Spatial Planning in Flood-prone Areas

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Abstract

The main aims of this study are to achieve a better knowledge of the flood-prone area challenges and possible measures for flood risk reduction scheme based on an interpretive research study of case studies through three phases. The first examined Can Tho City as a case study to identify processes as flood driving forces associated with natural and anthropogenic characteristics. The next phase was conducted by the expert in-depth interview to evaluate the responses to flood-related issues in chosen cities (Can Tho and Ho Chi Minh Cities) and to reveal current approaches of the management patterns embedded national and international policy schemes. The last used comparative research method to collect primary reflections through France and Germany flood mitigation scheme; and the European policy on flood risk management as well as international cooperation mechanism. The content analysis method was used to answer the research questions.

The study recognized some significant findings. First, both natural and anthropogenic groups of flood driving forces are on developing processes contributing negative impacts; and in combination, these exacerbate flood vulnerability. Second, the assessment on study sites frames the failures of authority's responses regarding the current approach, constraints towards non-structural measure implementation, poor land use planning in flood risk contexts, and insufficient strategy on river basin as well as trans-boundary management. Third, European practices on spatial planning performed as the appropriate land use planning providing guidelines for adjusted directions of flood risk reduction policies in Vietnam context, primarily regulating on protecting existing and new development on flood-prone area use.

Keywords: Flood risk management, Spatial planning, Land use planning, Flood-prone areas, Flood mitigation.

Zusammenfassung

Mit der vorliegenden Arbeit werden am Beispiel von Vietnam und der Stadt Can Tho die Prozesse analysiert, die zur Hochwassergefährdung von Städten beitragen. Hierbei werden die derzeit in Vietnam genutzten öffentlichen Maßnahmen bewertet und mit der Vorgehensweise in Europa exemplarisch verglichen. Die Stadt Can Tho, im Mekong-Delta gelegen, wurde aufgrund ihres städtebaulichen Wachstums und der besonderen Betroffenheit durch regelmäßige Hochwasserereignisse ausgewählt. Deshalb wurden zunächst die wichtigsten Hochwasserfaktoren identifiziert, unterteilt nach natürlichen und durch den Urbanisierungsprozess verursachten. Um einen vertieften Einblick in die derzeit genutzten raumplanerischen und sonstigen Maßnahmen zur Reduzierung von Hochwasserereignissen bzw. zur Vermeidung von Hochwasserschäden zu gewinnen, wurden Interviews mit vietnamesischen Experten aus Forschung und öffentlicher Verwaltung durchgeführt. Die hierbei erzielten Erkenntnisse wurden mit den Ergebnissen einer Analyse der raumplanerischen und sonstigen Maßnahmen zur Hochwasservermeidung und Schadensminderung in Deutschland und Frankreich, am Beispiel des Rheins, abgeglichen. Hieraus werden Rückschlüsse zu einer Anpassung der Raumplanung in Vietnam und einer Kooperation mit den Anrainerstaaten entlang des Mekong gezogen.

Die Arbeit zeigt einige signifikante Erkenntnisse. So wird die Hochwasseranfälligkeit sowohl durch natürliche als auch anthropogene Entwicklungen erhöht, wobei sich diese in Kombination beider verschärft. Die bisher ergriffenen öffentlichen Maßnahmen zeigen, dass sowohl bauliche Maßnahmen wie auch die Raumplanung nicht in der Lage sind, das Hochwasserrisiko signifikant zu reduzieren. Ebenso fehlt ein grenzüberschreitendes Flussgebietsmanagement. Aus den Erfahrungen der Umsetzung der europäischen Raumordnungsansätze am Beispiel des Rheins können abschließend raumplanerische Leitlinien zur Verringerung des Hochwasserrisikos in Vietnam bzw. im Flusseinzugsgebiet des Mekong abgeleitet werden.

Schlüsselwörter: Hochwasserschutzmanagement, Raumplanung, Bodennutzungsplanung, Überschwemmungsbereiche, Minimierung der Auswirkungen von Hochwasserereignissen.

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ACRONYMS/GLOSSARY OF TERMS

ADPC	Asian Disaster Preparedness Center
ADRC	Asian Disaster Reduction Center
APFM	Associated Programme on Flood Management
BMZ	Federal Ministry for Economic Cooperation and Development
CEC	Commission of the European Communities
CEMAT	Council of European Conference of Ministers responsible for Spatial/Regional planning
CLG	Department for Communities and Local Government
CTCPC	People's Committee of Can Tho City
DEFRA, & EA	The Department for Environment, Food and Rural Affairs, & Environment Agency
DGPR	General Directorate for Risk Prevention
DKKV	German Committee for Disaster Reduction
EEA	European Environment Agency
EU	the European Union
FLOODsite	an Integrated Project in the Global Change and Eco-systems Sub-Priority, co-funded by the European Community
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (The German Development Cooperation)
GAR	Global assessment report on disaster risk reduction
GSO	General Statistics Office of Vietnam
IPCC	The Intergovernmental Panel on Climate Change
I.C.E	The Institution of Civil Engineer
ICPR	International Commission for the protection of the Rhine
LAWA	German working group on water issues of the Federal States and the Federal Government
MESDE	Ministry of Ecology, Sustainable Development, and Energy
MESDTH	Ministry of Ecology, Sustainable Development, Transport, and Housing
MoNRE	Ministry of Natural Resources and Environment
RIZA	Institute for Inland Water Management and Waste Water Treatment
SIWRP	Southern Institute of water resources planning
SRV	Socialist Republic of Vietnam
UBA	Umwelt Bundes Amt (Federal Environment Agency)
UFCOP	Urban Floods Community of Practice
UN	United Nations
UNDP	United Nations Development Programme
US$	the United States dollar
UNISDR	The United Nations Office for Disaster Risk Reduction
UNECE	The United Nations Economic Commission for Europe
WB	World Bank
WMO	The World Meteorological Organization

CHAPTER 1. INTRODUCTION

1.1 An introduction of problematic issues on flood risk

Development in riverine areas has had long-term significance in nations worldwide because it provides necessary conditions for economic activities; however, economic growth attracts more risks, especially riverine floods. It could be a severe problem when flood impacts influence on receiving objects regarding physic, economic, and environmental.

Flood risk exists when people decide to settle in a field, a floodplain known as taking advantage of people living. The land encroachment can be claimed as the main fundamental attempt giving people into flood risk, or risk has been built and developed mainly based on a floodplain or flood-prone area occupancies (DKKV, 2004, pp.16). The areas are occupied due to advantages support of accessibility and beneficial aspects; then, the progress has evolved and strengthened (Waananen, A. O. et al., 1977). Also, flood impacts exacerbated by people exploiting the use of floodplains.

Natural exploitation is an option to increase development momentum in the long-term development plan. Riverine areas contain valuable conditions for economic activities, and these are continuing with urbanization and globalization process, the consequences of these processes could be predicted and observed via the increase and development of the environmental crisis.

Flood risk took a critical part of the natural disaster, with the increasing damage trend during the last decade on a global scale (IPCC, 2012). The affected people in 2011 by extreme flood counted to 106 million, and flooding is the primary cause of billions of dollars on reported damage worldwide (GIZ, 2014; Hessel et al., 2015). Vietnam is also affected by many natural hazards, including riparian flooding, due to a large number of people living in low-lying delta (Bangalore et al., 2016).

Vietnam witnessed severe flood damage. As a transitional country, the flood damage threatens not only annual mortality and the public healthcare system but also economic growth by enormous combined financial losses (Figure 1). According to UNISDR(a) (2015) (Global Assessment Report on Disaster Risk Reduction), National flood losses from 1990 to 2014 in the death toll accounted for 68.8% and the proportion of combined economic losses at 64.6% according to flooding. From the hazard contribution to average annual loss view, the significant financial losses were generated by 96.6% by floods (appropriate 2,295.39 million US$) on average yearly loss (UNISDR (a), 2015; pp. 2). A natural disaster as a flood must be considered as a direct threat with severe consequences that harms social security, sustainable development, and especially the poor (Nguyen Huu Ninh, 2007).

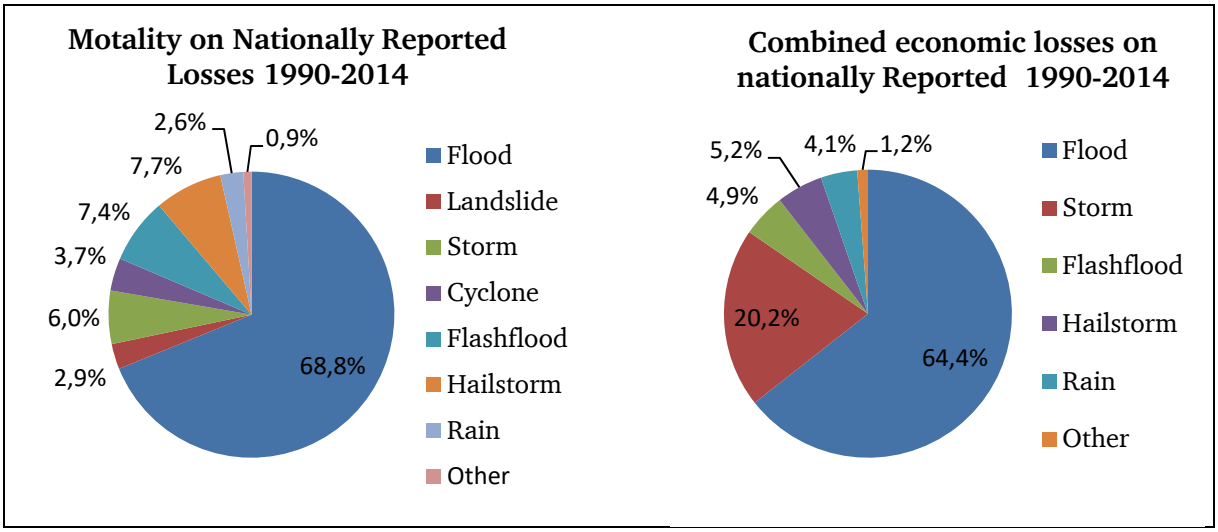


Figure 1 Major flood damage in the natural disaster losses in Vietnam 1990-2014
(Source: adapted from GAR, 2015)

Flood risk management widely recognized being a process of decision-making to reduce flood damage. According to Hall et al. (2011), this process runs under uncertainty and involves the implementation of flood risk management plans, strategies, and measures. Schanze (2006) presented flood risk management as a continuous process of analysis, assessment to reduce flood risk. More details, flood risk management was defined as a process of information gathering, assessment, suggesting options, and making decisions aiming to decrease risks of flooding' (Hall et al., 2003a). Flood risk management acted as intervention implemented by the government via appropriate measures to reduce flood risk.

Traditionally, government interventions support the protection of floodplain with different degrees of protection. Flood risk management practices have concentrated control predominantly by the technical measure used to reduce the probability of flooding (Newman et al., 2011). This trend increased and developed due to measure's advantage promotion in the short-term or particular situation, i. e. the introduction of flood defense systems such as dikes or drainage systems creating safe and protected in the community. The responses on flood-prone areas influenced flood charging magnitude; thus, these interfere changing the areas' physical characteristics results in substantial damage to properties and threatens human life (Waananen, A. O. et al. 1977). The recent flood risk management strategy witnessed the full range of direct government intervention to protect people and development, with the motto of 'stay away from the flood' on a global scale, but development attracts land encroachment and results in more damage when a flood strikes.

Intervention by measures may keep flood-prone areas safe from flood risk, however examining into factors triggering flood event could find an appropriate approach in flood risk management schemes to minimize flood consequences. Flood driving forces were defined as "processes that change the state of flooding system" (DEFRA and EA, 2006) or "factors contributing to flood risk or flood determinants" (APFM, 2008). The physical measure applied to flood risk management schemes addressed economic aspects, regardless of a social movement, and environmental reactions and disadvantages showed on efforts implementing structural measures in a flood zone. An investigation into main flood driving forces forming flood risk may correct fundamental basement on decision progress.

Precise knowledge of flood risk systems may contribute to flood risk management strategy; nevertheless, the process contributing to risk rarely integrated into flood risk management plans or strategies. There are little efforts on examination on processes to construct flood risk's components increasing flood risk damage (which enhancing flood vulnerability in flood-prone areas). The study on these flood driving forces as the processes

influencing flooding systems may promote explicit knowledge of understanding the constructs of flood risk components and are intended to serve as a useful tool to the decision-making process to implement appropriate measures in flood-prone areas.

It was recognizable that flooding response is a subject undertaken by the responsible authorities, and the policy scheme plays a significant role in activities involved in flood risk management schemes. Vietnamese flood risk management policy addressed the law on natural disasters and control that employing structural and non-structural measures. These responses cover long-term objective achievement, natural disaster prevention's contents, and trans-boundary flood-related issues; nevertheless, flood risk management schemes witnessed the predominance of technical measure implementation. This situation implies a need for more knowledge to represent flood risk management in current conditions and associated policy performance. By finding drawbacks and shortcomings from policy reactions to these circumstances enable improving flood situation in flood-prone areas.

Many countries threatened by flood risk and specially challenged with flood-related issues in a shared river basin. Flooding causes physical, financial, and environmental problems; thus, this issue calls for actions in both national flood risk management activities and trans-boundary commitments within countries. Both in France and Germany, long-term efforts on spatial planning have been made for flood mitigation through the movement of national responses on planning and policy measures. Both countries are located in the Rhine river basin, as a major river basin of the European Union, and challenged by trans-boundary flood-related issues. Recognized as international concerns, flood risk issues in trans-boundary regions approached by enhancing international cooperation regime in the EU policy schemes. These practices within the European Union Member states, as well as a policy framework for trans-boundary flood-related issues, bring reflections that can contribute to Vietnam riparian cities adapting and reducing flood risk damage.

1.2 Research aims and questions

This research has studied what extent challenged and how spatial planning applied in flood-prone areas in the manner of long-term and sustainable development. Flood risk or flood-related issues have become significant problems, with catastrophic consequences recorded in riparian areas. Pressure on flood risk management is higher than ever before due to the risk is on the increasing potential.

This research concentrates on a variety of aims. The first aim is to examine the main flood driving forces in the riparian areas where are in the high-risk of flooding. These forces contribute to form flood vulnerable in riparian regions. The second aim is to identify the current approach in flood risk management schemes in a specific area by assessing the measure implementation on national as well as trans-boundary flood-related issues. The last is to provide European patterns revealing the factors shaping flood risk management practices reflected in spatial planning schemes. The research aims to inspire the following research questions to lead the literature review and analysis: ***What are the challenges of spatial planning in flood-prone areas? And which measures can be used to deal with flood risk reduction and other flood-related issues in flood-prone areas?***

Can Tho City and Ho Chi Minh City are riparian places selected as typical flood-prone areas to examine the research questions.

1.3 Research approach

1.3.1 Research methodology: a combination of research methods and critical reflections to interpret context-specific subject matters

This research has been structured into different phases that show several findings to approach its subject matters. These approaches discovered current, and future development patterns of flood-induced forces in a flood-prone area through a case study evaluated the motive of measures utilization by interpreting the experts' interviews, and then examined good practices to cope with extreme flooding and flood-related issues through comparative study. Case research supported the evidence and understanding of the general view of the

main driving forces as risk components, forming flood risk in Can Tho City (Phase 1). The experts' interview data revealed the main measures approaching flood risk reduction of the Vietnamese government's arrangement (Phase 2). And, the comparative work's reflections explored the fundamental methods of the European Union member countries to deal with flood risk through French and German spatial planning measures and policy frameworks (Phase 3).

The variety of techniques has been designed subsequently to each other through phases, with differential data collecting method of the interpretive research methodology. During study phases, the real subject matters have emerged; therefore, reflexing the knowledge in which addressed the context-specific consideration: flood risk management in flooding-high potential areas. Each period has been structured and developed with a particular research method to achieve such setting goals. The research method on every stage, thus, is different from each other. Figure 2 shows the conceptual linkages, and Figure 3 indicates the whole study process, and the study methods have been described in more detail in the following.

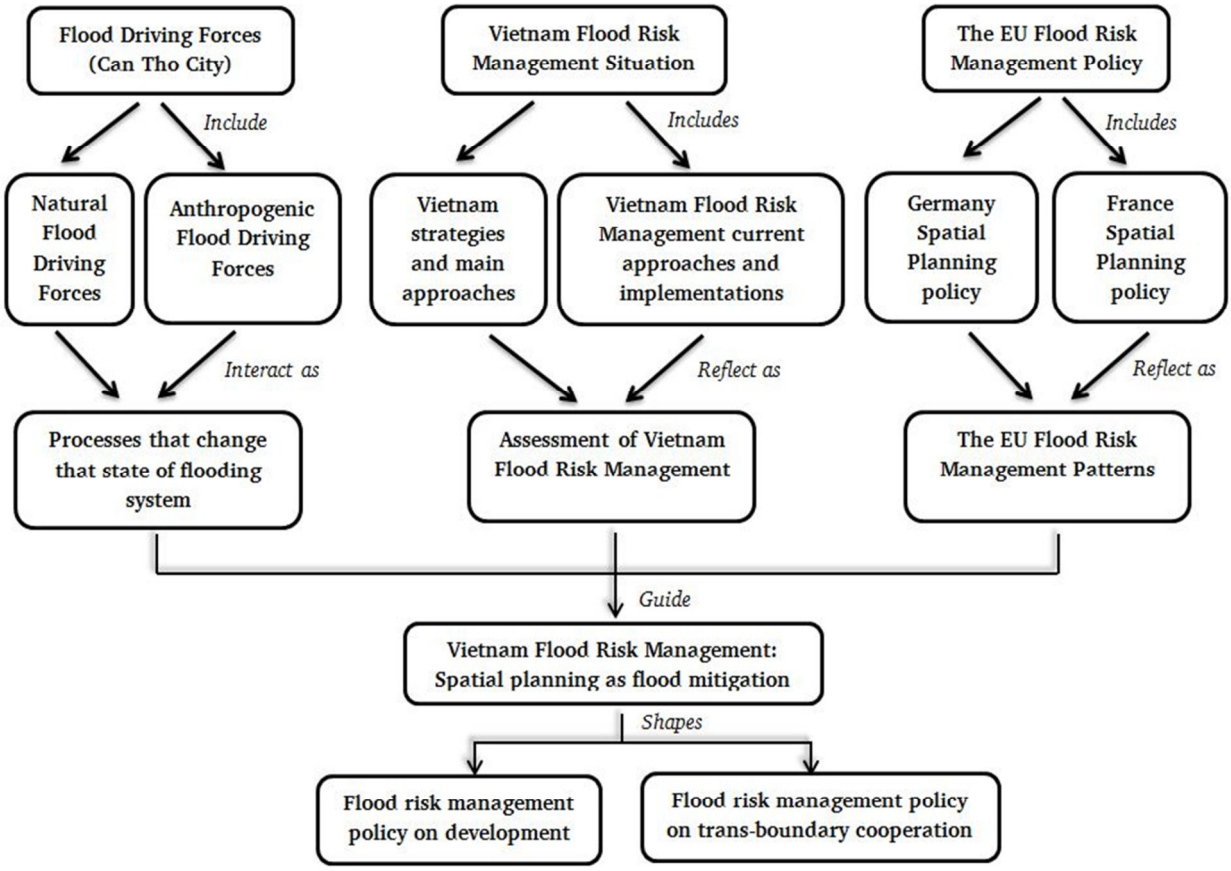


Figure 2 Conceptual linkages between flood driving forces, flood risk management assessment and reflected patterns to shape spatial planning policy in flood-prone areas

I. RESEARCH DESIGN

Research problem: processes induce flood risk's components, current responses, and good practices' reflections linked to implementation of appropriate flood mitigation measures in flood prone areas.
Research focus: flood risk management policy, spatial planning applied in flood-prone areas, flood driving forces contributing to flood vulnerability, the current approach implemented on national and trans-boundary flood-related issues, good practices' reflections shaped via the European spatial planning scheme.

Research questions: What are the challenges of spatial planning? And which measures can be used to deal with flood risk reduction and other flood-related issues in flood-prone areas?

- To what extent do flood driving forces induce flood vulnerability in a flood-prone area?
  - Which driving forces do contribute to flooding risk component, in the manner of increasing flood vulnerability?
  - How these driving forces did form and may increase flood damage potential regarding people and assets?
- What are the significant measures that shape specific flood risk responses? How can land use planning be involved in the current flood risk management framework? And how can trans-national flood-related issues be addressed in international river basin institutions?
- To what extent of flood mitigation strategy was the cross-national comparison of the flood risk management issues through France and Germany cases reflected?
  - Which and how factors do contribute to strategies' efficiency within nations in general and identify deficiencies in details of the decision-making process?
  - What is the theoretical background for increasing cooperation in the cross-national regions in the view of flooding mitigation?

