control infrastructure measures and blanket land use regulations failed and it is highlighted that need of find measures to reduce the consequences of floods. The traditional flood risk assessment and management approach emphasize the need to tackle the community vulnerability. It is increasingly acknowledged that the flood control infrastructure measures need to associate with spatial planning measures in order to achieve resilience for urban floods. The past literature emphasized that the water management and spatial planning domains have developed their bodies of knowledge over a long time separately.

However, water management and spatial planning domains are sharing a similar perspective more and more. Although parallel, both domains have walked through similar paths. The best answer to flood management lies in an integrated approach and joint actions.

The shift to integrated flood risk management has been highlighted the need of perceptional changes of experts and society. Flood risk resilience requires integration of space, time and socio economic activities, it should integrate all the actors mainly, authorities, inhabitants, developers, etc. Flood risk perception has received growing attention in recent years owing to the assumption that they provide useful insights for flood risk management. Moreover, the urban flood resilience depends on the inclusion of diverse views, knowledge and perceptions. The perception of flood risk is governed mainly by the situational and cognitive factors, which are specific to the context. Therefore, there are two main approaches in flood risk assessment and management predominant in the literature (1) rationalist approach (the official authorities define the acceptable level of risk) (2) constructivist approach (individuals and social groups define their acceptable level of risk by considering their social context).

The technical flood protection measures always play a substantial role in reducing the impacts of flooding in Colombo. The repeated urban flood events and the increasing of flood impact over the last years challenging the existing flood management approach in Colombo, integration between the spatial planning and water management as well as the governance systems. At last the paper question the appropriateness of 'rationalist approach' and the 'constructivist approach' for flood risk management in the context of Sri Lanka.

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