URBANIZING MEKONG DELTA IN VIETNAM: THE
CHALLENGES OF URBAN EXPANSION ADAPTING TO
FLOODS

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ABSTRACT
The Mekong Delta is the water – saturated delta region. There is struggling with extreme
consequences of natural disasters and floods are the most serious potential. Traditionally,
two parallel-moving factors: earth – high levees, patterns of settlement, roads and dikes
and water – rivers and canals have coexisted and developed. This mutual relation not only
created city’s images but also allowed cities survive from and adapt to floods. Currently,
urbanization is taking place in low-lying and flood prone areas. The water-city is
transformed into the road-city in which the role of water in city structure seems to be
neglected. As a result the cities are losing its unique characteristics and local
communications are becoming more vulnerable to floods. By using the 3x3x3 framework
(3 layers – natural environment, infrastructural network and human occupation; 3 times –
past, present and future; and 3 scales – basin, delta and cities), this paper analyzes the
transformation of cities in the Mekong Delta that recognize they as evolving systems
responding to fast changes in natural, economic, cultural, and social conditions. Special
attention is paid to how cities grow and what the impact of this growth will be on their
susceptibility to floods.
The discussion is proposed strategies to develop cities in a way that they become more
flood-resilient. These strategies can also play an important strategic role to urban
development in the Mekong Delta, but also might be relevant for other urbanized deltas as
well.

KEYWORDS Mekong River Delta, urbanizing deltas, urban expansion, flood
vulnerability, 3x3x3 framework, climate change, sustainable urban development

1. INTRODUCTION
Đất nước – or ‘earth and water’ is a phrase that the Vietnamese calls their nation or
‘homeland’. A map of Vietnam was drawn in 1838 and a map published in 1490 under
the Le dynasty render only the inter-connected waterways and the numerous mountain
peaks [20, 24]. In Vietnam, the rivers and land have determined the form of the landscape in a continuous shift and influence each other.

The Mekong Delta, one of the largest deltas in the World, is a landscape shaped by a dense river, canal network and vast rice fields, systems of protection dikes, orchards and a pattern of continuous ribbon-like settlement residing along the banks of freshwater course, sometimes stretches over tens kilometers. The mutual relation between earth and water in the Mekong delta not only creates its unique landscape but also is the adaptive strategy that people might avoid damages of frequent floods [2].

Water is an important element behind the patterns of soil that form the natural landscape. Water presents everywhere and in all the aspects of deltaic life [12]. Water has always had two-side effect in the delta. On one hand, water serves as main transportation, communication as well as bringing many benefits to agriculture, aquaculture. On other hand, water as frequent flood is main devastating factor affecting to social, economic values and damaging of property and infrastructure.

Land is a result of deposited sedimentation process and of human attempt to struggle with extreme consequences of water disasters in form of floods in the wet season and saline intrusion in the dry season. Land creates a high, fertile base for human settlement in the uncertain environment and provides a favorable condition for urban development. The urbanizing Mekong-Delta is very clearly the result of mutual influences of three different layers: layer of landscape, layer of infrastructure network and the layer of human settlement pattern.

(i) The layer of dynamic, complex landscape is described as the result of combined social and natural forces. The basis natural form is shaped by natural forces of rain, floods and tide with processes of sedimentation, alluvial deposits and land-loss; and its cultural technical adaptation, which related to the history of reclamation.

(ii) The layer of infrastructure is a overlapping of multiple networks. The waterway system, including natural and man-made canals, creates a good condition as a foundation for other systems were laid [20]. The elevated banks of canals, resulting in the dug process for military, agricultural drainage and irrigation purposes, become a land consolidation for settlement as well as turn creates a fabric of orchards woven into that of paddy. The road network crosses to or parallels the waterways, forms a network spread across the delta.

(iii) The pattern of human settlement in the Delta is not uniform. Historically the population firstly settled on the slightly higher terraces and later on the levees along the rivers; these areas are still the most densely populated. With the excavation of canals,
people started to settle along the canal banks, resulting in a typical pattern of the population ribbon-like settlement. At the confluences of networked systems, there is the intensification of urban development [19].