II. THEORETICAL FRAMEWORK

Literature review and relevant document examination
- Flood risk management: concepts, components, and governance.
- Integrated flood risk management: from traditional measures to an integrated approach.
- Spatial planning and flood-related issues.
- Spatial planning in Flood risk management context.
- Land use planning in the integrated flood risk management context.

III. CASE STUDY

Can Tho City

Flood risk components ⟷ Literature review
Natural flood driving force group ⟷ document data examination
Anthropological driving force group

IV. EXPERT IN-DEPTH INTERVIEW

Case study, Ho Chi Minh City - Can Tho City

Integrated flood risk management approach ⟷ Literature and policy review
Land Use Planning approach ⟷ International initiative examination
River basin and trans-boundary flood-related issues ⟷ Expert In-depth interview

V. COMPARATIVE ANALYSIS

Case study, Germany France spatial planning policy

Spatial planning in the EU context of flood risk management ⟷ Literature review
France-German planning system ⟷ Comparative analysis
National and trans-boundary flood risk management

VI. CONCLUSIONS

Flood driving forces, evaluation on policy scheme for flood risk deduction, spatial planning applied to flood-prone areas
- The high trend of growth of existing flood driving forces, including natural and human-made groups.
- Problematic issues on the current approaches in flood risk management schemes.
- Evaluation of responses and impacts of legislative framework change in the Vietnam flood risk management
- Flood risk management policy via reflections of the European flood risk management practices: restating the spatial planning role, adjusted policy as spatial planning applied to flood-prone areas (regulating on protecting existing development and regulating on flood-prone area use).

VII. RECOMMENDATIONS ON POLICY ADJUSTMENT

Recommendations for policy adjustment towards flood mitigation and trans-boundary flood-related issues
- Regulating on protecting existing development, flood early warning system, floodproofing.
- Regulating on flood-prone area use, zoning, plat regulations, structure control regulations, strengthening trans-boundary cooperation in the river basin scale.

Figure 3 An overview of the study process

1.3.2 First phase research approach: A case study

1.3.2.1 Data collecting method

Case research is used in an interpretive manner to examine the study inquiry via documentation. This part was designed as document data collecting or desk research, concentrating on flood risk component investigation to examine main flood driving forces in a specific riparian area as a study site. The technique promotes using relevant data to explore a new thesis as in which flood determinants influence to flood system in the giving context. The selected study site was Can Tho City, which has been known as the hotspot of development as well as the economic hub within the region. Under the pressure of socio-economic development, the government issued the policy adjustment through physical interventions as well as setting a development strategy. Nevertheless, the city was being threatened by severe flood damage and high flood vulnerability. The flood reasons have been claimed for the annual flood damage, and the severe consequences from flood risk have been predicted in the study site, especially on the threat of uncertainty progress of extreme weather events.

The process is set by data investigation undertaking through available data preparation as selecting sets of texts from the population of texts. The central philosophy is to systemize the study of relevant data and information; these outcomes were contextualized that constitute evidence in responding to research inquiry. The method mainly based on using already assembled or existing databases and official archives; the process has been conducted through two main stages.

The first stage includes data resource preparation and collection. The main concentration in this stage is searching, examining, and collecting relevant documents and disciplines, regarding data searching criteria by setting context inclusively. The related data has been identified and then filtered through setting standards for the proper theme to fit the research inquiry. A range of sources ranging across the various relevant disciplines has been gathered and collected cautiously, with the priorities of validity data seeking out. This progress headed to prepare the facts that addressed closely enough to the study inquisition, based on controlling the collection process, importantly regarded data resources and contextualization.

Data has determined in which selected associated with the study inquiry; hence, data sources carefully were separated to ensure a fitting research theme and data validity. The collected documents included published articles, relevant books, official government statistics, legal documents (legislation, regulations, directives, etc.,), archived reports in government agencies (planning, water, etc.), plans and visions (strategic plans) and statistical databases, published concerning research's results, etc. These written materials must be accessed with ensuring data validity, fitting to study inquiry and data collection control.

The supposed information for analysis is the prepared data that contextualized to address the research theme's evidence. The contextualized data helped to gather the validity data and available knowledge that associated with the study and ensuring these written materials have been built to answer the study question through a different angle on the data. The input data which selected from the available and appropriate sources examined with criteria; in the process, the inclusion criteria were: all official published or archived documents expanding the flood vulnerability within study site or existing data containing factors worsening the flood susceptibility in the area. Dataset was excluded from the study if they had one of these conditions: political pressure on published contents, selective reporting contents, and unauthorized disclosures. All selected data was then transferred to the supposed information to construct the fact's evidence for the study. The contextualized process, therefore, turned data into relevant information to provide and contribute to study inquiry by interpreting the data resource to be information in which reflects better understanding.

The second stage was a data content analysis to execute what is measured and why. This stage examined and identified in the texts the extent to which factors accelerated and worsened specific facts in the selected study area. The analysis took the contextualized data to draw information proposition and then related them to central issues. Therefore, the proposed

information has presented as evidence constituted to respond to research inquiry through the process of how data was defined, collected, and compiled.

The analysis took the appropriate data from official issues from local and higher-level governments; also, recent descriptions and findings may describe the increasing trends of flood vulnerability in the study site. The analysis's description linked and related proposed information to what extents in which accelerate flood risk component growth in times.

Within the process, the data has been chosen and measured for linking the relationship between main flood risk driving forces and the flood vulnerability situation in the study site; focusing on main driving forces within an area, therefore, may touch the variety of social facts as well as associated relevant these facts' properties. These properties are varying, from official statistics to scenario predictions as well as independent research propositions. All relevant evidence constructing the relation to the inquiry examined from a broad range of data sources.

1.3.2.2 Data analysis

In this study, the primary outcome was determined as main flood drivers increasing people and assets vulnerable within the study site, namely, flood driving forces. Driving forces were defined as (1) performance possibly increasing exposure level to flood risk; (2) motivation on increasing flood damage potential. The production should be noted that in the study scale, driving forces concentrated on socio-economic and political potential factors.

All data was carried out according to the established analysis framework. The framework helps to achieve the study setting outcomes by drawing on insights of facts the proposed information for the study questions. The fundamental research question is: ***"To what extent do flood driving forces induce flood vulnerability in a flood-prone area?"***

The following sub-questions are derived from the central study inquiry to guide the research:

Question 1: Which driving forces do contribute to flooding risk component, in the manner of increasing flood vulnerability?

Question 2: How these driving forces did form and may increase flood damage potential regarding people and assets?

The analysis criteria are developed with associated directions of the case study's investigation (Table 1). Each standard is detailed and has validated by observation of the study site as well as the examination of a relevant data resource that is available and accessible to serve the investigation process.

No	Examining direction	Direction's description
1	Natural constitutions	• Existing and potential properties caused increasing flood vulnerability; and • Characteristics constitute the decrease of flooding and inundation resistance, potentially on growth.
2	Non-climatic establishments and management	• Existing and potential mechanism changing the current states of development facts, being prone to flood vulnerable; • On a stream of development policies or regulations affecting flood vulnerability and susceptible capacity; • The potential growth of people and assets loss caused by establishments and management; and • The potential for damage is prone to increasing flood vulnerability caused by interventions.

Table 1 The main directions of investigation based on study criteria

1.3.2.3 Study Procedure

Data resource content analysis was conducted as the primary approach applied for the first phase, addressing paths of study investigation. This study examination was based on preparing and collecting relevant data sets, and then the available and accessible data has been gathered collectively with a concentration on actual and potential facts in the selected study site. The official development decisions and plans used as the reference resources; however, part of the research data obtained by other research findings and suggestions. The gathered data then was transformed into information by contextualization with appropriate criteria to draw to insight existing flood situations and trends.

The proposed information was collected to construct the proofs that confirm the study inquiry. The examining criteria have set in the analysis framework were the main investigated direction-base. The analysis outcomes were a combination of driving forces associated with flood vulnerability in the study site; the drivers classified into two groups, namely as natural and non-climatic driving forces. Critical reflections have constructed to the study inquiry assessment through flood vulnerable driving forces as study evidence.

1.3.3 Second phase research approach: An expert in-depth interview

The second phase of the study develops an analytical framework to obtain empirical evidence by gathering non-numerical information via expert viewpoints. Data collected by an expert in-depth interview method is suitable for the subjects that experts are familiar with, and hence, the informants' opinions are credible (Bhattacherjee, A. 2012). This method is assigned aiming to assess the current instruments developed by official authority and other relevant through setting analysis criteria. The process, then, is designed and conducted mainly through an in-depth expert or semi-structured interview investigation — the method selected due to allowing the interviewer an opportunity to probe issues in a more detailed discussion based on the review criteria in the previous step.

This expert sampling method also assures the chance to explore setting themes or further responses via a set of open questions. These in-depth, semi-structured interviews that supported by the informants did not limit the consideration of receiving the related information in the context of interviewee experiences and viewpoints. Overall, ten interviews were conducted across the two cities directly involved in flood risk management schemes, policies, and initiatives concentrating on examining themes towards selected case study sites.

The policy implementation and response in practice is the right approach to identify the measure applying assessment and possibly alternating tools to adapt to the situation. The policy performs as a dynamic range and requires sufficient descriptions of the planning process to achieve adequate adjustment and amendment in the principle of less affected to the long-term objectives.

1.3.3.1 Data collecting method

In light of situation evaluation, the essential methodological questions for this phase are: ***What are the significant measures that shape specific flood risk responses? How can land use planning be involved in the current flood risk management framework? And how can trans-national flood-related issues be addressed in international river basin institutions?***

Pursuing the contemporary situation assessment and potential finding, the setting themes of in-depth interview process synchronized via five main fields of core contents (Table 2) from the previous literary review on relevant schemes. The related topics have transferred through 6 open interview questions to provide precisely crucial points and to allow informants to extend or clarify these key points.

Themes	Themes' key points
1	Currently employing measures on the Vietnam flood risk management theme.
2	Applied non-structural measures on the Vietnam flood risk management theme.
3	Land Use Planning may be a useful measure of flood risk management and its roles in flood-prone areas.
4	The role of river basin management on flood risk management.
5	Trans-national policy issues on flood risk management theme.

Table 2 Integrated main points in five themes of the interview's contents

Ten participants are selected based on the relevant profiles regarding their expertise. These experts, who work in the policy-making environment, are the priority for viewpoint collecting and then following the researchers as well as an environmental sector – involving experts. Urban Development Policymakers excluded because of their conditions that may influence data. The interviewees were eligible if they had a long-time experience with appropriate risk management expertise, with policy instrument employment as a priority. Then, the environmental experts, as researchers and academic lecturers, were taken into account. All informants were sent the interview's questions before interview processing and recorded. Interviewees issued written consent and could withdraw from the study at any time without giving appropriate reasons. The interview setting was in Ho Chi Minh and Can Tho cities, Vietnam.

1.3.3.2 Data processing and analysis

The conceptual framework for analysis ensures the true reflection by collecting and analyzing the expert's viewpoint through knowledge concerning flood risk management policies within two most developed cities as well as on the threat of flood risk from the development pressures. The same general social-economy mechanism through two cities make the excellent case studies to explain the form of policy on flood risk theme and reflect the potential adjustment to adapt with a circumstance shortly in the context of natural disaster uncertainties in the long run.

The analysis is conducted based on the research approach's criteria. These criteria were established to qualify and evaluate the differences of the setting concerned research themes and from the process of reviewing relevant legal documents, involving policies from the currently Vietnamese guidelines on management actions (Table 3).

No	Analysis Criteria	Indicators of expected assessment
1	Priority measure applications and their roles in the National legal framework, planning plans, and practices	• Structural and non-structural measures: - Roles - The reason for implementations - Situation of Implementation - Trend of development - Trend of alternatives
2	An integrated approach addressed non-structural measures in the legal framework and practices	
3	River basin issue on flood risk management theme	• Roles in flood risk management theme • Trend as an alternative
4	Trans-boundary flood risk management issue	• Requirements and potential applications for the long-term on flood risk management.
5	Land Use Planning roles in riparian areas	• Situations and potentials of the basin approach • The contemporary situations • Current approaches to legal framework and practices
6	Land Use Planning as a comprehensive tool, supports flood risk management	

Table 3 The setting analysis criteria (with the expected assessment)

The interview questions will be arranged to reflex these criteria; therefore, items that prompt discussion can provide detailed answers rather than shortly descriptive viewpoints. The questions were designed to cover the themes' key points through dimensions of approaches (Based on analysis criteria setting), with the pre-determined and open characteristics. These allowed interviewees to discuss and approached issues might not have considered. Interview questions include:

Interview question 1: *What are the current approaches towards flood risk management in urban areas from the government policy theme?*

Interview question 2: *The combination of structural and non-structural measures is the standard choice in flood risk management themes to deal with increasing flood damage trends. In the case of Vietnam, should the next phase of flood risk management strategy be steered to non-structural measure applying? If yes, what have non-structural measures applied in Vietnam cities? Which ones have employed in large urban areas in detail?*

Interview question 3: *The riparian urban areas affected by the urbanization process, land used planning has employed as a sustainable development tool in the context of flood risk management forwarding to reducing potential flood damage in the next recent years? If so, what are the real reasons for the land use planning role in the Vietnam planning theme?*

Interview question 4: *In the riparian urban areas, what are the roles of river basin management in the flood risk management theme? What are the central policies or execution steps in this field?*

Interview question 5: *In riparian areas, what are the contributions of trans-regional or trans-boundary flood risk management policies? What is the legal framework in current Vietnam circumstances in the trans-regional or trans-boundary areas to manage water resources in general and to reduce flood risk damage in detail?*

Interview question 6: *What are the roles of land use planning in the flood risk management theme focusing on riparian urban areas?*

All transcript data was carried out according to an established analysis plan — the collective responses classified according to a single question. The consensus on key points on

each matter is the fundamental base to form the critical reasoning for each setting criterion. The degree of response from interviewees in the dimensions of approaches was considered; and then may explain the setting situation as well as the potential of policy development on flood risk management theme.

1.3.3.3 Interview procedure

The interview process has been implemented on personal appointments, with the manner of open question inquiry. The informant answered question by question with discussions, the data then collected by writing (to keep tracks with informant viewpoints) and recorded — this procedure achieved on effort concentrating on crucial points and sufficient data collecting.

The recorded Vietnamese interview data through interview days have been collected in the interview's venue and stored digitally, and then was translated into an interview transcript by English. During the interview period, the discussions took place in an attempt to focus on the content vital points, preventing irrelevant data that affects the interview mainstream. Interview transcript data then collected under the same analysis criteria; later issued the findings by express the synchronized critical reasoning.

1.3.4 Third phase research approach: Comparative analysis

1.3.4.1 Overview of method and critical reflection on comparative analysis

The advantages of cross-national comparative research are reflections of the finding knowledge to understand processes and social patterns in given countries (Berting, J. et al., 1979; Breuillard, M. and Fraser, C., 2007, pp.3). Many problems and difficulties have been presented due to confusions on terminology, incompatibility of structures, cultural non-equivalence, etc., however, three research goals could be identified in comparative analysis methodology in the planning system: i) the theory's advancement; ii) the improvement of practices; and iii) the planning systems' harmonization (Faludi and Hamnett, 1975; Breuillard, M. and Fraser, C., 2007, pp.2).

The primary objective is to examine the main research question: "***To what extent of flood mitigation strategy was the cross-national comparison of the flood risk management issues through France and Germany cases reflected?***" The literature review and analysis, therefore, has been guided to following sub- research questions:

Question 1: Which and how factors do contribute to strategies' advantages within nations in general and do identify disadvantages in details of the decision-making process?

Question 2: What is the theoretical background for increasing cooperation in the cross-national regions in the view of flooding mitigation?

This research will review flooding situation in the state-of-the-art; and compare the context of the strategy of flood risk management, focusing on flood mitigation in medium and long terms and evaluating the national as well as the cooperation policies in the trans-boundary regions.

1.3.4.2 Data collecting and comparative analysis

The primary data supporting this analysis is collected through documentation to examine further insight into analysis inquiry. Collected data is selected from a variety of sources, ranging from several reviews from the past and current researches that related to flood policies from governments or official reports issued from the central governments and local authorities. The following data sources provided by the recent findings focusing on flood risk management researches; on relevant experts' viewpoints as well as on scientific magazines and books in the field of flood mitigations. Notably, the main concentration spotted to projects' reports or good practices' experiences.

Answering the first research questions requires a demonstration from the national flood risk management strategy. Further, the discussion into the development of the criteria for comparing the legal and institutional framework and the process of flood risk strategy establishment as well as the implementation is the requirement of comparative analysis. The first research question, therefore, is the investigation into vast available and well- documented data from projects or good practices within two nations. The primary objective of this process is to put the research matters into many critical perspectives and reflect the characteristics and the most differential aspects from both sides.

The latter question required a full range of observations as well as available resources from the general approach. The reference point for this part of the comparative analysis is from the general framework of the European Union on the assessment and management of flood risk. Although the setting European context on flood risk management is the backbone of flood risk management for the whole region of Europe, the adaptation from the Member States' policies is the main factor reflecting the efficiency of the European's endeavor to reduce the risk's consequences. Therefore, the inquiry into detail of programs in terms of flood risk assessment and management framework could contribute knowledge of principles and indicators for international co-operation.

Comparing and contrasting from the framework and legal background in both systems to answer the two main research questions are based on the developed evaluation approach. The analysis, therefore, established the standard evaluated criteria in both modes:

(1) The legal and institutional framework of flood and flood-related management issues;
(2) National strategy for flood mitigation progress; and
(3) International cooperation process in the trans-boundary regions in the light of the European framework on flood risk management.

1.4 Structure of the dissertation

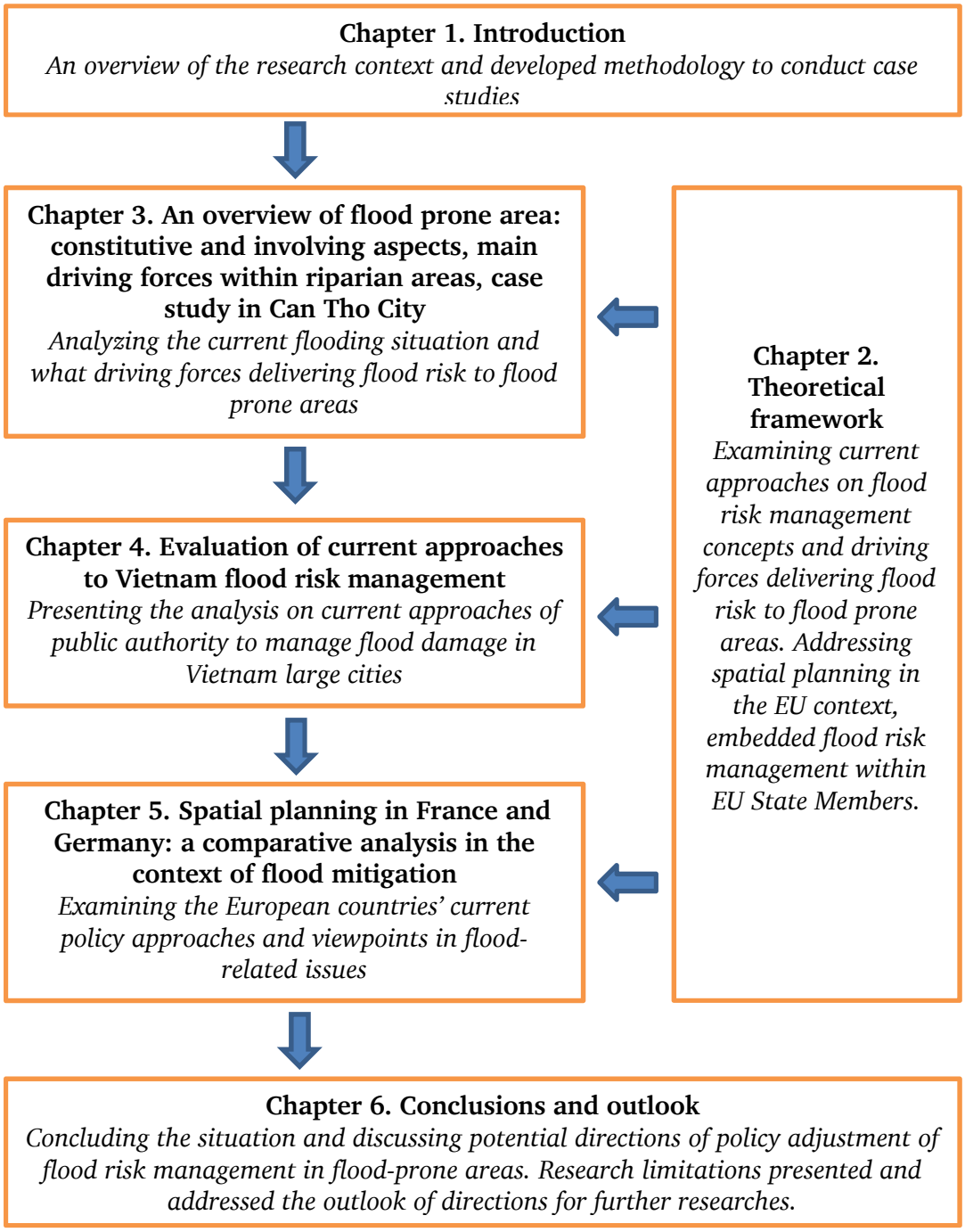


Figure 4 The structure of the dissertation with each chapter addressing the research stage

The dissertation has been divided and encompassed six chapters (Figure 4). **Chapter 1** frames the introduction is covering an overview of the research context and developed methodology conducting case studies.

The body part (Chapters 2-5) consists of the in-line arrangements of the flood risk issue: how spatial planning is a useful measure to deal with flood risk in the flood-prone area. The left-hand side examines the research's main questions through case studies, while the right-hand side supports the theoretical base forming original contexts in conducted case studies.

Chapter 2 covers and explores the fundamental flood risk concept and approaches to reduce the flood's damage regarding integrated flood risk management. Also, this part

introduces spatial planning in the European context as a useful measure of coping with flood-related issues within the Member States and other border-shared countries.

Chapter 3 describes mainly the case study of Can Tho City. It defines main driving forces inducing the area into high-rated flood risk in which catastrophic damage analyzed in the past, current, and future development. From the flood risk concepts, the approach of flood risk mechanisms, including flood risk driving forces, has been executed from the relevant and available data resources. The flood driving forces, then, have been found and investigated based mainly on available data collected, synthesis and analysis, and interpretation of results.

In **Chapter 4,** current flood responses are assessed by findings through in-depth interview proceeding in chosen urban areas (Ho Chi Minh and Can Tho cities). The first expectation in this designed method is to reflex the currently employed measures and to assess the situation as well as existing constraints from the authority's approaches. This process finished via the specific analysis criterion that adopted from the context review of temporarily relevant policy measures in both International initiatives and Vietnamese flood risk management legal documents. The framework is useful to the delivery of the concerned issues in which examined matters of i) current approach in flood risk reduction; ii) which prevailed measures applied? And alternative methods; and iii) employing urban land use planning and the next trends of the action in the context of flood risk management in flood-prone areas.

This evaluation delivers the concerned inquiries in which examined issues of i) the current approach in flood risk reduction theme; ii) which prevailed measures applied? And possible alternatives; and iii) employing urban land use planning and other options in the context of flood risk management in flood-prone areas.

Chapter 5 examines the factors in which reflected from the cross-national comparison of the flood risk management patterns through French and German case study. It devises contributions of effective management from the in-line policies in which toward flood risk management framework in both study sites. Two types of inputs emerge i) efficiency of national strategies and ii) background of international cooperation in flooding mitigation. They could be potential measures in future development patterns for other flood-prone areas, and further improved to better national policies and global initiatives.

Finally, **Chapter 6** concludes critical issues from the synthesis of chapters' findings. The conclusions define the situations and frame the challenges in flood risk management schemes, and discuss the directions of possible measure employing based on existing theories review and knowledge contributions. This chapter also mentions the limitation of research conduction and the outlook as well as trends for future researches.

CHAPTER 2. THEORETICAL FRAMEWORK

2.1 An overview of flood risk concepts, flood risk components, and flood risk governance

2.1.1 Introduction of flood risk concepts

The idea of flood risk has been undertaken and presented as a combination of a group of elements (APFM, 2008, pp.3). In recent literature, according to Crichton (1999), the flood risk could be interpreted as a triangle, constituted by three main components, namely flood hazard, flood exposure, and flood vulnerability. Three parts may form a "risk triangle" with the definition as follows: "Risk is the probability of a loss, and this depends on three elements encompassing hazard, vulnerability, and exposure. If any of these three elements in risk increases or decreases, then the risk increases or decreases, respectively." (Crichton, 1999; APFM, 2008) (Figure 5).

Crichton's concept of risk triangle drew the relation amongst risk components, which reveals the effectiveness of each element to the threat. The cause-effect principle has been implied as to the main characteristic of the concept when each "side" (component) increases or decreases, then interpreting into a change of risk probability. Following the concept's theme, no risk achieved when a single risk triangle's side is moving to zero; and the effect applying for all components may be an essential principle for risks of extreme weather events as a flood. Flood risk, in this case, is illustrated by the triangle area, with the flood risk value depended on the flood risk components' size. In other words, the triangle concept accepted reducing components' amount to decrease the flood risk consequences.

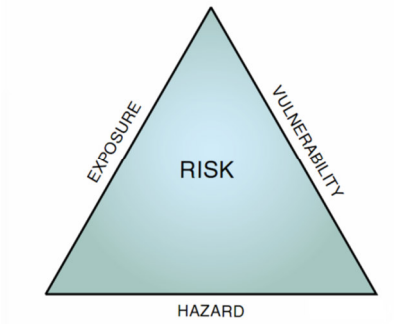


Figure 5 The Crichton risk triangle
(Source: Crichton, 1999)

The related flood components are forming flood risk adopted as the flood risk function, of which flood risk changes identified as the increasing or decreasing within three flood risk components (APFM, 2009; Jongman et al., 2012). Flood risk function presented as this mechanism:

$$\text{Risk} = \text{Hazard} * \text{Exposure} * \text{Vulnerability}$$

Both concepts, as risk triangle and risk function, shared the constitutive components in which the combination of these elements forming the risk consequences. Therefore, these concepts showed a flood risk mechanism within an area where flood consequences might be modified to decrease flood risk by attempts to decline the flood risk components.

In the relevant literature, I.C.E (2001) and DEFRA & EA (2006) suggested the "source-pathways-receptors" model aiming to flood mitigation (Figure 6). In this concept, the flood risk is based on flood hazards, area vulnerability, and people's vulnerability. The risk's components referred by climate hazard or "sources," while hazards' receptors reflected through the area and people's vulnerability. The model applied the flooding system's inputs, known as "processes that change the state of the flooding system," in which inducing flood risk damage potential and could be intervened.

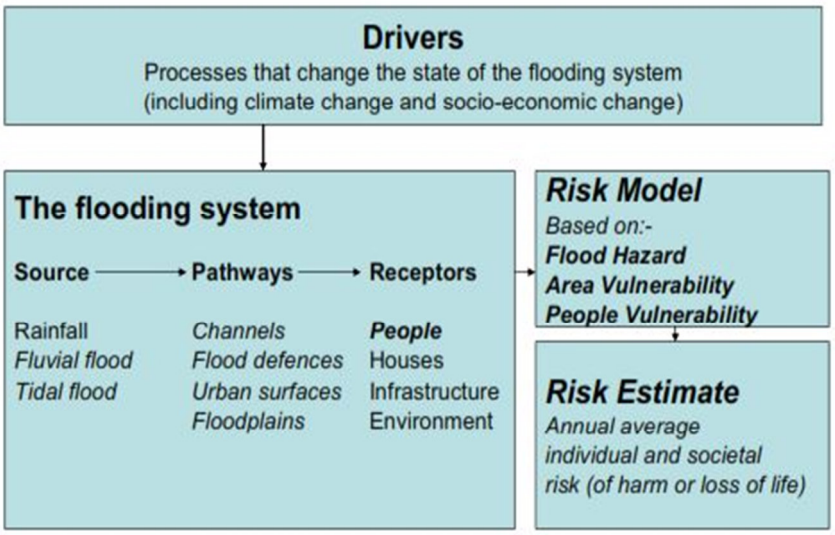


Figure 6 Source – Pathways – Receptors model of flood risk
(Source: DEFRA & EA, 2006)

A similar concept has been accepted by Aleksandra Kázmierczak and Gina Cavan (2011); on this stance, flood risk encompassed flood hazard as "source", and flood vulnerability was defined as "the intrinsic characteristics of hazard's receptors." Adopted from the Crichton risk triangle concept, the flood exposure was justified as "the concept of a flooding pathway." The flood risk triangle, therefore, was recognized as the modified definition consisting of flood hazard as "source"; flood exposure as "pathways"; and flood vulnerability as "receptors" (Figure 7).

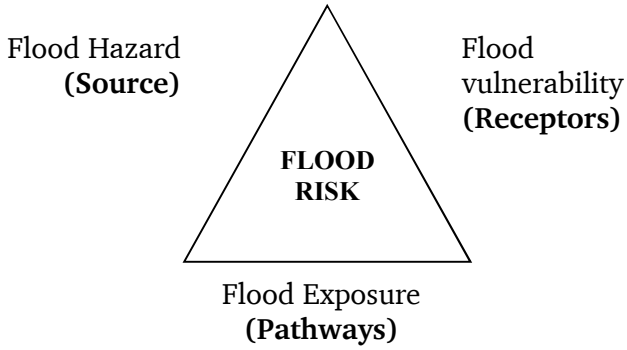


Figure 7 Flood risk triangle, adapted from Crichton (1999) and DEFRA&EA (2006)
(Source: Aleksandra Kázmierczak and Gina Cavan, 2011)

In this viewpoint, the authors presented that degree of flood risk is constituted from components: flood hazard and flood vulnerability, whereas flood vulnerability encompassed exposure elements and their susceptibilities to the hazard (DEFRA & EA, 2006). On the same stance, Sayers P. et al. (2013) stated that the consequences of a given flood contributed by the components of flood risk. The receptors include flood exposure defined as "number and type of receptors flooded" and flood vulnerability known as "the agreed expression of the consequence that results when a receptor exposed to given depth, velocity, and duration" (Sayers, P. et al., 2013, pp.4). Hence, "pathways and receptors" decide the degree of losses while extreme weather events presented as "sources."

Similarly, UNISDR (2009) suggested the frequent use of flood vulnerability with an inclusive element's exposure. The suggestion implies flood vulnerability as "the characteristics

and circumstances of a community, system, or asset that make it susceptible to the damaging effects of a hazard" include the element's exposure. Exposure, in this stance, consists of the presence of items (e.g., people, assets, or system) that subject to loss potential. Adopted the same view, FLOODsite (2009) on the effort to conclude flood risk with its components has been recommended to understand flood risk as to the combination of hazard and vulnerability:

Flood risk = flood hazard * flood vulnerability
(of which, flood vulnerability = presence * susceptibility)

According to this adoption, flood risk had been understood and figured as the synthesis in which constituted by flood hazard and flood vulnerability. In this literature, the first component flood hazard referred to as the probability of flood event, while flood vulnerability is presented as event receivers or receptors, compassing of elements' presence and existing susceptibility to flooding (FLOODsite, 2009; FransKlijn et al., 2015).

2.1.2 Flood driving forces as developing processes

Flood risk as "source-pathways-receptors," for the state of flooding system, the inputs that changes of the state of flooding system (or namely flood driving forces), must be approached as "developing processes." "Source-pathways-receptors" equally referred to flood hazard and flood vulnerability, respectively, might be modified and then changed their status from the flood driving forces.

The changes in driving forces affect flood vulnerability in flood-prone areas globally. The research's evidence suggests demographic and economic development may increase flood vulnerability (Jongman et al., 2012; Frans Klijn et al., 2015); hence, flood vulnerability, closely related to development progresses within flooding-affected areas.

Flood risk driving forces, according to APFM (2008), have been presented as factors contributing to flood risk. These may be classified into three groups, encompassing of meteorological, hydrological, and human factors (Table 4). These flood risk-institutive factors address flood risk by the natural and human driver's recognition; thus, they could contribute the basic form for flooding protecting measure decision making.

Meteorological factors	Hydrological factors	Human factors
- Precipitation; - Cyclonic storms; - Small-scale storms; - Temperature; and - Snowfall and snowmelt.	- Soil moisture level; - Groundwater level before the storm; - Natural surface infiltration rate; - Presence of impervious cover; - Channel cross-sectional shape and roughness; - Presence or absence of overbank flow, channel network; - Synchronization of runoffs from various parts of the watershed; and - High tide is impeding drainage.	- Land-use changes (e.g., surface sealing due to urbanization, deforestation) increase run-off and maybe sedimentation; - Occupation of the flow plain obstructing flows; - Inefficiency or non-maintenance of infrastructure; - Too efficient drainage of upstream areas increases flood peaks; - Climate change affects the magnitude and frequency of precipitations and floods; and - Urban microclimate may enforce precipitation events.

Table 4 Factors contributing to flooding
(Source: APFM, 2008)

Similar to demographic and economic development affected to flood vulnerability (Jongman et al., 2012; FransKlijn et al., 2015), the natural and human (or human-made) driving forces claimed as the main drivers increase flood risk through flooding process (APFM, 2008). Flood risk is as a state in which resulted from the components' development processes (DEFRA & EA, 2006; APFM, 2008); as a result, the driving forces, hence, are observed and analyzed as processes instead of barely considering as flood risk's roots. In this scheme of observations, APFM (2008) argued that human factors play critical roles regarding contributing flood risk's source and receptors via the presence of urban characteristics that have been known increasing the flood risk in low-developed or developing countries. The human driving forces include:

- The concentrated population due to income-earning opportunities;
- A large number of impermeable surfaces and construction of buildings;
- The concentration of solid and liquid waste without any formal disposal systems;
- Obstructed drainage systems;
- The high value of infrastructure and properties;
- Forcing out of poor from official land markets giving rise to informal settlements;
- Housing without any health and hygiene standards; and
- The changes in regions around cities.

Pressing on territory at risk, Hirabayashi et al. (2013) also concluded that increasing trends in river flood risk in Southeast Asia due to challenged driving forces. And these dynamics contribute to the growing trend of flood risk, especially to future river-induced flood risk globally (Hessel et al., 2015). Driving forces, in this context, encompasses climate-driven changes and expected socio-economic development; Therefore, these drivers addressed as processes that change the state of flooding regime.

Flood driving forces interpreted as processes in which change the flooding system and induce a range of climatic and non-climatic impacts in specific areas. The drivers, thus, could be classified into two groups. One group of natural driving forces is likely increasing of flood risk by climate-driven and naturally-related processes, while the other human driving forces may tend to affect non-natural objects by the method of socio-economic changes. For instance, climate change is likely the primary driver increasing river flooding, while changes in socio-economic development induced the state of flood system (Hessel et al., 2015; DEFRA & EA, 2006).

2.1.3 Natural and anthropogenic driving force groups

It is recognized flooding system had been changed in worldwide scale by processes or phenomenon that turns the system into states (Hall et al., 2001). A definition of drivers of future change of flooding has been illustrated by the Foresight Future Flooding study[1] as "phenomena that may change the state of the flooding system, such as climate change, urbanization or changing agricultural practices" (Evans et al., 2008, pp.4). On the flooding system, any processes or phenomenon change the time-averaged state claimed as flood driving forces or drivers of change (Hall et al. 2003b; Evans et al. 2004; Thorne et al. 2007).

Natural driving forces or climatic driven changes claimed as the causes of flooding system changes in general and in river-induced flooding. Milly et al. (2008) pressed climate change as the most claimed process behind flood system change, and Kundzewicz et al. (2010) cited climate change is the central flood driving force group. Alfieri et al. (2015) suggested a significant increase in the frequency of flooding systems in European countries by investigating climate scenarios on patterns over Europe. The European Environment Agency favored climate change impacts threat essential city services and intercity-support networks

[1] The Foresight Future Flooding study (2004) is an important research to examine challenges that might happen to UK flood risk in the future (Evans et al. 2008, pp.3).

(EEA, 2016). On the same viewpoint, Frans Klijn et al. (2015) claimed that natural drivers are affecting deltas where are susceptible to these effects by changes in more frequent catastrophic events. These drivers, in some cases of joint probability, might multiply the damage by coincidence in a combination of flood driving forces such as prolonged precipitation combined with high tide in the river estuary region (FLOODsite, 2009). Those natural drivers, therefore, contribute mostly part in river-induced flood events, which is a remarkable statement.

The vulnerability of riparian areas to development mentions that these areas might be susceptible to river-induced flooding due to anthropogenic driving forces. Globally, Jongman et al. (2012) found the highest population facing riparian flooding concentrated in Asian countries; in the same concern, Hessel et al. (2015) concluded the Mekong river basin that witnessed the dense urbanization within the region could suffer from the increasing economic impacts of river-induced flooding. Frans Klijn et al. (2015) suggested the expanding flood risk caused by the real losses in the delta because of its attributes in which attracting development. The land attributes, as well as superior characteristics on livelihood (e.g., flat surface terrain and fertile soils; or waterway access), invite new growth and demands for a land extension. These factors accelerate the socio-economic development within the region as driving forces; thus, increasing the losses in both tangible and intangible flood damage must be examined by considering the human-made (or non-climatic) drivers in the flood-prone areas.

2.2 Flood risk management: from traditional measures to integrated approach

Flood risk management is a decision-making process that aims to flood mitigation objectives by using appropriate measures to collaborate with stakeholders. Flood risk management considered as the management process that comprises information gathering, assessment, analysis and decision making to reduce flood risk.

The definition has been mentioned as “a process of the decision making under uncertainty” (Hall et al., 2011, pp.7); or “the process of data and information gathering, risk assessment, appraisal of options, and making, implementing and reviewing decisions to reduce, control, accept or redistribute risks of flooding” (Hall et al., 2003a). On the same viewpoint, Schanze (2006) suggested flood risk management as “the holistic and continuous societal analysis, assessment and reduction of flood risk.”

The management of flood risk focuses on avoiding and reducing the flood’s consequences by providing appropriate solutions in the manner of achieving objectives based on the legislation platform (CEC, 2007, pp.03). Flood risk management can be rephrased as “continuous and holistic societal analysis, assessment and mitigation of flood risk” (Santato et al., 2013, pp. 31), or as a process keeps “the balance between various objectives and across spatial and temporal scales inherently comprises collaboration between multi-stakeholders and multi-disciplines” (Van Herk, S., 2014, pp. 176; Potter et al., 2011). Managing the flooding pursues flood mitigation and prevention aims by implementing appropriate strategies and measures (Albrechts, 2004).

From viewpoints of the flood risk concept, the targets of flood damage reduction might be achieved by reducing flood risk components; or flood consequences could be reduced by decreasing the risk hazard, the presence in the flood-prone areas, and increasing the flood susceptibility within communities. Reducing flood risk components (e.g., flood vulnerability) was pressed as a sustainable approach in flood-prone areas besides protection constructions (Santato et al., 2013, pp. 25). These flood risk reduction targets could be reached by implementing a range of means, appropriate strategies, or measures.

2.2.1 Conventionally structural and non-structural measures

The conventionally structural measure is a concept of direct intervention placed on areas in which were at flood risk, with the main focus on controlling the floodwaters and reducing the disastrous consequences by applying to the river system a certain of engineering structures (ADPC, 2005). Structural measures consisting of means of structure aiming to flood

protection and flood prevention including dykes and walls, retention basins, reservoirs, and dams, etc. (Figure 8) (UNECE, 2000; ADPC, 2005; Precht, E. et al., 2006, pp. 234); and these measures used as a primary approach on flood control theme.

In flood risk deduction, the description of these technical measures often stated as heavily engineered structures or engineering interventions; and emphasized as flood defending attempts. These interventions refer to the main principles of i) controlling the flow of water inside and outside urban areas (e.g., constructions as dams, levees or mobile measures as a sandbag or mobile floodwall, etc.), and ii) diverting water by making space for water (e.g., room for the River initiative) (APFM, 2008, pp.22). These direct interventions were utilized as the most reliable measures for hundreds of years; basically, these have been the most popular tools from the perspective of flood risk management.