However, this pattern has changed dramatically during recent decades because of two specific conditions: the development of hydraulic works (additional canals, dikes, etc) for fostering irrigated rice product as well as protecting human-settlement areas and the development of land-based infrastructural network (road and bridge). Currently, urbanization is taking place in low-lying and flood prone areas. The water-city is transformed into the road-city in which the role of water in city structure seems to be neglected. As a result, the cities are losing its unique characteristics and local communications are becoming more vulnerable to floods.

Moreover, the constant change of relationships between these three layers brought to light the specific spatial characteristics of the delta’s landscape and tended to change urban form and city hierarchy. The consequences of human interventions into natural process have caused huge alterations to the ecological structure of the delta and put at risk its inhabitants. Many present day challenges facing society and ecology in the delta are thus the result of enormous investments through its historical development to transform from an uncertain environment to an inhabitable and unique landscape. What was the transformation of deltaic landscape and urban pattern and what are major factors effected to these changes; and what will be main factor influenced on the developments of the Mekong Delta?

In order to answer these questions, it is important to analyze the interaction between different layers, which reveals how basis natural landscape, the historical development of multiple networks of infrastructure, and the different urban patterns have influenced each other. The objective of this paper is to provide the reader with general characteristics of urban types in the Mekong delta, which takes into account the changes in natural condition, water management, infrastructural development, and city hierarchy occurred through many centuries.

Three scales of analysis including shifts from basin to the delta where the implications of recent regional activities are analyzed with reference to the influence posed to cities.

Finally, to obtain insight forward new spatial strategy for a more sustainable urbanizing delta, the paper will focus on urban growing process of Cantho city as a case study and on the possible future changes of the delta due to climate change.
2. NATURAL PROCESS AND THE COMPLEXITY OF THE MEKONG DELTA

The Mekong River is the seventh longest river in Asia. The Mekong Delta is commonly defined as a vast triangular plain, beginning at somewhat downstream of town of Phnom Penh in Cambodia. The Mekong Delta covers roughly 5.9 million hectares of alluvial plains including 4.9 million in Vietnam and 1 million in Cambodia [8, 21]. From upstream to the sea, the Mekong Delta can be divided into two parts: the upper and lower deltaic plains. The upper deltaic plain is characterized by the floodplains and natural dike along rivers with dunes in the riverbed. The lower deltaic plain is a result of the alluvial silt directly deposited by the river under the influence of mix of waves and tides. It is characterized by alternating grip on the tidal plains and hillocks of sand and the narrow valley swamps [16, 8].

The natural processes of erosion and sedimentation processes, influenced by sea current that come form both South China Sea and Gulf of Thailand and annual flood condition form complexity of the Mekong delta. A high freshwater alluvial zone in center of delta, two large seasonal flooding areas with a strong dynamic coastline characterize the typical form of the delta. Sediment transport to the Mekong Delta has not changed significantly over the last 3000 years [8]. However, the mean discharge and sediment runoff of are completely irregular betweensummer and winter monsoon seasons. The large sediment runoff of the Mekong River contributes to intense progradation of delta into the sea. The Mekong River, each year, carries 160 million tons of sediment. Most of that supply to the South China Sea occurs between June and November when river flows is the highest. The volume of mean annual discharge at mouth is 175x10^9 m^3, but discharge in the high flows is eight times higher than that in the dry season.

The Mekong delta is a wave- and tide-dominated delta, with as a result of meeting of two branches of Mekong River and a coastal area with mixed influence of tide and wave. Two separate tidal fluxes along the western and eastern coasts, one hand makes sediments dumped along rivers and widened river mouths with large mouth bars; other hand, creates a strong coastal area of sandy beaches. In the flooding season, these high grounds prevent sediment transported further outside the riverbanks. The strong wave current combined to formidable northeast wind during the winter monsoon causes the sediment to be carried further river mouths. The annual flood forms a vital part of life in the delta. When the delta range is expanding, capacity to drain water into the sea in the rain season is compromised by the longer route and adds additional effects of the tides. At the same time, the influence from the sea (tides, waves, wind) has contributed to form mounds of sand plains terrain in the Dong Thap Muoi floodplain and Long Xuyen Quadrangle. The
hydrological regime of the Mekong River and processes of sedimentation formed the freshwater alluvial zone located in center of the delta. Along the main rivers and the bank of channels, the natural processes created a territory of deposits fresh sediment with alluvial banks that rise 2-3 meters above mean sea level. The richest natural paddy fosters the development of agriculture allowing two and three rice crops per year. The combination of high banks and good drainage allows farmers to irrigate easily and offered a safe condition for human settlement without fear of flooding [3].