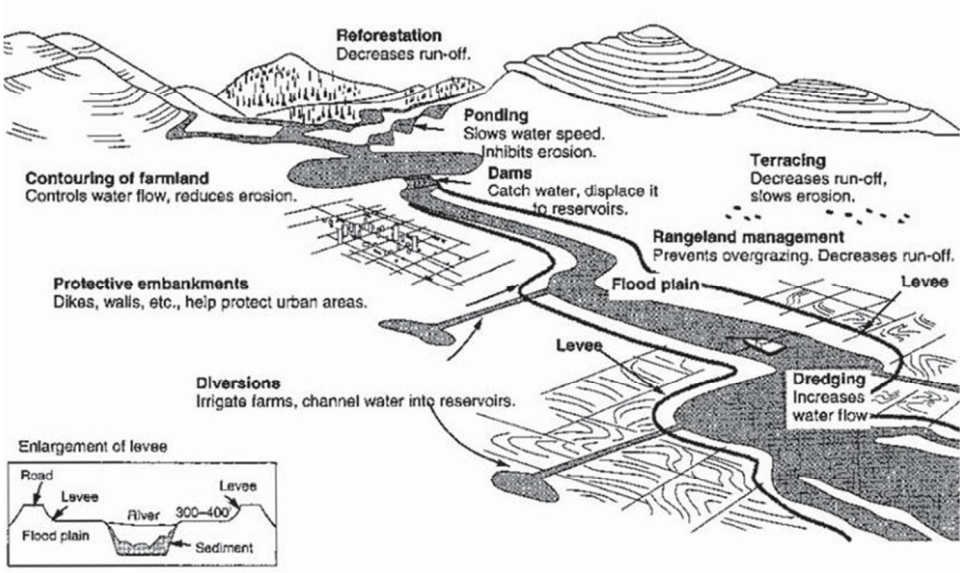


Figure 8 Typical structural measures intervention in the floodplain
(Source: ADPC, 2005)

The central principle of structural measures is transferring floods from one place to another (WB, 2012); thus, these measures promote flood risk than reduce flood's impacts as expected roles. Furthermore, the risk could exacerbate human behaviors and building-up development within flood-prone areas because of safe and protected perception as well as well-control flood though (UNECE, 2000). According to Crichton (2008), the biggest problem of technical measures is the uncertainty of effectiveness due to lack of funding or lack of data. Crichton stated the other issues could be:

1) Fail sense existing of flood security within communities and residents;
2) Floods can damage these technical structures, at any scale of structures;
3) Structural measures required frequent maintenance. More cost for maintenance could take a considerable part in the public investment budget;
4) The height of the sediment level of the riverbed could cause an increase in the floodwall system's level. Consequently, the demand for more investment;
5) These mechanical structures can keep a place safe, e.g., upstream area. The problems would be increased in another place, e.g., downstream area;
6) The damage could be more significant when measures fail. More human life and property would be lost due to people's low responds;
7) These structures may block the flood draining to river or sea; and
8) Concerned climate issues (e.g., climate change, sea-level rise) would require floodwall rising repeatedly.

There are, however, many downsides to the engineering measures. The technical structures revealed many disadvantages such as cost, level of protection, social impacts,

maintenance, capacity, multipurpose projects (designed water-storage makes difficult on water release, etc.,) (ADPC, 2005, pp.119-125). On the cost-effective viewpoint, the obstacles could encompass the reducing the asset's value by being inharmonious with surrounding (e.g., blocking the view of the building) and the false of security sense of community as well (Precht, E. et al., 2006). Further, the uncertainty of structural measure effectiveness denoted at, on the one hand, there is no guarantee that these tools protect a community completely from floods or such structures, failing their functions or being overtopped (World Bank, 2012). On the other hand, by questioning the effectiveness of heavily engineered solutions, the dikes system, for instance, requires high cost and planning on a large scale due to changing flood characteristics. The disadvantages increased the demand for approach, which in turn can eliminate the downsides of technical strategy.

The non-structural measures have been introduced as "flexible solutions," which evolved from the understanding of ineffectiveness and from recognizing the drawbacks of structural measures. The approach towards non-structural methods has been developed from a paradigm shift of transforming to "living with water" instead of "fighting against water." The turn witnessed the movement of "Making Room for the River" applied in European countries, for instance, the version of "Room for the River" represented for the active transformation of the new Dutch flood policy fitting in the paradigm shift (Warner, J., and Van Buuren, A., 2011).

Non-structural measures, in general, can be classified into regulation, insurance, and flood defense groups (Petry, B., 2002) or preventive, precautionary and preparative measures (Petrow, T. et al., 2006, pp.725):

Planning and Regulation
- Zoning
- Coding

Flood defense and Enhancing preparedness
- Forecasting
- Education and Warning of people at risk
- Floodproofing
- Evacuation and relocation

Insurance and other financial instruments
- Governmental
- Private
- Mixed

According to Dawson, R. J. et al. (2011), non-structural measures in the context of flood risk management showed the effectiveness in land use planning, insurance and strengthening the construction resistance to flood's consequences.

2.2.2 Flood risk governance and integrated approach to flood risk management

Flood risk governance is the concept that could be accepted by the attached flood field into risk governance and described by the type of risk (Alexander, M. et al., 2016). Governance was implied as "an arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets." (Ansell and Gash, 2008, pp.554), or defined by UNPD (1997) as "the exercise of political, economics and administrative authority in the management of a country's affairs at all levels. Governance comprises the complex mechanisms, processes, and institutions through which citizens and groups articulated their interests, mediate their differences, and exercise their legal rights and obligations." In the context of flood risk management, flood risk governance represents for institution implementing flood risk management policy.

Flood risk governance scheme adopted flood mitigation measure employment at first by using a wide range of essential equipment. These attempts witnessed the transformation

from dominated structural measures use into the integrated approach in a combination of structural and non-structural measures. The domination of structural measures can be distinguished for a long time of employment as main and effective measures to deal with flood-related issues.

On the contrary, flood risk, in the European community viewpoint, has been considered as an issue that cannot be prevented, with the awareness that risk's roots are natural property, and thus, it is unable to control completely. Based on the point of view from flood risk, the European Union's member states pointed out the most effective management approach is the cooperation amongst elements: prevention, protection, preparedness, emergency response, and recovery as well as lessons learned. Flood risk management could be taking both structural and non-structural measures in a specific and particular area to reduce the disastrous consequences of flood events (CEC, 2004).

Flood risk governance should be put in an integrated manner, with the recognition of reducing flooding losses. The built-in way might be based on "cooperation and coordination during the planning and implementation of flood risk management measures" and requires cooperation among stakeholders in different management levels, horizontally and vertically (Table 5) (GIZ, 2014).

Cooperation	Actors
Horizontally	Sectors: land use and urban planning, water management, disaster management, meteorological services, and the environment.
Vertically	Different levels of decision-making and administration (regional levels), river basin levels, national to the local level (municipal authorities).

Table 5 Horizontal and vertical cooperation in flood risk governance
(Source: adapted from GIZ, 20014)

The "whole system" by combining the two systems (structural and non-structural measures) has been mentioned (Sayers et al., 2002), an integrated approach of flood risk management. According to Pender, G. et al. (2011), flood risk management implemented regarding sustainable approach must recognize an integrated approach that represents a paradigm shift of continuously using technical defenses in combination with developing coping policies to increase community resilience when a flood strikes. Flood protection, indeed, pursue targets of providing mostly structural measures ranging variety of technical solutions; however, the disadvantages by applying mechanical means from the ineffectiveness side identified by economic, environmental cost and the possibility of failures (Crichton, 2008). Non-structural measures, although bringing benefits from economic and ecological perspectives, is an approach with sensitive to socioeconomic context and government behaviors (Dawson, R. J. et al., 2011). Attempt to utilize hard engineering structures with the economic and environmental benefit consideration in the flood risk management context vested the framework for integrated approaches by taking the advantages from each method (Hayes, B. D. et al., 2004; Hall et al., 2006). This integrated approach (by applying non-structural measures in a combination of engineering tools in the context of flood management) will bring more convenience to the local community scale.

2.3 Spatial planning and flood-related issues

2.3.1 Institutionalization pathway of spatial planning in European countries

Spatial planning and territorial cohesion were discussed in years within Europe's nations. The concept of spatial planning in the European Union level suggested in the 6th Conference of European Minister responsible for Regional Planning held at Torremolinos, and

then put the remarkable milestone of institutionalization process of spatial planning with a fundamental objective: the cohesion of European.

The Torremolinos Charter content (European regional/spatial planning charter) in May 1983 aroused an advanced concept of spatial planning. In the Charter, the Council of Europe set the landmark of spatial planning development by adopting the European Regional/Spatial Planning Charter. In this viewpoint, the European cohesion is the fundamental objective that could be achieved by applying the spatial planning approach. In detail, the spatial planning concept knew as a measure of "Regional/spatial planning gives geographical expression to the economic, social, cultural, and ecological policies of society. It is at the sometimes a scientific discipline, an administrative technique, and policy developed as an interdisciplinary and comprehensive approach directed towards balanced regional development and the physical organization of space according to an overall strategy." (CEMAT, 2010, pp.12).

The overall fundamental objectives were identified to achieve the cohesion of the region:

i) Balanced socio-economic development of the areas;
ii) Improvement of the quality of life;
iii) Responsible management of natural resources and protection of the environment; and
iv) Rational utilization of land. The spatial planning concept recognized as a solution for the premier goal of Europe as a whole.

As a beginning of the spatial planning approach concept, the challenges came from the matter of the region's growth controlling has been expected and kept tracks on development balance. The first mention of the process of rapid development or growing too fast may threaten by the inadaptable infrastructure system, etc., or the unbalanced growth situation in different areas within a country or differences among countries in the region. The next keeping balance objective pointed to life's quality as an encouragement to people development by supporting many options from the vast range of choices to reach the optimum possibility, including employment, housing matter, and leisure, etc., for every section of people. The third destination aiming the efficiency of natural resource use and environmental protection measures are the main concentration of spatial planning, in which resolving the fundamental conflicts between resource exploitation and preservation. At last, the objective of the concept concentrates on the complex issue of balancing land use.

The spatial planning concept in this situation has emerged as an appropriate measure to replace the previous approach, and an efficient tool to cope with the hard circumstances that were the current challenges of regional development. Spatial planning was expected as an approach with democratic, comprehensive, functional, and pursuing long-term vision characteristics. The mechanism, therefore, requires coordination among different sectors, levels of decision-making, and resources. In detail, the Charter identified the implementation of the spatial planning process by "reflects the desire for interdisciplinary integration and coordination between the authorities involved."

An official spatial planning term was then adopted by the European Commission (EC - as an institution of the European Union) after the consideration of the differences among European countries on spatial planning meaning. As defined in the EC's declaration (CEC, 1997, pp.24):

"Spatial planning refers to the methods used largely by the public sector to influence the future distribution of activities in space. It is undertaken with the aims of creating a more rational territorial organization of land uses and linkages between them, to balance demands for development with the need to protect the environment and to achieve social and economic objectives. Spatial planning embraces measures to coordinate the spatial impacts of other sectoral policies, to achieve more even distribution of economic development between regions than would otherwise be created by market forces and to regular the conversion of land and property uses".

Within the European Union, the process of spatial planning development also derived from two main reasons enhancing further cooperation in i) rapid growth and development response; and ii) a cross-boundary dispute arising. In the first reason, spatial planning offers measures to rearrange the disorder development and the pressure of growth in each country; and to adapt to uncontrollable situations from disorganized and distorted outputs in space and time.

Spatial planning demonstrated throughout definition as an essential concept to influence the future distribution of activities in space, and promoted by the European Union. In 1999, the adoption of the European Spatial Development Perspective marked a new recognition of spatial planning role within the European Union. In the vision of territory development within the European Union in the future, the European Spatial Development Perspective drew up a framework of reference for policies and actions; and these steps could be the next stages to achieve cohesion goals.

In details, the European Spatial Development Perspective embedded three primary goals which could be applicable in all the regions of the European Union (CEC, 1999):

(1) Economic and social cohesion;
(2) Conservation and management of natural resources and cultural heritage; and
(3) More balanced competitiveness of the European territory.

As pressed in the trans-boundary dispute concern, the future development issues across the European Union "only are resolved through co-operation between different government and administration levels," and once, the core principle of dispute issue solution is confirmed on the European Spatial Development Perspective by through discussion and negotiation theme. Setting the law for problem-solving resolution is an indispensable prerequisite to the sustainable growth within the European Union. Although the document did not require any responsibilities at the community level, the European Spatial Development Perspective applied as the first step toward the regulatory framework of the European Union (Zonnevel, 2005).

Based on the previous documents of the Council of Europe and adapted from Torremolinos Charter (1983) and the European Spatial Development Perspective (1999), the guiding principles for the sustainable development of the European Continent have adopted at the 12th Session of the European Conference of Ministers responsible for Regional Planning in 2000. These guiding principles set the framework of sustainable development aiming to keep "a regionally more balanced development." These are:

(1) Promoting territorial cohesion through a more balanced social and economic development of regions and improved competitiveness;
(2) Encouraging development generated by urban functions and improving the relationship between town and countryside;
(3) Promoting more balanced accessibility;
(4) Developing access to information and knowledge;
(5) Reducing environmental damage;
(6) Enhancing and protecting natural resources and natural heritage;
(7) Strengthening cultural heritage as a factor for development;
(8) Developing energy resources while maintaining safety;
(9) Encouraging high quality, sustainable tourism; and
(10) Limiting the impacts of the natural disaster.

And on the detailed and specific spatial development measures, the guide went into the nine distinct zones that were proposed to take into account high priority in the spatial development policy. These different types of territory range were listed:

(1) Cultural landscapes;
(2) Urban areas;
(3) Rural areas;
(4) Mountainous areas;
(5) Coastal and island regions;

(6) European corridors;
(7) Floodplains and water meadows;
(8) Redundant military sites; and
(9) Border regions.

The notable recognitions in concerned natural disaster issues have found from the guiding principle and specific zone of concentration. The former, as in flood-related matters, flood risk identified as a source of harmful consequences affected on human life, health, and the region's economy. The suggestions then proposed preventive measures in the context of integrated spatial development alignment. Also, the non-structure action, land use, and building planning tools have been taken into account as a fundamentally affected set to reduce the inevitable consequences and vulnerability level within the regions. The later shapes a specific challenge to spatial planning by putting the floodplains and water meadows in one of the priority types of the spatial approach. In this viewpoint, the floodplains and water meadows described as risk-prone areas; by characterized the essential elements that shaped the flood exposures within the regions, natural and human-made drivers.

There are three movements of spatial planning's roles in risk management. Actions on spatial planning emerged in the European Union policy contexts via changes, in details: (i) the transformation from master plan to spatial development policy requirement in this region; (ii) the integration of flood risk issue into the spatial policies within areas; and (iii) the identification of floodplain (or flood issues) development matters in spatial development policy.

2.3.2 The fundamental role of the water framework directive in flood-related issues

The adoption of the Directive 2000/60/EC (CEC, 2000) in 2000 as "a framework for community action in the field of water policy" marked a turning point of the water management field within regions of the European Union. As recognized in the directive, water and water issues treated as a heritage draws up a new approach in water policy. Water has arisen in this directive as an object that needs to be protected, defended, and treated as in legislative framework. And this framework ensures coordination and integration within regions.

The directive aims to specific measures for the water management issues, based on trying to draw up the legislative framework within the Member States of the European Union. This legislation framework covers the inland surface waters, transitional waters, coastal waters and groundwater, and their involving issues; nevertheless, the remarkable recognition goes to the mitigation of the effects of the flood (Article 1, e).

As in the basis, the transnational water involvement matters have been put into consideration and set up the administration arrangements within the Member States. Regulated in the article, Member States have to set the coordination within their river basin districts by:

(i) Identifying an existing national or international body of the competent authority for this directive;
(ii) Recognizing competent jurisdiction by the date mentioned in this directive;
(iii) Submitting a list of relevant authorities; and
(iv) Informing the commission of any changes to the information provided. And, the trying to arrange appropriate coordination with the non-Member States has been recommended to the Member States in case of territory dispute derived from the river basin extending beyond the territory of the member state regions. Although the limitation of flood risk matters has found within the Directive's content, this water matter related framework draws up the guide of general interactions for the water related-issues and sets up the critical fundamental policy related to flood risk.

Also, the Directive of Water Framework Management brings remarkable initiatives to the flood risk issues into the European Union level by addressing:

(i) The flood mitigation (contributes to mitigating the effect of floods and droughts - Article 1, part e); and
(ii) Welcoming new approaches of river basin management, with appropriated measures (by consideration flooding as a force majeure).

These essential initiatives did lead to a more integrated flood risk management to spatial planning within the European Union.

Also, the trans-boundary contradictions and management are considered a practical approach that needs to support by the spatial planning system. Although the recognition of spatial planning as the primary role of flood risk management is less in some aspects, the applying spatial planning to flood risk management recently emphasized as a suitable measure, by pressing on the flood mitigation (CEC, 2000) and trans-boundary cooperation mechanism. The cross-border issue management in flood risk management recognized as a challenge in many channels, and then demand for resolving trans-boundary disputes was at the increasing pace. On the task force on flood prevention and protection submitted to United Nations in 2000 (UNECE, 2000), the joint and coordinated action was presented as the primary momentum to integrate the collective international bodies into sustainable flood prevention. The guidelines on sustainable flood prevention emphasis on proper motions for the "interdisciplinary cooperation regarding all phases of risk management: risk assessment, mitigation planning and implementation of measures."

2.4 Spatial planning in flood risk management context: flood mitigation

The abstract meaning of spatial planning identified by a range of disputing and different understandings from countries to countries — the concept and definition of spatial planning found in the context of coordination on dispute relief, measure for planning, and sustainable development tool. According to the Organization for Economic Co-operation and development, spatial planning is a useful measure by using the coordination of policies aiming to resolve disputing matters among policy sectors (OECD, 2001). At the regional and national levels, spatial planning expected as a measure for the planning policies (Faludi, 2009). In line with spatial planning as a tool, according to Mitsuhiko Kawakami (2013), the spatial planning effort expects to promote the development of the region to enhance the quality of life as well as the social justice in the context of the sustainable environment of the community.

Identified by the European Union, the term used as an understanding of specific adjustments for space development within each country which affect in their territory. With the notion of the potential of the further abstract meaning of the spatial planning where applied the term in states, the official definition proposed the collective agreement from the Member States that "the methods used largely by the public sector to influence the future distribution of activities in space." As stressed, spatial planning "…encompasses elements of national and transnational planning, regional policy and detailed land use planning" and then, describes the spatial planning system "…the various institutional arrangements for expressing spatial planning objectives and the mechanisms employed for realizing them" (CEC, 1997: pp. 23-24).

In the current literature, indeed, that spatial planning is a potential instrument to deal with the flood, due to contributing to flooding mitigation and an effective measure to approach interregional issues in the context of flood risk management. The term spatial planning links to flood mitigation from the viewpoints of comprehensive management on flood risk. The employment of structural measures in a long period experienced that utilizing flood prevention and protection measures deal with the flood consequences and associated impacts on communities is not the long-term approach. Sayer et al. (2002) introduced the concepts of a system as a whole flooding system approach and defined risk-based flood management in which combining structural and non-structural measures; this way enables to assess the cause of the consequence of the entire flooding system.

According to Butler et al. (2011), the shift from engineering measures to non-structural measures (or flood policies) recognized, and the process is in a trend. In the same line with this shift of structural to non-structural interventions, Jong et al. (2013) pointed out

the development of spatial planning to flood risk management, focusing on flood mitigation. Also, this gradual transition strengthens spatial planning's role in flood risk governance. In a research conducted by Howe, J., and White, I. (2004), the authors suggested that flood risk could be prevented and mitigated by the planning system, with the main component of spatial planning: land use development policies and regulations.

The other example goes to the idea of White, I. and Richards, J. (2007), the study claimed that the planning system could contribute the efficient and sustainable method to manage flood risk, by affecting or enhancing factors within the regions (location of activities, type of land use, design of physical structure, scale of development, etc.). In the research conducted by Neuvel, J. M. M. et al. (2009), the flood mitigation presented as a target by applying appropriate spatial instruments. Spatial planning could be a useful measure to deal with flood risk regarding sustainable development by strengthening the local government power.

In line with flood mitigation, spatial planning is also serving to help the community optimizing the mutual synergies and relieve conflicts on interregional issues within regions. In the European Union, effective trans-boundary governance and coordination may deal with flood issues in the manner of long-term management; and support the implementation of each State Members's plans. For instance, flood-related issues demand good co-ordination to prevent shifting the flood consequences from one to surrounding areas. In this stance, CEC (2004) pressed many river basins located and lied on many Member States' territories such as the Rhine, Oder, Meuse, Danube, Saar, Moselle and Elbe, there were costly programs or plans established for flood protection; yet, trans-boundary problems need more consensuses to cooperation among the Member States and between European and non-European countries.

In the European Union, a flood is a trans-boundary event (Arellano, A. V. et al., 2005), with the most complicated characteristics of trans-regional issues. Therefore, flood management often faces challenges arising within the trans-boundary areas where disputing territory existed. The disputed matters dropped mainly within European Union member states' boundaries and the cross-border regions between European Union Member States and Non-European countries. The trans-boundary flooding consequences management calls for an interregional and transnational coordination approach, with the enhancement of voluntary cooperation than forced actions in significant areas as well as the incentive for coordination amongst stakeholders (B. Haupter et al., 2005).