Behind the delta coastline expanded into the sea which amounted to 70 -140 m/year at the mouth of the Haubranch near the CaMau Peninsula [16], the natural processes created a wetland area along the eastern coastlines a protective buffer against storm surge. The increasing in land areas under rice and the length of the network of irrigation canals caused the sediments to be carried further into the South China Sea, degradation of mangrove along the delta coastline, and loss of their coast protection function. Mangroves loss increased the vulnerability of the Mekong Delta to frequency and power of typhoons.

3. SETTLEMENT IN THE WATER-SATURATED DELTA REGION – The Dialogue Between Water and Land

The first choice for early modern settlement on what is now the Mekong delta attests to largely responses to the natural conditions of territory and the way cities were able to exploit these conditions.

The earliest forms of cities in the Mekong delta are: (1) cities situated on the levees. These cities located next to watercourse, on the high river banks, which not only were safe places to settle with annual floods but also to transport easily. In the nineteenth century, the establishment of canal systems offered favorable conditions for new cities arose. The canal systems provided highly situated ground in the polder areas as resulting from the digging progress. New waterways were not only the trans-regional infrastructure but also used for drainage, irrigation, water supply, and fishing. These are referred to as (2) canal cities. Later on, the development of road system changed urbanization patterns. Settlements and cities developed at confluences point of road and waterways that waterway became less dominant. Cities transformed to linear street cities. These concern (3) cities situated at the crossroad. In the eastern part of the delta and along the western coastline areas cities arose on the more highly situated sandy grounds, which are not influenced by floodwater. These cities named (4) coastal cities.

3.1 Settlement on the levees - the “river cities”
The largest cities, in the Mekong delta such as Vinh Long, Can Tho, Sadec, My Tho, and Long Xuyen situated at two main branches of the Mekong River: the Mekong and Bassac. On the natural levees along the river course cities established. These locations were both safely and attractive places for urbanization. They were attractive because they are situated on the trade-flourished route that connected to hinterlands such as Cambodia and further China. They also were high places that offered a good condition for survival on floods.

The waterways served as trans-regional infrastructures, which transport took place inside as well as outside delta. The markets were usually formed at the point where a creek or canal flows into a larger river. Quay, market and ferry station became the heart of the city. The creeks and canals, as the only public space, dominated an important function in the city structure, where goods could be transferred or traded from the sea to the hinterland and vice versa. The riverfronts functioned as the center of various transport routes and became the most important places offered the favorable spot for urban development. The pattern of street ran perpendicularly or towards canals and rivers formed spatial structure of city. The drainage sluice was able to accommodate only relatively small ships and the cargo from larger ships had to be transferred or traded on the quay. In some cities, the exiting of these sluices is still visible in My Tho or filled to built boulevards in Sai Gon and Can Tho.

3.2 The “canal cities”

The development of the canals system during the Colonial period increased the amount of land under cultivation. In a period from 1886 to 1930, the drainage works were permitted the drainage of 1,425,000 hectares of land [5]. At the intersection of main waterways, the floating markets were established as a place to goods exchange. The new towns were created to provide services to the famers. Silt from digging the canals created a high ground. These man-made levees allowed a road and house to be built on that able to safe
with flooding. This was the most important condition for the creation of cities in these lowland areas. Water had a structuring role in all these unique city type. The crossroad of the waterscape resulted in a pattern of redialing lines from the central void. In these cities, the waterway dominated as a mainly transportation route. The ribbon development of building sited along the canals as settlement forms, but was also the basis for urbanization. Examples of this were Moc Hoa and Phung Hiep - sites of the delta’s largest floating market.

3.3 The cities situated at the crossroad

Tan An, Cai Lay, and Go Cong were the cities situated in which main road crossed a river or a canal. This was embodiment of the economic significance of transport from the waterway to the road and vice versa. The road was used as a regional infrastructure. The waterway regarded as a strong relationship with the surrounding agricultural product area. From the intersecting point, city expanded parallel both road and river that formed a geometric shape. The rising of national land-based infrastructure system in combination with the increased vehicle traffic were the cause that these cities definitely changed their character. The road replaced the water as the domain of city and played a role in the embellishment of the city. Urban centers were joined by built-up strips that stretch along the roadside for kilometers [26].

![Figure 3: Urbanization process in Tan An town](image)

3.4 The coastal cities

The sandy ground along eastern and western coastline created the safe condition to settle as well as offered for economic sense oriented at sea. Waterway played as an important role in a relationship with the hinterland. Thoai Ngoc Hau canal (1818-1823) connected
Ha Tien and Chau Doc and Thoai Ha (Long Xuyen – Rach Gia) canal completed in 1816 were trading routes and administrative communication in the western delta. Port shave developed at canal which discharged into the sea. However, war, silting deposit, and change of navigating route were made to declination of these ports.

![Figure 4: Urbanization process in Rach Gia city](image)

4. **URBANIZATION AND THE CHANGE URBAN PATTERN**

Urban pattern in the Mekong delta is defined by the natural conditions of territory and is the result of the way cities and regions were able to exploit these conditions. This was determined not only by the availability of innovative technology but also by a legacy of up to centuries of urban policy and decision-making. Cities are evolving systems, which respond to faster changes in physical, social, economic and institutional conditions than previous generations had been used to. Over a long period in history, cities have always coped successfully with new environmental conditions and thus have been extremely resilient. Understanding the role of time and the way it conditions future urban option is a crucial part of urban resilience [30].

Since ancient times, the Mekong Delta can be described as a continuous dialogue between the powers of the nature and those of humankind. In the ancient world, the Mekong Delta was an important halfway point for sailing trips travelling with the monsoons between India and China. Through its history, the delta’s landscape has undergone several transformations. The first landscape transformation was acknowledged during a period when the first Vietnamese came to the area to exploit new agricultural opportunities. Although settled to some extent since at least the 2nd century, delta struck by the 18th
century when waves of immigrant from the Red Delta and province of the center following southwards to made their fortune [27]. Until this time, there was an almost wild landscape of rivers, ecologically sharp by water, monsoon climate and tide of sea [9]. During the pre-colonial period, the Mekong delta became a thriving hub of regional commerce.

One of greater landscape transformation is dictated from the end of 19th century, when the French achieved political control over the delta to the end of the Second Indochina War in 1975. From French colonization to American militarization, the taming of nature occurred vigorously and the water management was seen to be very central of regional policy. As the result of the expansion of the agricultural, large parts of the delta pass into cultivable land [26].

The third landscape transformation has been occurred in recent decades when business was improving and market places expanded. In order to promote economic activities, roads have come to replace river as the economic, social and cultural centers of the delta. Waterways are reducing their function as a major transportation. One of the features of this transition is a reorientation of region’s major transport corridor away from rivers to roads. Urban form is changing from the water-city to road-city. As the result, water disappears from the cityscape.

![Figure 5: Canalization process and urban pattern in the Mekong Delta](image1)

![Figure 6: Road network in 1900](image2)

### 4.1 Regional policies of hydraulics and urbanization

In the mid-19th century, there were two new conditions that have had significant impacts on hydrological system and radically changed urban patterns in the Mekong Delta, as well as their hierarchy. In the 1867 entire delta was administered directly by Frenchmen. New
national policy focused on constructing a nationwide system of infrastructure such as railways, roadways, port facilities, bridges, and canal system, which directly promoted development of commercial agriculture and growth of urban system. Urbanization process occurred vigorously. Exiting urban centers greatly increased in size and a network of new types of cities was formed as commercialization of countryside and land reclamation proceeds [12].