The management efforts or flood risk management strategies demand essential components to relief the disputes or to minimize the arising conflicts among involving actors. In the research conducted by Arellano, A. V. et al. (2007), the authors suggested components addressing in the management strategy:

- The water body consortia (e.g., the International Commission for the protection of the Rhine River);
- The binding framework legislation (e.g., the Water Framework); and
- The incentive amongst actors (problem and benefit-sharing).

Recent findings, as well as the concentrations into spatial planning's roles within the European Union, reveal the main contributions to flood mitigation and flood trans-boundary issues. Moreover, the application of integrated flood risk management as a new potential in which supported by spatial policies can be a useful approach reducing the flood consequences for the whole region. Spatial planning means strategies which are "largely used by the public sector" to intervene "the distribution of activities in space" (CEC, 1999); and suggests the comprehensive management in which land use planning treated as the main important direction by adapting with two main tasks in both inbound and cross-border issues, in the context of integrated flood risk management.

2.5 Land use planning in the integrated flood risk management context

2.5.1 Spatial planning as a land-use planning approach

Planning could be the term with many and different meanings (Sayers, P. et al., 2013, pp.113), and spatial planning, after that, heritages the complex understandings with broad definitions from many perspectives or specific contexts in which the term applied. Davidoff and Reiner (1962) pointed out planning as choices; nevertheless, in another aspect Faludi (1987) defined planning as subsequent decisions, and Friedmann, J. (1987) approached this term as a link between knowledge and action. Spatial planning, according to Albrechts (2004), implied "the frameworks for action which shape spatial structure (spatial structure refers to space use in the cities)." These approaches describe planning as an abstract term and understanding of this term, depending on the giving context. Spatial planning in climate change adaptation may play a vital role in a city's resilience (de Vries, 2006, pp.225). On the same line with the planning term, the spatial planning approach accepted within places. Spatial planning on flood mitigation, therefore, requires putting into the flood risk management context.

In the context of flood risk management within the European Union, spatial planning definition has many descriptions across Member States and regions; and in the "the European Union sense" spatial planning has been adopted as government's methods to influence the activities' distribution in space in the specified time to achieve specific goals. In this dimension, the spatial planning points out the tools or set of tools used mainly by public sectors to complete the planned objectives, with addressing the water cycle management in the whole region as well as managing land and water as a whole (CEC, 1997; UNECE, 2009). In flood risk management context within flood-prone areas, spatial planning can be translated into the appropriate land use planning approach to achieve flood mitigation, and trans-boundary flood-related issues resolve objectives. The spatial planning regime thus "brings together and integrates policies for the development and use of land with other policies and programs, which influence the nature of places and how they can function" (Potter et al., 2011). Spatial planning has been confirmed as a useful approach to delivering sustainable development by "setting broad policies and allocations for an area taking full account of flood risk" (CLG, 2009, pp.6).

In this translated meaning, spatial planning considered as appropriate land use planning goes beyond conventional land use planning, embedded land use planning, and development management. Multiple suggestions advocate land use planning as a proper measure to reduce flood's impacts by minimizing flood vulnerability in the flood-prone areas. And from the economic development viewpoint, pressures for development growth in a new floodplain are unavoidable (especially in the emerging economies). According to CLG (2009, pp.6), planning might be an effective way for both tasks: reducing flood risk to existing development through means of management (e.g., surface water management, stormwater storage or conveyance, etc.); and decreasing flood risk damage from new construction. Furthermore, land use planning could be considered as an essential measure aiming to flood vulnerability reduction in flood-prone areas for both existing areas and discouraging new development (Yovel, 2013; Wheater and Evans, 2009; White, 2010).

Minimizing flood vulnerability in urban areas implies reducing the presence and strengthening the flood susceptibility by reducing contact with the flood regarding settlers' location. According to Moll (2005), being a measure of urban planning, land-use planning can reduce the degree of exposure to flood hazards by rearranging the locations of settlements and infrastructure or reconciling the spatial demand and economic development pressure. Practically, the implemented land-use plan revealed:

(i) Land use planning was possible applying in the cities growing at moderate rates, with towns that in high spatial demands for economic development, the flood exposure was unavoidable; and

(ii) With any arguments arising about urban land uses and short-term economic benefits of growth in terms of flood risk reduction, the financial reason often prevails over the demand for " more space for water".

2.5.2 Roles of Land use planning in flood mitigation scheme

As adopted in the European Union context, land use planning has defined as an instrument used for land and property transform; and for the mechanism of plan use plans' implementation. Land-use planning can be operated at the municipal level and used with the full range of applying, from general frameworks in the vast areas to detailed patterns in a specific building plot (CEC, 1997).

From the European Union perspective, integrating land use planning into a flood mitigation scheme requires appropriate mechanism due to fundamental challenges of policy implementation in which 1) what is the principles that land use planning could integrate into flood risk management framework? 2) What kind of land-use plans? And 3) in which mechanism does assure the land use plan implementation?

The first question based on the central principle of land use planning's function, and that focuses on how the land policy could adapt to risk management. The measure pursues a balance between the conflicting goals of the resident's desired applications in the floodplain. Land-use systems could prevent the disorderly expansion of industry or housing sectors, which also increases flood vulnerability or potential losses. Land-use planning may:

- Create communication channels between decision-makers and residents. Land use planning is a critical precondition to guarantee the success of the planning process. An efficient communication channel just can be built when both sides focus on overall objectives and avoid being directed by other issues;
- Define appropriate areas that are suitable for the specific function: based on the compromise among stakeholders' interest;
- Identify particular zones with a high risk of inundation or flooding, restricted or low developed areas;
- Define spaces of environmental or cultural heritage, which tend to be of lesser interest for the investor. As they maximize stockholders' wealth, they tend to ignore the public interest; and
- Focus on urban development. The determination of urban shape could integrate resident's viewpoints, individual interests, and civic participation.

Land use planning solves potential conflicts arising from the starting stage to implementation steps, and then puts bilateral cooperation between two main groups of people, residents, and authorities, into a scheme with the overall aim to reduce flood risks in a flood-prone area. Appropriate recommendations or advice from the administration to communities brings many benefits, e.g., people's consensus and guidance to proper development, which steers the development into flood exposure reduce objectives.

On the second question, what kinds of land use plans should be considered in the manner of bringing optimal interest as well as assuring good coordination amongst sectoral bodies? From the European spatial planning perspective, land use planning or physical planning comprises a broad range of activities, from the municipal to specific site levels. The planning instruments, in this viewpoint, are varied from regulating land conversion in municipal level to support particular details of building the design in the new development areas and building requirements on conservation or protecting areas (CEC, 1997). Embedded-specific situations and area's circumstances, land use plans vary to adapt to the wide-range contexts. Four aspects have been pointed out, including:

(i) Regulation: covering the restricted development areas, resettlement regulations, the degree of penalties in the contexts of balancing the velocity of economic development, and minimizing the floodplain exposure.

(ii) Commercial promotions: applying a different level of taxation as a tool to reduce the possibility of land occupation.

(iii) Knowledge and awareness enhancement: informing regularly and properly about flood risk of areas. Settlers must be notified and received their chances to raise awareness about flood risk and its consequences via awareness campaigns, education programs, participation process, etc.; and

(iv) Public Investment: orienting the public facilities outside risk zones or limiting the public investments can minimize or reduce the overdevelopment in the floodplain areas.

According to APFM (2008), land use plans applied in these areas in which human factors addressed. These factors play critical roles regarding contributing to vulnerable elements via the presence of urban characteristics and increasing flood susceptibility in low-developed or developing countries; thus, land use plans in these areas, in details, focusing on:

- Concentrated population due to income-earning opportunities;
- Large existing impermeable surfaces and construction of buildings;
- The concentration of solid and liquid waste without any formal disposal systems;
- Obstructed drainage systems;
- The high value of infrastructure and properties;
- Forcing out of poor from official land markets giving rise to informal settlements;
- Housing without any health and hygiene standards; and
- Changes in regions around cities.

The last question faces the most challenging aspect of integrated flood risk management: how and in what means of a mechanism to implement land-use plans within the regions and trans-boundary territories? A flood risk management plan tailored for a specific area, and programs based on the particular aspects (e.g., common goals), the consensus from the political will, the cultural elements, etc. to assure the plan implementation. Nevertheless, in some of the trans-boundary regions, the application of these plans is often delayed because of the arising obstacles amongst the areas themselves.

Many challenges, in general, have been identified in transboundary regions exacerbating difficult situations. These obstacles worsened the effort of cross-border cooperation on over 150 transboundary rivers in the European (UNECE, 2009). Lacking early warning system, for instance, from the upstream areas could lead to catastrophic flood's impacts by exacerbating the damages because of slow responding reactions; thus, transboundary cooperation and frameworks of coordination are necessary by enabling the information sharing as well as establishing the strategies with shared visions and agreements.

In the European Union, international cooperations have been supported by the establishment of a cooperation framework by adopting the EU Water Framework Directive and the EU Floods Directive. The Water Framework Directive was sanctioned by the European Parliament and the European Council in 2000 to start the program for community action in the field of water policy; and to create a framework for holistic water protection (CEC, 2000; CEC, 2007; UBA, 2010).

The EU Water Framework Directive (2000) tailored to all kinds of water body within of river basin and coastal water management; on its concern, the framework focused on four main aspects in which including i) inland surface waters; ii) transitional waters; iii) coastal waters, and iv) groundwater. This Directive takes the coordination of administrative arrangements within river basin districts into consideration. The Directive identified and set up the protected corridor for the related stakeholders by adopted the "international river basin district" in Member state territory and competent authorities for the relevant issues in the directive. The directive also mentioned the promotion of water pricing policies within each member states, with the scale of financial coverage as well as addressing the user-pay principle in the European water conservation context.

The EU floods directive (2007) established and adopted, mainly based on the series of previous flood risk management policies and experienced knowledge such as the EU water

framework directive - Directive 2000/60/EC (CEC, 2000), program of Communication on flood risk management, flood prevention, protection and mitigation (CEC, 2004) as well as other relevant strategies on flood risk management in scale of the European Union. The EU water framework had initiated a protected corridor for community action in the field of water policy, while the EU floods directive has concentrated on measure application based on two main lines of inside and outside Member States' boundaries (Table 6).

No	Name of the European Directive that deals with flood-related issues	A brief description of the addressed flood-related issues	Flood Risk Management Phrase
1	Directive 2000/60/EC of the European Parliament and of the Council of 23rd Oct 2000 establishing a framework for Community action in the field of Water Policy.	It established the framework for protecting the inland surface waters, transitional waters, coastal waters, and groundwater. This Directive promotes the coordination of administrative arrangements within river basin districts. It firstly put the foundation of international cooperation on the flood-related issues by addressing the current flooding matter on the international water framework officially.	Respond and Mitigation
2	Directive 2007/60/EC of the European Parliament and the Council of 23rd Oct 2007 on the assessment and management of flood risks.	It aims to establish a framework for the assessment and management of flood risk to reduce the risk of flood damage. This Directive sets up the framework for measures from the two lines of national initiatives and international cooperation approaches by addressed Flood Directive planning cycle: Preliminary flood risk assessment – flood hazard and risk maps – Flood management plan, with six yearly cycles of reviews and updates.	Mitigation

Table 6 The central European directives that deal with flood-issues: a brief description of flooding aspect addressed and flood risk management phrase
(Source: adapted from Arellano, A. V. et al., 2007)

While the recent EU water framework directive paved a corridor on the water protection framework, the latter EU floods directive was the next stage of the recognition of flood risk management related issues. The EU floods directive put the active cooperation on the flood risk assessment and management through three-phase approach within the European Union: i) preliminary flood risk assessment (end of 2011); ii) flood mapping (end of 2013); and iii) flood risk management plans (end of 2015). This EU floods directive strongly emphasized on the assessment and management of flood risks within the Member States to reduce the flood risk's consequences by measures, especially on coordination throughout the primary European river catchment in the regions.

Both directives have paved a protected corridor for the transboundary conflict issues, from the arising matters between two or more Member States shared country borders to problems among the Member States with non-Member State countries. By putting into consideration the demand for more effective management between river catchment and land use planning, these adopted directives promote the integration between spatial plannings and the river basin planning systems for the whole region as a one (Santato et al., 2013).

CHAPTER 3. AN OVERVIEW OF FLOOD-PRONE AREAS: CONSTITUTIVE AND INVOLVING ASPECTS, DRIVING FORCES WITHIN RIPARIAN AREAS, CASE STUDY OF CAN THO CITY

3.1 Case study site

Can Tho City's core area covers the entire administrative border with an area of approximately 1,400 square kilometers; and accommodates 1,238,300 inhabitants (GSO, 2015). The city average population density reported at 879 people per square kilometer, approximately twofold in comparing to the whole Mekong delta region (432 people per square kilometer). Officially, Can Tho City divided into five urban districts located along the river (Ninh Kieu, Cai Rang, Binh Thuy, O Mon and Thot Not districts) and four rural areas (Phong Dien, Co Do, Thoi Lai, Vinh Thanh districts) (Figure 9).

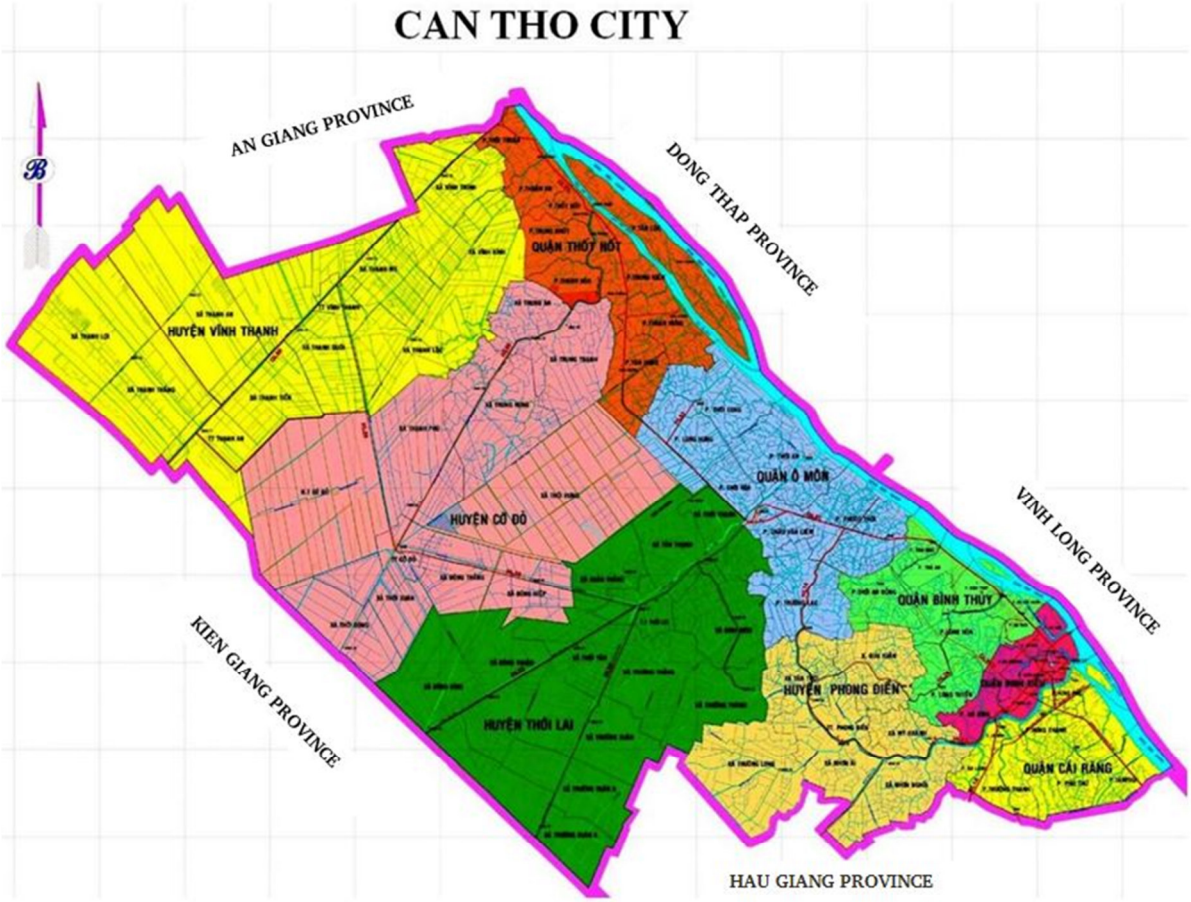


Figure 9 Can Tho City administrative map

Located in the central position in the Mekong Delta, Can Tho City expected as vast of the capacity of development. From the transforming to the grade I urban center[2] (since 2004), the city was being developed as an economic hub with the premier task enhancing for the whole region of Mekong Delta to be the expanded area, in both means within Vietnam as well as surrounding areas (Figure 10). A city development strategy has set for this hub city towards next decades being the typical riparian city, with visions of multi-center developed

[2] Vietnam urban center grading is in compliance to Decree No.42/2009/ND-CP of May 7th, 2009 (including 6 grades, namely Special grade, grade I, grade II, grade III, grade IV and grade V and recognized under decision of competent state agencies. Urban center of grades I and II include centrally run cities with urban districts and rural districts and possibly attached urban centers; and provincial cities with wards and communes (SRV(a), 2009).

functioning urban area (e.g., the high tech industry, trading, service, and tourism center; the center of science and technology as well as the health and education).

Based on the important geographic position within the region as well as its provincial status of grade I urban center, Can Tho City has planned to be a dynamic development for the whole Mekong Delta region. Furthermore, the city transformed as main development forces that affect not only within the Mekong Delta but also on the adjacent international areas (WB, 2012).

Figure 10 Can Tho City – In the economic relationship with adjacent regions

3.2 Can Tho City's flooding issue: current situations and trends

Located in the center of the Mekong Delta, in which reported as a higher level of "very severe" flood risk (SRV, 2004), Can Tho City has been witnessed the fluvial flooding damage and adopted a flood risk management; however, the existing and potential of losses caused by flooding was varying. Also, flood risk management assessed as a straightforward approach. Annually, inundation has been occurred from rural to urban districts, especially from July to November. In this time of year, many inundated areas appeared within the city, with the observed water level depth fluctuated from 0.3 to 1.5 meters. According to SIWRP (2009), shallow inundation reported in urban areas, while profound flood events often have taken place in rural districts. Flooding phenomenon in the city is considering as an "as-usual" season and well-coordinated with the Mekong Delta Flooding mechanism.

The attempt on flood risk reduction was planned and implemented with measures; however, they are insufficient and incapable of coping with incremental flood risk. For instance, flood frequency could be assessed based on historical data that recorded mainly in existing gauge stations, but according to SIWRP (2009, pp.12-16) the capacity of flood response task is more difficult for a long run, following hereafter reasons:

- Annual riparian flooding in combination with tide mechanism (15 day-tidal cycles);
- The unpredictable about the consequences of the Climate Change thread (e.g., Sea level rise, precipitation, etc.);
- Weak infrastructure system (e.g., poor drainage system); and
- The unclear efficiency from the protected measures in the high potential of government investment via regional development policies.

Along with the rapid urbanization process, the city has been faced with several development footprint issues as pollution, rapid population growth, and profoundly affected by climate change, etc. Flooding has considered one of the most severe problems. Inundation often takes place in annually flooding season from September to November. SIWRP (2009) stated that the average flooding reached from 1.0 to 1.5 meters during the years when the high magnitude floods occurred, such as in 1961, 1978, and 2000 in the rural districts (at the end of September to the end of November). Statistically, even in the years appearing small magnitude of floods, these mentioned-districts were still in inundation situation with the average water depth over 0.5 meters.

In the potential of the dense frequency of occurrence, flooding in Can Tho City is increasing; and creating more losses within vulnerable areas. Many main roads usually were in inundated situation recorded in the city core. There is a shift from short time inundation within the city's district to the long duration of inundated circumstances as well.

The inundation took place when flash flood and heavy rainfall in combination with high tide. Within Ninh Kieu, Binh Thuy, and Cai Rang urban districts, several inundated areas were occurred during the period from many hours to a couple of days, especially in residential areas, offices, and the public regions with average inundation depth from 0.3 to 0.5 meter. According to Tran Van Tu (2010), the flooding area within the city has increased up to 50% recently compared with 30% inundated areas of the whole town in the past[3].

In the year 2000, one of the most severe floods ever occurred in the Lower Mekong Delta. Reported by the National Hydro-meteorological Service (2010), the river level was 1.9 meter as observation at the Can Tho hydrological station and then reached the highest peak within the last 40 years. Figure 11 points out the inundation depth and duration of the historic flood of 2000. Consequently, this catastrophic flood caused more severe damage than any previous floods. The total economic loss was estimated appropriately VND 602.3 billion (Table 7).