New technologies using in digging canal were developed that resulted in expansion of cultivated land. Thank to use the steam-power dredging machine to the Mekong delta in the late 1880’s, more than 165 million cubic meters of earth were dredged and the total area put under cultivation rose fourfold to over 2 million hectares. Following this process, the delta’s population quickly rose from some 500,000 in 1860 to over 4 million in 1930 [2].

In the decades following 1867, the maps showed the changed drastically in deltaic landscape. From a wild landscape of rivers, ecologically sharp by water, monsoon climate and tide of sea, the delta’s landscape started to transform into a hydraulic system of canals, dikes, and sluices. During this time, the water management began to aim principally at drainage and irrigation. The urban growth in this period specifically followed the logic of the canal system. The waterways dominated as a main factor formed the supporting structure of the cities. Cities are situated next to the water of rivers or canals. Rivers and quays formed the most important traffic infrastructure, while the waterways and their higher banks were the main public areas. At the same time, the construction of railway and roadways improved access from the Sai Gon to delta and linked cities with other. The parallel and overlapping multiple networks of waterways and land-based infrastructure were defining spatial quality of delta’s cities [20].

However, canals greatly modified the territory and the distribution of water through delta. Many of the waterways proved to be both economic and ecological disasters such as brought on higher flooding and its embankments cut off exiting water circulation. Canals also led to drying of soils in floodplains that were high in sulfate content. This drying of soil produced acid sulfate that then leached into the waterways and in turn quickly reduced crop productivity [4, 5]. According to Brocheux (1995), in the zone of floating rice, roads built perpendicular to flow of floodwaters toward the Gulf of Thailand blocked water's escape. In the intermediate zone, canals dug parallel to the Mekong impeded drainage. In the tidal zone, newly constructed waterways leading to the sea induced the rapid desiccation of soil following the wet season, which it turn caused alum to rise to the
According to Mekong Delta’s landscape, many programs of public works are built such as national road networks and construction of bridges which transport took place inside as well as outside the delta. The roadway has gradually replaced the waterways as the economic, social and cultural center of the delta. The road vehicles, particularly motorbikes, have replaced boats as the preferred form of transport [12]. These changes are again taken as a conquest of nature. The result was a radial transformation of the landscape, economy and spatial pattern of the urban communities in the delta.

The interest arose for the significance of road network in the delta is remarked in the 1960s, because rapid troop transport and connecting urban centers in countryside was a main strategy to survival. Today, the expansion of road infrastructure was done for various reasons. Alongside the national security it is attempts to strengthen capacity adaptation to a long-term seasonal flood cycle. The flood is probably one of main causes that damage to loss of human life and influence on economic development as well as environment in the delta.

When floods occurred, the road provided a strategic and safe place for human temporary settlement. After the historical flood occurred in 2000, the thousands of length kilometers of road were heightened as a government policy to reduce impacts of frequent floods.

A road network is seen as a further step in ‘opening’ or exploitation of the delta for national economic benefit[26]. The development of land-based infrastructure was source of many changes in relationship of cities as well as their hierarchy. The first phenomenon which concerns this development was construction of new bridges. Cao Lanh province was a fine example. Cao Lanh grew in the 19th century from a small village to a commercial city. For centuries this place was once of the important markets to the river for Dong Thap Muoi (Plain of Reeds) – a huge granary of the delta. At the same time this place was the bustling hub of inter-provincial traffic of Long Xuyen and Sai Gon. The My Thuan Bridge completed in 2000 provided a favorable route from Ho Chi Minh City to Long Xuyen and further Phnom Penh, Cambodia. Cao Lanh became a marginalized city.