[3]Tran Van Tu, chairman of the Can ThoSocial Sciences and Humanities Association: Status of some coastal areas related to adaptation and sustainable development of Cuu Long River Delta (MRC), 2010.

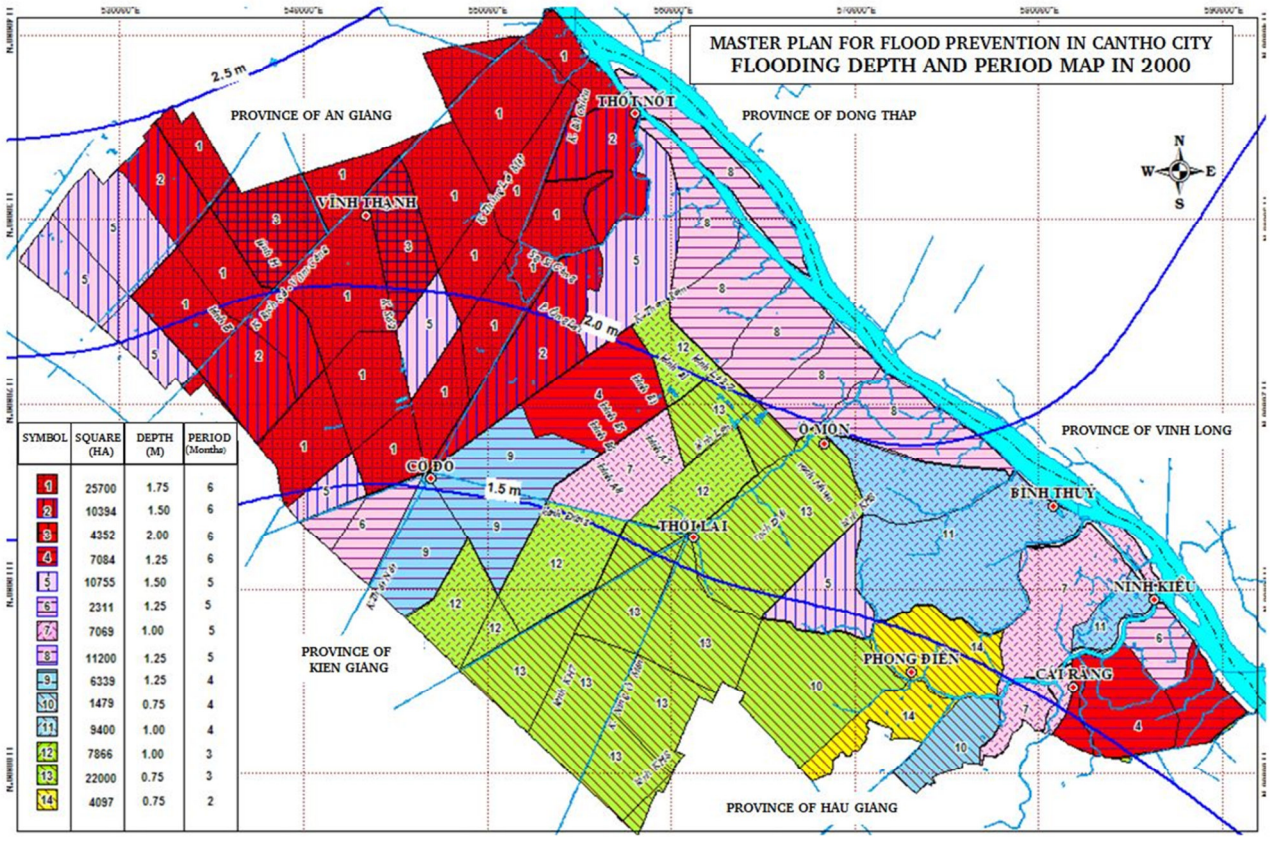


Figure 11 Flood Depth Map and Inundated Duration in Can Tho City in 2000
(Source: SIWRP, 2009)

Items	1991	1994	1995	1996	2000	2001
Rice production	38.70	52.18	7.00	27.20	86.25	21.50
Vegetable and Industrial Plants	13.71	15.50	2.00	5.00	15.60	4.60
Fruit tree	147.50	242.66	28.80	60.06	206.40	58.65
Fishery	6.50	8.20	2.16	0.03	1.25	0.50
Transport and Irrigation	72.50	38.32	26.25	40.40	138.60	38.28
Education	3.50	8.46	0.15	2.90	6.90	2.60
Health Care	1.70	1.50	0.03	0.14	1.50	0.70
Housing and others	35.00	21.37	1.20	65.80	145.80	55.20
Total *(Unit: VND billion)*	**319.11**	**390.19**	**67.59**	**201.53**	**602.30**	**182.03**

Table 7 Flood Damage in Can Tho city 1991 – 2001
(Source: SIWRP, 2007)

Inundation in Can Tho City has occurred in more ordinary circumstances, a more massive scale, and longer duration. According to a survey conducted for the inundation status within Can Tho City from 2002 to 2009, the striking finding reported that in the flood season of 2006, there was 80% area inundated, with associated inundated points observing over 0.5-meter flood depth (Table 8).

No	Date	Flooding Causes	Inundation Status	H max (cm)	H max Date
1	12th Oct 2002	Flood	Inundated	195	12th Oct 2002
2	5th Oct 2004	Flood + high Tide	6 districts inundated	193	12th Oct 2002
3	19th Oct 2005	Flood + high Tide	Inundated >50 cm	195	-
4	8th Oct 2006	Flood + high Tide	20 streets inundated 30-50 cm. 80% city inundated	199	12th Oct 2002
5	28th Oct 2007	Rainfall + high Tide	21 streets inundated 30 cm	203	12th Oct 2002
6	17th Oct 2008	Flood + high Tide	80% city inundated 20-30 cm	200	12th Oct 2002
7	5th Oct 2009	Rainfall + high Tide	-	-	-

Table 8 Reported inundation within Can Tho City from 2002 to 2009
(Source: SIWRP, 2009)

Within urban districts, the inundation was documented in-depth and duration categories. Ninh Kieu urban center district was in the difficult inundated situation, with most of the district's wards affected. The average inundated water level was at 30 to 40 cm during hours, especially some regions water level reaching to 50cm, e.g., Ly Tu Trong street (An Cu ward), Cau Duong street (An Khanh ward), hamlet no.232 in 30/4 street (Hung Loi ward), etc. The inundated period in these places ordinarily remained from 2 to 3 hours, in case of hamlet no.232 even inundation occurring from 2 to 3 days.

In Binh Thuy urban district, the recorded average depth fluctuated from 20 cm to 30 cm for 2 or 3 hours. Deep inundation was reported in National Road 91 (40 - 50 cm), road 918 (50 - 60 cm), and Tran Quang Dieu street (50 - 60 cm), with inundated duration appropriate one day. In the agricultural area within this district, several submerged zones were even 1.0 or 1.1 meters and caused severe damage to agrarian productivities.

In Cai Rang urban district, the frequently inundated depth was from 20 to 4 0cm, with duration up to 3 hours. The deepest inundation zone located near the Quang Trung bridge (Hung Phu ward) with the water level up to 50 cm. Inundation took place up to 80 cm in paddy field zones within the Tan Phu ward.

In O Mon urban district, the data in inundation was from 20 to 30 cm from 1 to 3 hours. Flooding in paddy field zones often occurred with 70 to 80 cm inundated depth; notably, some paddy fields were inundated up to 1.2 meters during one month or two months in the massive flooding seasons.

The trend of flood inundation in urban districts is on the potential of growth. According to Pham Thi Mai Thy et al. (2013) in the analysis of inundation situation in the Ninh Kieu district (expected as the most urbanization area in Can Tho City), the data is revealed the expansion of inundation trend of this area through the year of 2004, 2007 and 2009 (Figure 12). In the viewpoint of topography characteristics, Ninh Kieu urban district where the altitude is rather high (compared to other areas) and varies from 1.4 to 2.5 meters, the possible prediction concluded about inundation developing and potential in the future and become a challenge.

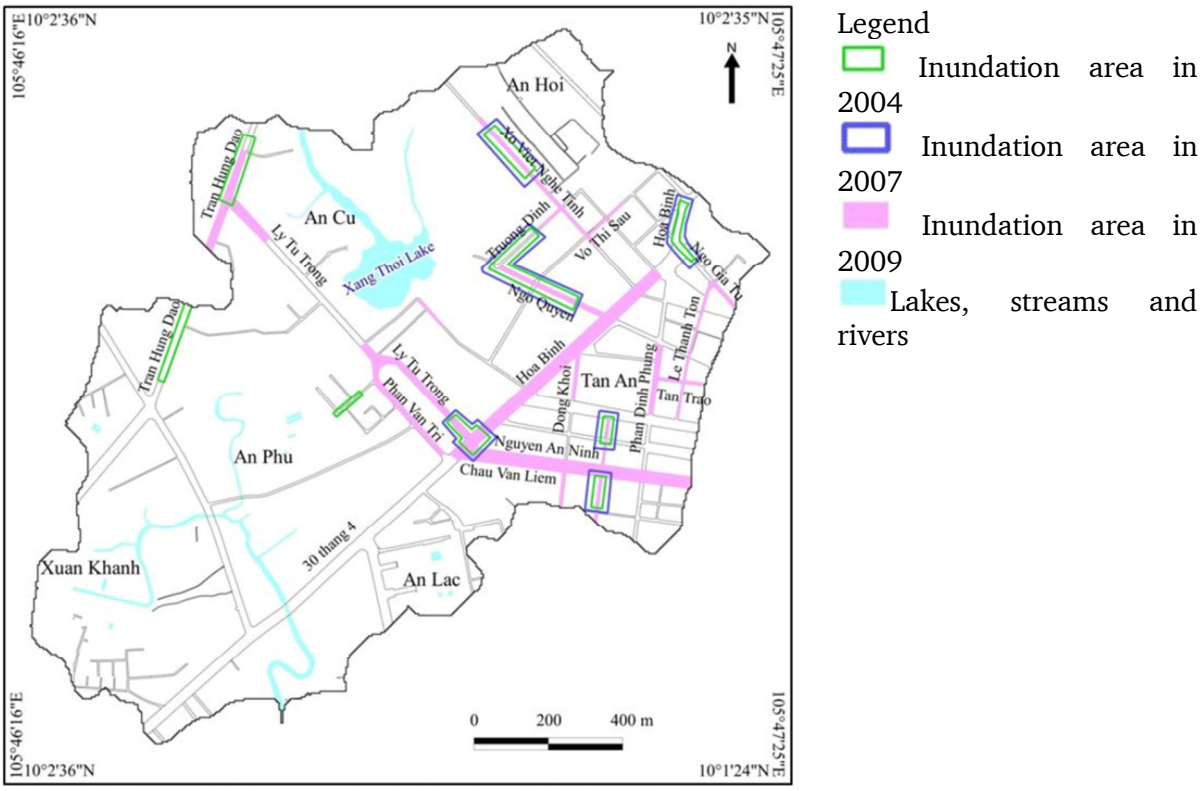


Figure 12 Inundation Map within the city's center in 2004, 2007 and 2009
(Source: adapted from Pham Thi Mai Thy et al., 2013)

In the long-term vision, the other flooding drivers possibly induce high potential and increasing inundation areas by raising flood risks within the city. Further, the low quality and lousy maintaining situation of infrastructure system treated as sources pushing Can Tho City into more severe flood damage when floods strike. Associated with the weak infrastructure system, the response from the involving stakeholders in the short term as well as the long-term strategy to reduce flood risk turns flood-related issues into complicated matters, demands the supporting and participation from actors, and comprehensive approach as well.

3.3 Introduction of Can Tho City flood driving forces

While flood risk and associated challenges claimed by natural factors, such as climate change impact increasing flood vulnerability (Aerts, J., Botzen, W., Bowman, P. J., Ward, P., and Dircke, P., 2012; Hallegatte, S. et al., 2013; Nicholls, R. J. et al., 2007); the other driving forces have been recognized as factors interrupted natural processes increasing the flood vulnerability in floodplain (Meyer, H., Bobbink, I., and Nijhuis, S., 2010). Delta cities especially are exposed to flooding due to climate change and other associated-action responses. The climate-related challenges facing delta city recognized. However, anthropogenic flood driving forces counted as increasing flood vulnerability in riparian areas.

Flood anthropogenic factors refer to processes or trend of actions disrupting natural operations, and then accelerated flood damage in particular. Public infrastructure (e.g., drainage system, land reclamation, etc.) may interrupt and limit the delta's capacity dealing with excessive flood water (Meyer, H., Bobbink, I., and Nijhuis, S., 2010). The disrupted function of the natural process can combine with other adverse natural events such as high intense precipitation, etc., increasing the ratio of losses and threatening urban development (Francesch-Huidobro, M. et al., 2016). The single effect or combination-state of flood driving forces able to draw the impacts that addressed in visions, strategies, plans, and action programs developed by city governance in delta cities, in general, and in flood-prone areas, in particular.

Can Tho City exposed to riparian floods, due to not only natural characteristics by location and climate-driven factors but also on other processes such as the potential of rapid development within urban activity mechanism. These processes examined in Can Tho City where exposes high flood vulnerability by highly connected to flood risk impacts and the examination is essential to acknowledge the city's capacity to respond and mitigate damage under increasing threat of flooding. The main flood driving forces enhancing flood vulnerability in the city have selected and classified based on relevant data and disciplines, which encompassing natural and anthropogenic driving force groups. The first group known as the natural processes includes natural topography pattern, land subsidence potential, precipitation changes, and Sea Level Rise. The second comprises urbanization factors (e.g., population, urban expansion situation, land-use changes, and drainage capacity).

3.4 Natural driving forces

3.4.1 Topography

Water disasters assessed as natural events with the most severe damage in the Mekong river delta due to the low topography for water-rice agricultural (Huu Ninh Nguyen, 2007). Can Tho City topography inherit flatness from the Mekong Delta, where daily tidal water mechanism claimed for the delta's flat characteristic (Kelly Shannon and Bruno De Meulder, 2012)? The city located on the low-altitude area and the city's topography is dominated by typically deltaic aspects, with an average level above means sea level varying from 0.8 to 1.0 meter above sea level (Figure 10). Low-lying (less than 1 meter) altitude is being a real challenge to city development; in fact, topography counted like the striking force contributing to forming flood vulnerability to communities.

As reported in 2009 (SIWRP, 2009), nearly 75% city's surface is covered by the altitude less than 1.0 meter (67.1% of ground level is ranging from 0.5 to 1.0 meter, and 8% of city's covering is under 0.5 meter); whilst 20.5 % lies varying from 1.0 to 2.0 meter in elevation. On the contrary, an area with a height over 2.0 meters above sea level reported at the only small part, at 0.4%. Detail of low-level proportion shall be found out in Table 9 and visualized in Figure 13 and Figure 14.

The city is characterized flat by the topography with somewhat prone, higher from the Southeast and lower spreading to Northwest. The city's main priority of height is from 0.6 to 0.8 meters from sea level (based on National level height at Hon Dau Island, Hai Phong of Province -Vietnam). The typical topography separated into four main types, including the Hau Riverbank, the urban center, the harvesting, and the islet areas. The first type, the Hau Riverbank, is mainly used for agricultural or fruit farming activities. This area silted annually. The area topography is higher from 0.3 to 0.6 meters compared with the open space. Next, the urban center area in which consist of 4 urban districts (Ninh Kieu, Binh Thuy, Cai Rang and Thot Not), covers by rather high topography from 1.4 to 2.5 meters; whilst the third type of other 4 rural districts distributed by 1.0 – 1.5 meter at residential areas and by 0.4 – 0.8 meters at harvesting areas. At last, on the islet area, which includes four islets (namely Tan Loc, Son, Khuong, and Au islets), the ground level is ranging from 0.7 to 0.9 meters (Table 9 and Figure 13).

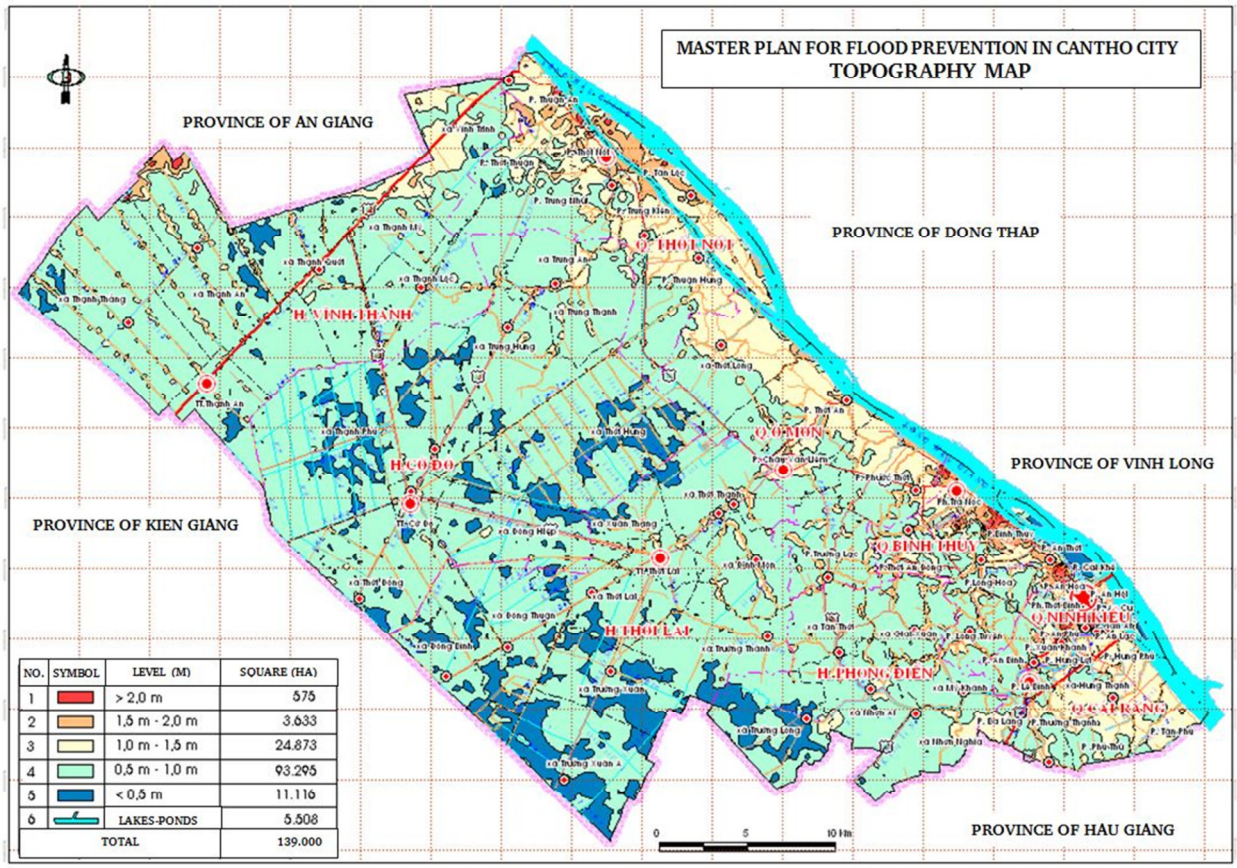


Figure 13 Topography map of Can Tho City
(Source: SIWRP, 2009)

No	High level	Area Square (ha)	Proportion (%)
1	Over 2.0 m	575	0.4
2	From 1.5 to 2.0 m	3,633	2.6
3	From 1.0 to 1.5 m	24,873	17.9
4	*From 0.5 to 1.0 m*	*93,295*	*67.1*
5	less than 0.5 m	11,116	8.0
6	Rivers and Canals	5,508	4.0
	Unit: meter (m)		
	Total	**139,000**	**100.0**

Table 9 Statistical area square by altitude
(Source: SIWRP, 2009)

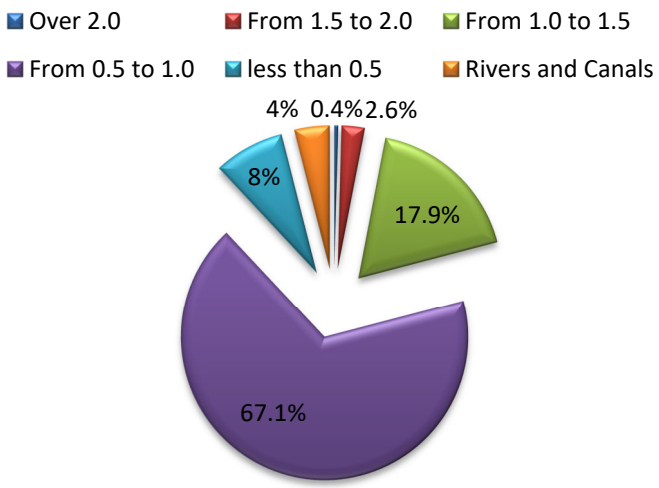


Figure 14 Proportion of Can Tho City's cover land and elevation
(Unit: m - Source: SIWRP, 2009)

Topography plays an important role, indirectly, of forming conditions to the flood-vulnerable area. First of all, a low and flat level accelerates uprising water level and widespread effects on people's lives and assets. Secondly, in the situation combining with other drivers (e.g., natural tidal mechanism or Sea Level Rise potential, etc.), simultaneously happened in the riverbank areas, in the commercial districts where is being in rapid development as well as the limited capacity of infrastructure system could exacerbate flooding damage.