In the city itself, sedimentation filled over the canals, which blocked water-based transport and deposited to heighten river islands located in front the city. As the result, the
city was isolated with the main river. The development of land-based infrastructure replaced waterways as a main factor dominated urban pattern. Water was no longer the city’s concern. Road vehicles replaced boats as the form of transport. The urban center moved from water confluence to crossroad. Houses, market, shops and transport service that related with the river banks now follow the roads. By the end of twentieth century, a series of floods occurred from 1990 to 2003 and especially in 2000 required new national policy focused on constructing a system of flood protections. Local government tried to integrate the dikes and road along canals into urban pattern as main strategy to reduce with flood threats. This result has been a fundamental transformation of urban landscape. The new dikes were fences that prevented citizen easily access to the open water. Along these canals, the floating houses were removed and reoriented towards the road.

Figure 7: Transformation of urban pattern in Cao Lanh city

5. URBAN EXPANTION – Cantho City as a Case Study

The Mekong Delta with the Red River Delta is the most populated areas in Vietnam. It is also a dynamic economic and urban growth area. Can Tho is a fine example that illustrated the urbanization process and increasing of the number of dwellers threatened by flooding. Can Tho has a diversified topography, ranging from urban areas at the bank of the Mekong tributary to a mainly agricultural and rural areas with a system of canals to south. Early settlements date back to the 17th century and were developed at the confluence of the Mekong River and the Can Tho River. Because of the middle portions of the Mekong delta created favorable conditions for trade and transportation, Can Tho developed to become a center of the delta for cultural and economic exchanges not only with other provinces in the region but also with the important economic areas in southern Vietnam. Similar to other cities in the Mekong Delta, Can Tho has experienced rapid changes in recent decades. Within the last 30 years, especially after the introduction of economic reforms in the mid 1980s, the city’s population has increased quickly from 180.000 in 1979 to approximately 1.1 million inhabitants in 2006 [6]. Following with increasing population and economic development, urban landscape was completely transformed. Within the last twenty years only, the extent of urban surfaces
has double and many of new urban areas have been developed on low-lying mash land. According to the Spatial Development Master Plan up to 2030 of Can Tho city, the development of city has gradually proved its role and position as a regional center of the Mekong Delta. The city is forecasted to grow significantly. By 2015 the population is expected to rise to 1.5 million and 2.1 million inhabitants in 2030 [19]. In addition to a substantial increase in population density, cities’ rapid growth has resulted in a considerable expansion of urban areas into the adjacent rural areas and the low-lying marshland. Cities are becoming larger and denser. Today, approximately 70 percent of urban area is located less than 1 m above sea level, making it highly vulnerable to projected sea-level rise. During the 1990s, economic liberalization led to the establishment of new planning project relation along highways responded for housing demand. The population growth led to the development of unplanned areas in the inner cities. This population movement promoted a increasing of precarious settlements located on lands sensitive to flooding.

Similar to other traditional cities in the Mekong Delta, Can Tho located along river with a system of dense canals in the inner city. These water systems provided sewage services that rainwater will be able to drain off quickly to large river. These systems were also storm-water storage areas during huge rainfalls that occurred frequently in the delta. Increased population density polluted these urban water systems. As a result, the traditional water systems became unusable because of state of severe disrepair or inhabited by illegal slum dwellers. Many of the inner city waterways became its backside and were seen as causing health problems, which need to be filled and replaced by new underground structures for drainage sewage. According to a survey by the Ministry of Construction, in the historical flood season from July to December 2000, only few low-lying areas in Can Tho was flooded from 30 cm or less; the flood season in 2006, more than 80 percent of city’s area was flooded, somewhere water level rose to 0.5 meter.

![Figure 8: Transformation of urban pattern in Can Tho city.](image-url)
6. CLIMATE CHANGE AND INCREASING FLOOD VULNERABLE

Many cities around the world are facing the challenges of sustainable living and development and are exploring ways to enhance their ability to manage an uncertain future [30]. According to the Intergovernmental Panel on Climate Change (IPCC), the Mekong delta is the most urbanized region in the developing world. As the same time, this delta is a vulnerable area to natural hazards. Due to the existence of an extensive lower reach network of the Mekong river system and the sea along side, the area has been susceptible highly to water related disasters. Climate change could lead the above issues to be even more serious, regarding sea level rise, increase in frequency and intensity of typhoons. The growing threat of climate change, upstream changes in water availability and indiscriminate urban expansion are rising new demands for the new way in which we design our city in order to maintain standards of living and avoid future catastrophes of natural.