The city's topography, especially of four urban districts that embedded the Hau River (or the Bassac River - one of two last main tributaries of the Mekong River within Vietnam boundaries), forming riverfronts characteristic is the typical type of public uses of space. Four urban districts that are planned as main forces to reach long-term economic growth objectives and could push surrounding rural areas to the proposed development are now in a more vulnerable situation of inundation.

Within four central urban districts, facts of inundation have recorded. In 2008 (SIWRP, 2009), approximately 21 streets in the sum of 81 streets inundated due to high tide, and several streets were over 30cm flood depth. Main roads often were in inundated circumstances after heavy rainfall or whenever high tide takes place. Also, many hamlets within the city were in the long-duration inundated situation. In brief, conditions within some districts were recorded as follows, which mostly in four urban areas.

Generally, it would be hard to claim or conclude the intensity of flood risk consequences based on specific characteristics within an area. Nevertheless, the previous observation and growth potential in the period could arouse the foreseeable consequences of a catastrophic event. Reflecting through the viewpoint of water urbanism, Kelly Shannon and Bruno De Meulder (2012) stressed that existing topography characterized as a unique landscape; however, this kind of topography also giving real challenges from the flooding perspectives by diminishing the lowlands absorptive and retentive abilities. Also, the development steered by the local authority should be put into reconsideration. The Vietnam planning system concentrated on a detailed plan with the product of the planning process is a master plan. However, the flood situation could exacerbate when the master plan based on the topography as a development factor.

3.4.2 Land subsidence potential

Land subsidence causes significant impacts on socio-economic development and increases flood-induced situations in areas, especially in flood-prone areas. Consequences predicted by immense affection on the infrastructure system, buildings, housing, etc., hence

land subsidence potential directly contributes to flooding vulnerability and risk. This issue, from subsidence-induced factors to the event's consequences, gets involved in many social fields and management policies; and contributes flooding vulnerability in communities.

The decrease of the earth's surface-level may claim to some fundamental causes for sudden and slow subsidence. The sudden collapse possibly is derived from soil degradation, which takes place rarely in catastrophic events (the earthquake, volcanic, tsunami, etc.) while the slow subsidence caused by the over-exploitation of groundwater resources during a long time. That could claim that it is a natural process and unpreventable or controllable. However, the anthropogenic reasons admitted as a primary factor attributing to soil deformation in low-lying areas or adjacent to the river (Zeitoun, D. G., and Wakshal, E., 2013).

As being non-climate driving forces, land subsidence has been considering as primary driver contributing to flooding in the urban area. It is reported to nearly 70 % of flooding costs in 2050, mostly due to land subsidence, and this issue could be put in remarkable consideration and need to continue research. The available data is the primary challenge to understand this issue of the phenomenon. Numerous studies are going on in the megacities as Bankok, Manila, or Ho Chi Minh City, with the likely conclusion about the damage from land subsidence. The driver quoted as a significant contributor to urban flooding (WB(a), 2010, pp.27).

Regions with addressing with low land altitude predicted to more severe and catastrophic consequences of floods, compounded by land subsidence process. The recorded evidence of land subsidence process conducted in study sites gives the outlook of increasing trend due to foreseeable causes. Water stress in many cities within the Mekong Delta, caused by overutilization of groundwater resources, claimed as the decline of groundwater levels (WB(a), 2010; Catalin, 2014). Details, ground-level decrease were documented from occurred cases in two large urban areas in Vietnam as Hanoi and Ho Chi Minh cities. The evidence of land subsidence recorded. Primarily, Ho Chi Minh City, with the rates from 6mm to 12mm per year could be classified to the urgent urban problems and require more assessments.

Also, the Mekong Delta region has noted as one of the most sinking areas due to land subsidence-induced causes (e.g., land compaction or groundwater extraction; and groundwater resource overexploitation, etc.,) (WB(a), 2010; Stefan Catalin, 2014). The level of subsidence was estimated at an average rate of 16 mm per year (Laura E. Erban et al., 2014) has been the urgent case of land subsidence. This driver of land subsidence might worsen the flood impacts, although the inquiry of more evidence and assessment is necessary. Within the Mekong Delta, Can Tho City is an unusual case of land subsidence. The rate of land subsidence has reported at an average of 17mm per year in Can Tho City (Hiroshi Takagi et al., 2016); remarkably, this rate is higher than the published scale of land subsidence in Ho Chi Minh City, as the most rapidly urbanized city in Vietnam (Table 10). Land subsidence, occurring gradually in years, poses a significant vulnerability to communities, and this driving force noted as in dangerous trend by exacerbating the vulnerability in combination with other drivers.

Regions	The Mekong Delta	Ho Chi Minh City	Can Tho City
Land subsidence rates *Unit: millimeter (mm)*	16 mm.yr-1	From 6 to 12 mm.yr-1	17 mm.yr-1

Table 10 Can Tho City land subsidence rate, in comparison with Ho Chi Minh City and the Mekong Delta

(Source: Stefan Catalin, 2014; Laura E. Erban et al. 2014; Hiroshi Takagi et al. 2016)

With the topography attribute, land subsidence issues may steer the whole city into more vulnerable areas by the flood. Keeping the city as an entire system with reactions among drivers, the contribution of land subsidence is possibly taking a significant part. Based on two aspects, the issue of land decline ultimately makes flood situation worse in the future of this region:

i) The "invisible development of the process" is trying to be observed and then, requiring more precise data of assessment for the whole area; thus, making the ignorance from people; and
ii) People awareness and perception about the groundwater overexploitation is limit, caused by the traditional method in water utilizing so the ineffectiveness of the policy to manage groundwater is explainable.

3.4.3 Sea-Level Rise

Sea-level rise has firstly observed since the 1950s globally, and then, the rising trend reported with the unequivocal announcement of continuous increase over hundreds of years or more (IPCC, 2014). Early, this phenomenon documented and perceived as a result of a complex process of global warming phenomenon — global warming effects on atmosphere and Ocean, and then increase the sea level globally after durations of ice melting mechanism.

Determination of the rise of sea level needs time and more investigation to be concluded or measured. Originated from the technical challenges from unstable movement and the other participated-factors (tidal cycles, land movements, etc.), the work of defining precisely the rise of sea level is a difficult task (John T. Hardy, 2003). With the same meaning, prediction of the sea level fluctuation is not an honest assessment because of the existing of uncertainty on scientific measurement, etc. Nevertheless, the data of sea-level changes are always necessary for many purposes as well as developing scenarios for the future adaptation to identify the flood risk and answer the question of how to deal with it sustainably.

Based on satellite altimetry measurements and traditionally tide-gauge methods, the increasing trend of sea level documented as a real potential. Sea level rise, so turns many places into vulnerable areas, especially in low-lying regions in Vietnam. Vietnam is among the countries most heavily affected by Climate Change, has been emphasized that the consequences of Sea Level Rise would be most serious (Dasgupta et al., 2007, pp. 29). As shown in Figure 15, Vietnam is the most severe country impacted by Sea Level Rise compared with East Asia's countries. The result indicated as to over 16% of Vietnam's territory would be affected by a 5 meter of Sea Level Rise, turning it to be the most vulnerable place among compared countries in which endangered by Sea Level Rise (including Taiwan China, Myanmar, Indonesia, Thailand, Cambodia, Philippine, Republic of Korea, D.P.R. Korea, Malaysia, Brunei, China and Papa New Guinea).

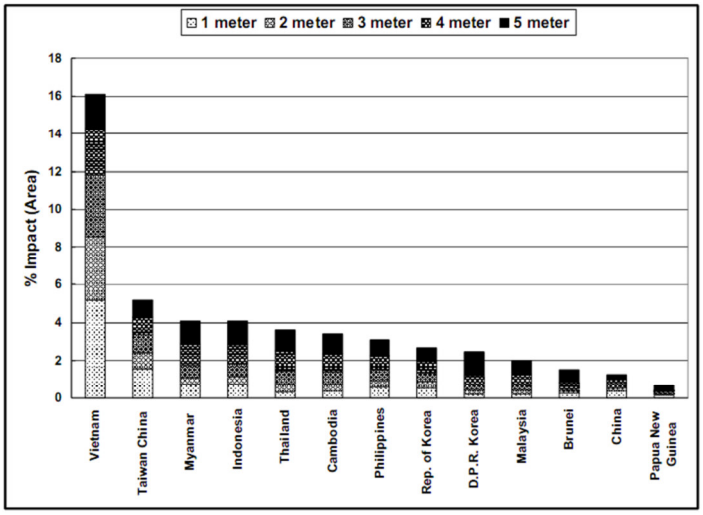


Figure 15 Estimated Sea Level Rise impact of Vietnam within the East Asia countries
(Source: Dasgupta, S., et al. 2007, pp. 29)

Assessed as the most vulnerable to climate change and its consequences, Southeast Asia is always paid special attention by the International institutions and researchers. Being one member of this vulnerable group, the Mekong Delta concluded as climate hazard hotspots; and Sea Level Rise has been the dominant hazard (Yusuf, A. A., and Francisco, H., 2009, pp.6).

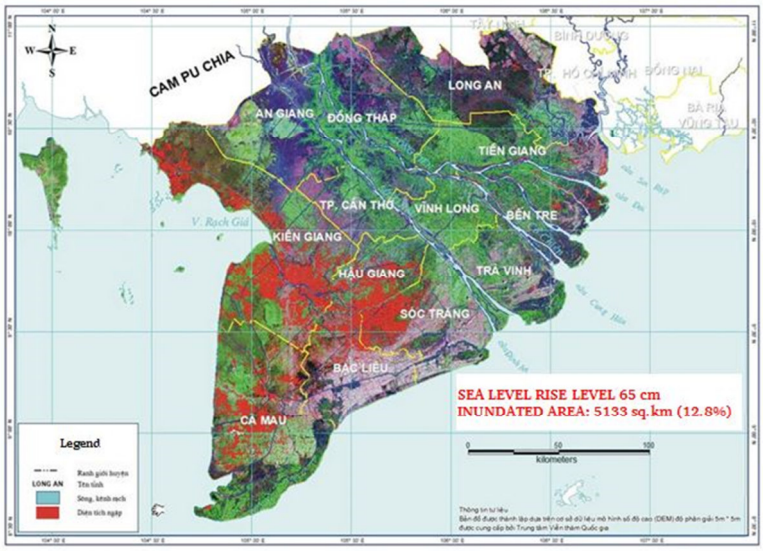
Sea Level Rise in the Mekong Delta is a noticeable issue and has been paid more attention due to being low-topography areas; the rising water level might form the predictable flooding consequences and associated impacts. The Mekong Delta is already suffering and will be the most vulnerable area with catastrophic results of Sea Level Rise and its associated effects such as land loss, saline intrusion, and landslides, etc.

According to MoNRE (2009), in the end of 21st century, it was estimated that up to 15,116 square kilometer of the Mekong Delta (approximately 37.8%) in the high potential situation of being inundated following a 1m Sea Level Rise scenarios of B2[4], with medium emission scenario in comparison to the period of from 1980 to 1999. In three levels of 65cm, 75cm, and 100cm of sea-level rise within the B2 scenario, the results of the 12.8%, 19%, and 37.8% affected the inundation area on the whole Mekong Delta, respectively presented in Table 11 and Figure 16.

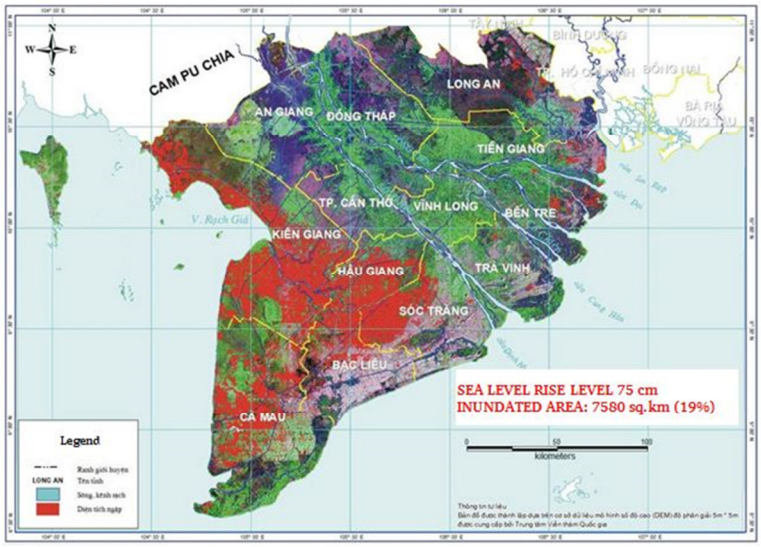
Scenarios of Sea Level Rise	Inundated area	Percentage of areas
65 cm	5133 km2	12.8%
75 cm	7580 km2	19.0%
100 cm	*15116 km2*	*37.8%*

Table 11 Inundation potential from 65, 75 and 100 cm sea-level rise scenarios for the Mekong Delta by 2100 in B2 scenario (medium emission scenario)
(Source: MoNRE, 2009)

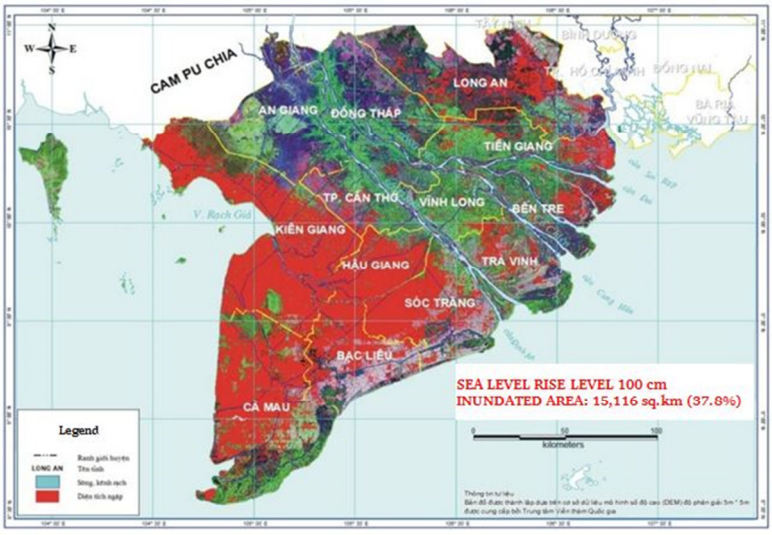
[4] Recommended by IPCC, emission scenarios are classified into 4 groups, arranged from low to high, including: B1, A1T (low emission scenarios); B2, A1B (medium emission scenarios); and A2, A1FI (high emission scenarios).



65 cm Sea Level Rise – medium emission scenario



75 cm Sea Level Rise – medium emission scenario



100 cm Sea Level Rise – medium emission scenario

Figure 16 Inundation map of the Mekong Delta by sea-level rise at 65cm, 75cm and 100cm by 2100

Note: Red dots represent inundation areas (Source: MoNRE, 2009)

As the rising trend of sea level in the Mekong Delta, Can Tho City predicted with the high tendency of Sea Level Rise potential. The fluctuation of sea level and its changing patterns observed regularly and then built potential scenarios. Sea level rise scenarios were constructed mostly based on sea-level rise scenarios of the Mekong Delta. Recorded data recorded at Vung Tau gauge station was used to analyze and to reflect Sea Level Rise potential in Can Tho City[5] (MoNRE, 2011). According to 40-year data in this station that recorded from 1978 to 2008, the average sea level was concluded increasing approximately 3mm per year, with the high rising trend of sea level (Figure 17).

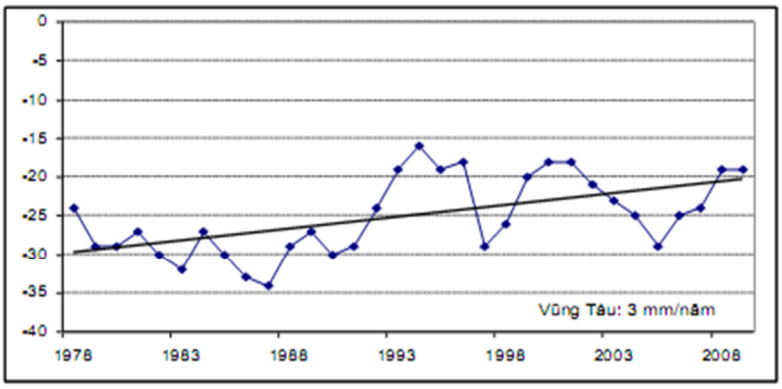


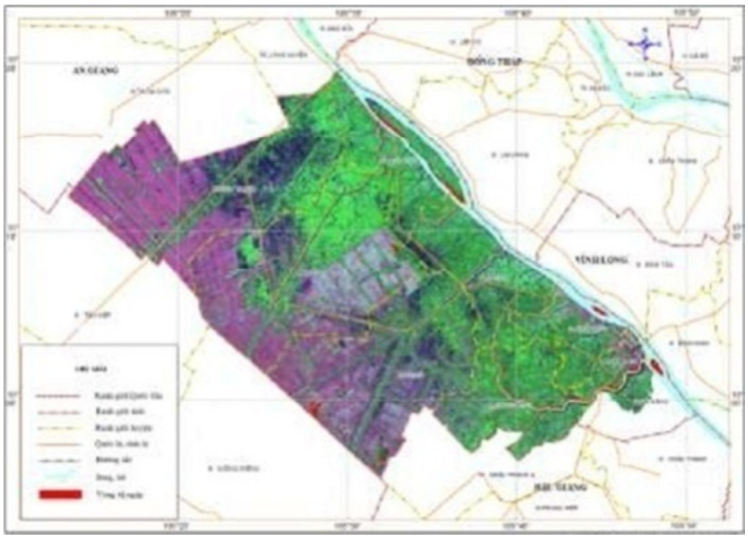
Figure 17 Sea level rise recorded at the Vung Tau gauge station from 1978 to 2008
(Source: MoNRE, 2011)

Being a profoundly affected area of Sea Level Rise potential, the city has established several inundation maps based on many Sea Level Rise scenarios in the coastal regions of the Mekong Delta. Among these scenarios, the medium emission scenario (B2) indicated that in the middle of the 21st century, Sea Level Rise could be started from 22cm to 30cm in the first 50 years and then might be increased around from 59cm to 75cm in the next last 50 years of the 21st century (MoNRE, 2011). Based on these figures, the inundation areas in Can Tho City were also estimated by the MoNDRE to examine the affected areas in the city. Table 12 and Figure18 pointed out the proportion of inundated areas based on the sea-level rise according to scenario B2.

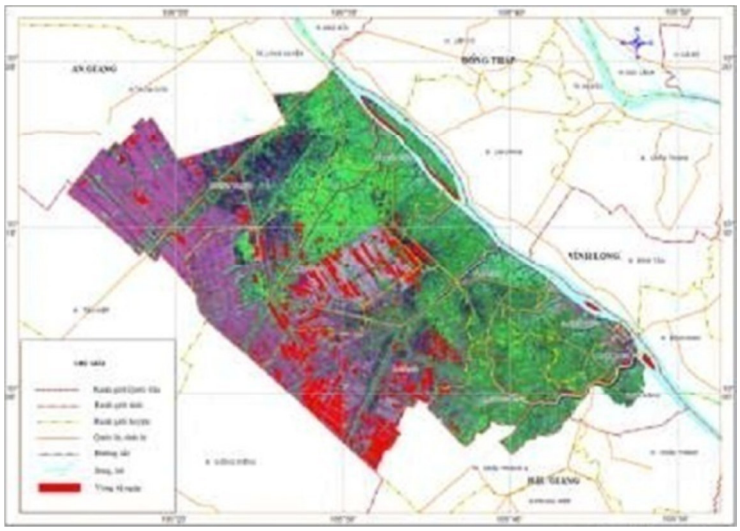
Average sea level rising	Percentage of the affected area	Inundation area
50cm	02.47 %	034.4 sq.km
70cm	11.90 %	165.5 sq.km
100cm	*58.30 %*	810.3 sq.km

Table 12 Inundated area estimate following sea-level rise scenarios in Can Tho City
(Source: MoNRE, 2011)

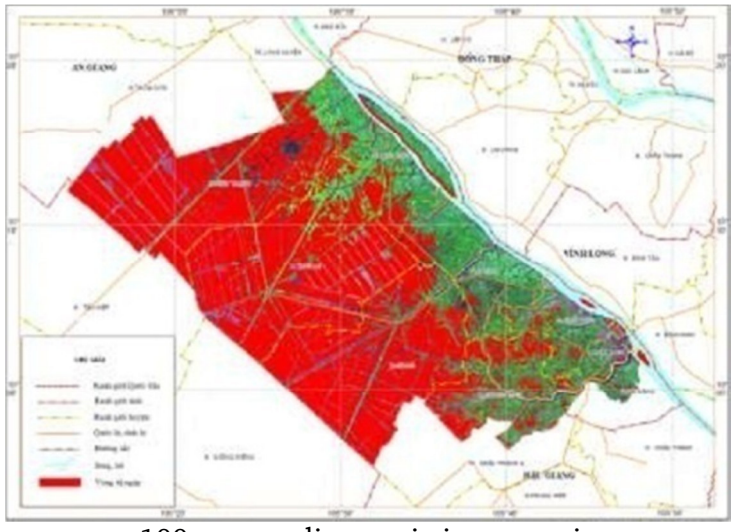
[5] Vung Tau gauge station data was chosen for the typical input data for the whole Mekong Delta and Can Tho City.