The Mekong delta recognizes the importance to integrate climate change and flood risk. Annual floods bring benefit to agriculture and aquaculture; however, they are devastating factors as well. Recently floods have enormously caused damaging the human life, property and infrastructure, especially settlement living on and along the rivers and canals. The trends set for this area show that the number of floods has become much more frequent and their devastating effects are increasing more than in former times.

Flooding may come from both river reaches and sea. Inundation is often found as combinations of storm surges, high tides from the sea and high flow discharge from the river. According to the Vietnam’s Central Committee for Flood and Storm Control, annual flooding season occurs in Mekong River Delta in five months starting from July to November. The water level in inundation area reached 1 to 3 meters. Flooding area in Mekong River Delta is the home for 8.5 million people, of which 17% urban and 83% rural [22]. Another potential source of cause is severe rainfall during and after match of typhoons. The increase in rainfalls is also related to higher river discharges. Water-networks are necessarily not only part of urban fabrics but also for drainage and storage of water during rainstorm. Especially, the big rainfall of more than 100 mm in many hours is common. The conjunction of climate change and urban expansion generate an enormous change in the urban pattern. Urban growing process has resulted in the transformation of land surfaces, making large areas virtually impermeable to rainfall. As a result, in many inner city areas there has been major problem with drainage even though the sewerage system has expanded. Some streets and residential areas with no storm drains at all quickly become small rivers after even modest rainfall [13].
Vietnam’s Mekong River Delta will be further affected if sea level rises due to global warming. Over the past 30 years, sea level in Vietnam has increased 5 cm. Sea level is expected to rise by another 9 cm in 2010, 33 cm in 2050, 45 cm in 2070 and 1 meter in 2100 [18]. Climate change and sea level rise have increased serious impacts of floods in low-lying lands. With a sea level rise (SLR) of 1.0 meter, approximately 20 percent of land areas will be flooded; 10 percent of the population could be directly affected; and economic losses are equivalent to 10% of the GDP. The sea level rise in combination with increased rainfall in the rainy season could have serious impacts on low-lying lands in the coastal zone and otherwise impairing water quality. Twelve provinces in the Mekong River Delta with an area of approximately 12,000 km2 and a population of 4 million people are predicted to be affected [7].

Another problem related to influences of floods is the soil-subsidence. By using high-resolution satellite, there search of Syvitski’s (2009) showed that the Mekong Delta did not receive a significant input of sediment. This lack of sediment can be the attributes to upstream damming and partly the result of past actions. The channels have been fixed in their location with levees to better protect populated areas from flooding. This process reduced the deltaic aggradations because land was not received enough sediment in annual flood. As a result, the Mekong Delta is sinking more rapidly change than rising global sea level.

7. CONCLUSION – Toward a More Sustainable City Adapting with Floods

The Mekong delta in Vietnam is a unique water-landscape, which is a result of the mutual, parallel and complex relationships between two factors: earth and water. This relationship made the Mekong delta a distinctive case in which the regional policy to reclaim by combining water-management strategies with national economic and infrastructure strategies transformed a natural landscape into a human-regulated environment. Especially during the 19th and 20th century, the canalization process and hydraulic management desirable as a crucial role to control nature and to concern economic development, urbanization and society-building. The deltaic urban patterns clearly reflect decision-making period of past and attest the strategy to survival from flood as well as adapt to the changing environment.

The climate-change is considered as the major driver for increased flood risk during last decades. From the perspective of flooding, concerns for indiscriminate urban expansion forces politicians, planners and engineers to look for new approaches. There is necessary to seek innovative strategies that diminish the impact of urban sprawl on the natural
landscape. The existing relationship between specific canal, road network, urbanization and protection of low-land should be changed into strong collaborations. There is need for more sustainable and less vulnerable form of urban development that addressing flooding in combinations between hydraulic engineering, urban planning and environmental qualities. The proposed strategy in planning and designing urbanized delta need to create new balances between economic activities, ecological protections and communistically benefits in all of local, regional and international scales.

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