50cm – medium emission scenario



70cm – medium emission scenario



100cm – medium emission scenario

Figure 18 Inundation maps of Can Tho City by S.L.R medium emission scenario at 50cm, 70cm and 100cm

(Note: Red dots represent inundation areas - Source: MoNRE, 2011)

3.4.4 Precipitation

Being one of the essential natural driving forces that constituted to flooding in the city, the extreme rainfall events have been claimed to be the primary driver. Unusual precipitation and high uncertainty on natural event forecast could be a big challenge for the city development by increasing flood vulnerability (H. T. L. Huong and A. Pathirana, 2013).

Can Tho City located in the pluvial territory and its precipitation level is reported generally stable, with average annual rainfall from 1600mm to 2000mm (WB, 2014)? The city's average rainfall days are over 120 days per year. Extended rainfall time concentrates within rainy season's months, which seizes over 80% yearly precipitations (from May to November). The unstable distribution of annual rainfall in combination with flooding season in Hau River makes the more inundated difficult situation.

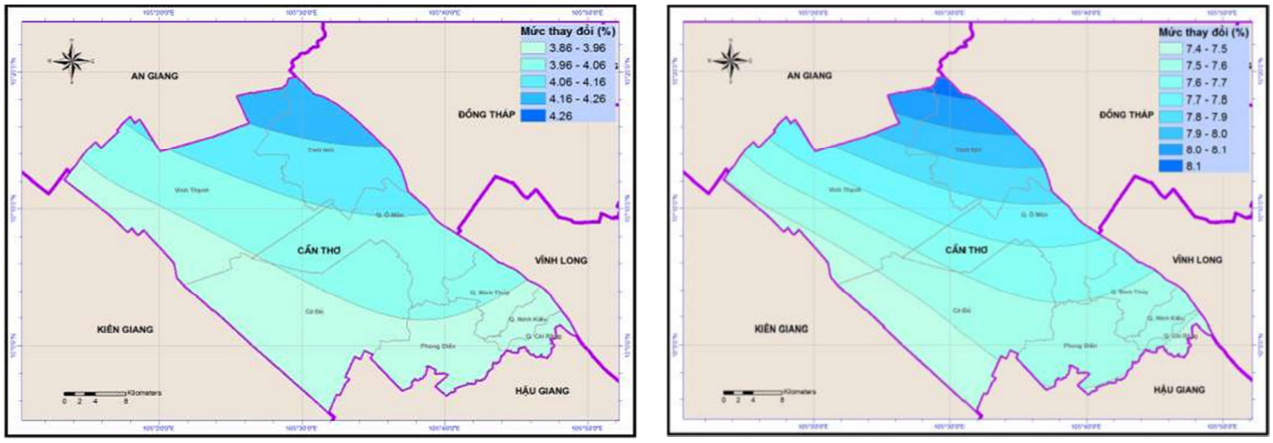
In the middle and end of the 21st century, the yearly changes with increasing trend presented the great challenge to the flooding situation in the city, by increasing flood magnitude as well as frequency. Generally, on the medium emission scenario (B2), rainfall in the dry season would decrease, especially in the Southern climate region of Vietnam, while precipitation trends in the rainy season and the total rain would rise in all climate zones. In detail, the B2 scenario indicated that by the end of the 21st century, the annual and rainy season's rainfall in Vietnam would increase about 5% in comparison with the period from 1980 to 1999 (MoNRE, 2009).

Based on the precipitation pattern from 1980 to 1999, MoNRE (2011) stated in the B2 scenario that the annual precipitation would increase 3.2% in the middle of the 21st century and rise to 6.1% by the end of the 21st century (Table 13). Following the scenario, Figure 19 and Figure 20 show the distribution of rainy season and annual rainfall changes. In this scenario, the high potential of losses predicted due to extreme precipitation. The longtime and heavy rainfall, possibly, exacerbate the flood consequences.

It is noticeable that the substantial changes would take place along the Hau riverbank. Regarding pluvial change distribution, the rainfall would pick the peak in the riverbank area, where rapid human activities and the high population have been taken place, so expanded the vulnerable areas. Thus, people's life and property losses would be huge in the long-term vision.

Milestones of the 21st century	**Period of year**		
	Dry Season (XI – IV)	Rainy Season (V- X)	Yearly changes
2020	-0.4	1.5	1.2
2030	-0.6	2.2	1.8
2040	-0.8	3.0	2.5
2050	*-1.0*	*3.9*	*3.2*
2060	-1.3	4.8	3.9
2070	-1.5	5.6	4.5
2080	-1.7	6.3	5.1
2090	-1.9	6.9	5.6
2100	*-2.0*	*7.5*	*6.1*

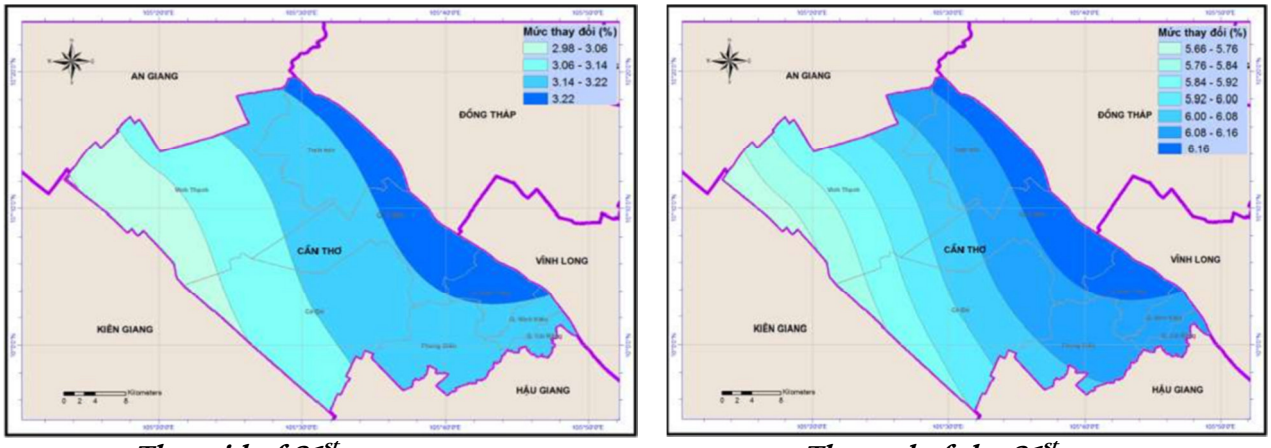
Table 13 Precipitation changes (%) by decades of the 21st century relative to the period of 1980 - 1999 of Can Tho City (medium emission scenario)
(Source: MoNRE, 2011)



The mid of 21st century *The end of the 21st century*

Figure 19 Rainy season's rainfall changes relative to the period of 1980 - 1999 in Can Tho City (medium emission scenario)

(Source: MoNRE, 2011)



The mid of 21st century *The end of the 21st century*

Figure 20 Annual rainfall changes relative to the period of 1980 - 1999 in Can Tho City (medium emission scenario)

(Source: MoNRE, 2011)

3.5 Anthropogenic driving forces

The process of urbanization has been taken place all over the world rapidly (Seto et al., 2011, Angel et al., 2011), and enhanced many urban negative impacts as losses due to people and asset accumulation (Hallegatte, Green, Nicholls, and Corfee Morlot, 2013). The trend of this accumulation expected further growth (Jongman B.P., Ward J., Aerts J.C.J.H., 2012). The huge trend of urbanization witnessed in many Vietnam urban centers. The centralized-development pattern in many metropolitan regions across the country intensified the fast pace of urbanization; therefore, development growth management challenged not only regarding keeping balanced development between cities and towns but guiding the growth adapted with natural hazards, especially urban flooding.

Rapid urbanization results in the increasing settlements, industry expansion and more infrastructure supply could worsen urban circumstances, within three aspects: i) uncontrolled situation of natural increase in urban population; ii) distribution matter of people from rural to metropolitan regions; and iii) transformation from rural to urban patterns (UN, 2006, pp.2). Due to worsening situations, risk takes place in urban areas in which increases vulnerability to natural disasters, especially flooding. According to the World Bank (WB, 2008), flood vulnerability rises in inappropriately developed areas (e.g., poorly maintained infrastructure, unprepared or lacking agreed land-use plan, excluded poor community in a formal proposal, etc.). Similarly, the vulnerability increases within the poor urban populations

due to the low resilient ability to extreme disaster (Parry et al., 2009) or resettlement in high-risk areas (Bicknell et al., 2009). Also, urbanization increases flood risk by increasing flood vulnerability within encroached areas. Increasing artificially impermeable surfaces due to commercial purposes will increase damage in the context of human life and property when floods strike. Flood magnitude and flood frequency are causing overloaded drainage capacity as well.

The profound changes in the relationship between development demands and available resources reflected in the urbanization process. This process includes many transformations, and whether they were recognized or not, the transformed situations create vulnerable sides caused by inappropriate approaches from the issue of overdeveloped. The flood vulnerability, in the links between flood risk and urbanization process, might be identified via the increasing main anthropogenic driving forces encompassing urban population growth, land-use conversion, urban expansion (imperviousness change), and drainage system capacity. The identification of these driving forces regarding the urban development process brings the necessary adjustment for development projection towards flood resilience in at-risk areas.

Among these aspects, the demand for available land and the requirement of new infrastructure support to serve urban growth are addressed and linked directly to the urbanization process. Land demand for more urban expansion is always urgent and also pushes the new upgrading stage of associated infrastructure into a new critical. Due to scare of land, the floodplain encroachment was documented, and then enhanced negative impacts on flood mitigation action implementation. The statement that urbanization can increase flood risk should be discussed, to the manner of risk management to achieve more fundamental perception and recognition from the stakeholders.

3.5.1 Urban population growth

Globally, the growth of the population is potential, especially in urban regions. In this view, human civilization's milestone was put in 2008 when, for the first time in history, more than half the world's population was living in urban areas. The forecast has been issued by the UN (2006) that by the year 2030, 59.9 % world population will be urbanized (Table 14). From 1950 to 2005, the urban population increased fourfold from 0.73 billion to 3.15 billion. The trend of rapid global urbanization has shown within over fifty years to the end of the 20th century.

World	**Population (billions)**					**The average annual rate of change (percentage)**	
	1950	1975	2000	2005	2030	1950-2005	2005-2030
Total	2.52	4.07	6.09	6.46	8.20	1.71	0.95
Urban	0.73	1.52	2.84	3.15	4.91	2.65	1.78
Rural	1.79	2.65	3.24	3.31	3.29	1.12	-0.03
	Percentage Urban					**Rate of urbanization (percentage)**	
	29.0	37.2	46.7	48.7	59.9	0.94	0.83

Table 14 Urban and rural population in the selected period of 1950-2030
(Source: UN, 2006)

The concentration of city resident population and their assets worsens their vulnerability (Hallegatte, Green, Nicholls, and Corfee Morlot, 2013). The population growth momentum in the developing countries was observed in the next decades. To cite an example, 15 mega-cities located in the less developed countries in 2005 and by 2015, as that 17 of the 22 mega-cities planned in developing countries (UN, 2006). The potential of rapid

urbanization in developing countries is not only the global trend but also create competition among growing regions.

Urbanization is taking place rapidly in Can Tho City. The increase of the city population has been witnessed the fast pace in the scale and high speed of urban population growth. In the past decades, the city has been observed quick acceleration in urban population growth, and this rapid upward movement indicated as a social development signal. It is essential in understanding that the population growth is on the urbanization trajectory or the local government development strategy — the long-term plan documented in the approval for socio-economic development planning of Can Tho City in the period from 2006 to 2020, issued by Prime Minister of Vietnam in February 2007.

The population was reported at 1,238,300 inhabitants (General Statistics of Vietnam in 2014), with an annual population growth rate of 9.7% (WB, 2014). The population may reach to 1,6000,000 dwellers in 2020, with urban dwellers could be a peak at 1,200,000. The urbanization rate on the population is 70% to 75%. In the next ten years of 2030, the city population could be at 2,000,000 inhabitants; further, urban district population could increase to 1,6 million urban dwellers (urbanization rate at 75% to 80%) (SRV(a), 2013).

The city population is distributed in an area approximately 1,408.9 square kilometers; the city average population density is 879 inhabitants per square kilometer. The population transformation between urban districts and rural ones reflects the rapid population growth not only in the current trend but several years later.

From 1996 to 2000, the population increase rate peaked at 4.43% per year; and from 2000 to 2005, the urban population reached 10.69% per year. On the contrary, the rural community decreased with an average population decreasing rate of 0.41% from 1996 to 2000 and reduced rapidly in the last five years (5.2% per year). In the case of the rural population in 2005, the number of people remained 76.57% compared to this in 2000 (SRV, 2007; CTCPC, 2007, pp.18). The urban population structure in which towards urban districts increased almost double (from 27.6% to 51.20%) within ten years from 1995 to 2005. Table 15 shows the population structure in urban and rural districts in 1995 and the period of 2000 – 2005.

	1995	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Urban District Population	**27.60%**	32.59%	32.58%	32.57%	49.86%	49.84%	**51.20%**
Rural District Population	**72.40%**	67.41%	67.42%	67.43%	50.14%	50.16%	**48.80%**

Table 15 Population structure in 1995 and the period of 2000-2005
(Source: SRV, 2007; CTCPC, 2007)

It is noted that this urban transformation in the city is on the high trend and that flux of migration to the metropolitan area caused by economic reasons or urban expanding. The movement towards urban areas and industrial zones, or by partially disaster refugees coming from other provinces, caused substantial population rise. Also, the transformation from rural districts to urban areas contributed to the local population increase.

Population concentrated rapidly within urban districts, with an average density of about 1,722 people per square kilometer, while population thinly distributed in the rural areas with an average density of around 570 people per square kilometer. The urban communities located along the river are the main poles attracting migration, with being in a high density of population (Table 16). Notably, the existing community at the summit of 7241 inhabitants per square kilometer in Ninh Kieu urban district is broader approximately six times greater than in Phong Dien rural district (the most rapid population density within four rural areas), with reported 1135 people per square kilometer.

Urban District	**Ninh Kieu**	**Cai Rang**	**Binh Thuy**	**O Mon**
Population Density (people/sq.km)	7241	1129	1258	1032
Rural District	**Thot Not**	**Co Do**	**Phong Dien**	**Vinh Thanh**
Population Density (people/sq.km)	1135	440	829	383

Table 16 Population density in Can Tho City regarding urban and rural districts (2005)
(Source: CTCPC, 2007)

The high concentration of population in the specific area may lead to an adverse impact on people's lives and assets. Flooding is not only harm within the city, but flood risk's impact could be exacerbated in the whole flood-prone area, using the loss of people's life (or pausing public system). Planned as the capital of the region and for over the next decades, Can Tho City was addressed to be a dynamic city serving the whole Mekong Delta and the adjacent international areas, with the associated rising on population. According to approved socio-economic development plan (option 3 out of total four proposed projects), the community is estimated increasing from 1,141,653 people in 2005 to 1,787,681 people in 2020 (CTCPC, 2007, pp.114). Regarding population density, the average population density recorded at 969 people per sq.km (in 2010) will increase to 1,284 people per sq.km (in 2020).

In Ninh Kieu urban district, population density may be settled to 12,000 people per sq.km. In comparison with population density in 2005 (7,241 people per sq.km), the mass will double in 2020. The urban population proportion will increase remarkably in the vision to 2020, while rural districts' population proportion is estimated decreasing from about 50% in 2005 down to 30% in 2020. The population structure will rise noticeably in the next decades. Table 17 shows the expected growth of the population in the master plan for socio-economic development, vision to 2030. In the next several years, the urban population planned as a real transformation; in detail, the downtown district population within 25 years increases from 51.2% in 2005 to 80% population living in the downtown area in 2030.

Year	**2005**	**2010**	**2015**	**2020**	**2030**
Urban District Population	51.2 %	60%	65%	**70% - 75%**	**80%**
Rural District Population	48.8%	40%	35%	**30%- 25%**	**20%**

Table 17 Estimated growth of population structure in 2010, 2015, 2020 and 2030
(Source: CTCPC, 2007, pp.128; CTCPC, 2013)

The controversial issues on population growth to urbanization theme in a place prone to flood risk are multilateral matters. Despite the relationship between urban population growth and economic development requires more evidence on that increasing population enhance the urbanization process; in facts, population issue documented in the rising potential. The growing trend likely motivated by supporting the premier goal of regional development.

The urban development demands and attracts population growth by increasing the flux of immigrants as well, and this rise enhances risk through a process in which altering the relationship between society and natural space. The increase of the migration influx towards urban areas creates two problematic issues. At the above point, the concentration to the

downtown area creates the needs of the shelter and gives a chance to encroachment (e.g., on canals and riverbeds) for settlement purposes (WB, 2014). In the unplanned areas, the creation of slums or illegal settlements is the most phenomena, and by time, the fields upgraded. And on the latter one, the development demands more human power to reach its setting economic goals. The invasion of the vacant position within urban space by the increasing of the population accepted in the economic growth context; as a consequence, the attack would be reported then or legally amended as urban development plan officially.

The threats from the rapidly increasing urban population through the process of urbanization create pressure on current infrastructure systems as well as other associated demands (e.g., services) (Jha A. K., Brecht H., 2011). The basic needs caused by the urban population development require more upgrading of the infrastructure system, however, the improvement of the primary supply system (water supply and drainage, electricity, vacant lands for education, health care system, communication etc.,) is often in a slow tempo because of shortage investment, the postpone of decision-making process or wrong planning in specified time. Also, the increasing population demands the consumption of land (Jha A. K. et al., 2012, pp. 142).

The increasing of the population or the movement of inward migration to the urban area directly exposes a particular area to flood risk, especially areas possessed vulnerable flood attributes (e.g., directly affected by monsoon season flood and in a combination of other natural flood driving forces). Built-up areas are spreading outward, decreasing the pressure of population density accompanied by urban population increase (Jha A. K. et al., 2012). The land encroachment to adapt to space demand is not treated in the manner of the settlement-problematic issue; yet, the matter is pinned and accepted by urban development reasoning. Achieved land from encroachment is planned for development purpose, instead of adapting to population rising by other options.

3.5.2 Land Use Change

The relationship between flood events and land-use change has confirmed (APFM, 2009, pp. 8). In the city, rapid land-use change progress has considered in a long time of observation; and the alternation examined by the investigation into the land transforming perspective. As a most effective tool to reach the premier goals of urbanization and modernization, land use planning measures used by the authority. The robust land transformation process implemented to accelerate economic growth and development at a fast pace. In detail, a series of official decisions and resolutions have been approved by the Central government as a political will to perform the most affected transformation to take the city to be an industrial and hub city within the Mekong Delta region. These decisions and visions comprise:

- Decision 151/QD-TTg on August 29, 2013, by the Prime Minister approving the adjustment to the general planning of Can Tho City to 2030, vision to 2050;
- Decision 1533/QD-TTg on August 30, 2013, by the Prime Minister approving the master plan of economic-socio development of Can Tho City;
- And, resolution No.57/NQ-CP on May 4, 2013, on the land use planning to 2020 and the first 5-year land use planning (2011-2015) of Can Tho City.

The master plan is the most comprehensive in contemporary, presenting the substantial transformation of land utilization. Due to the land-use measure as a vital driving force, the examination into the land transformation on differential purposes reflexes not only the urbanization rate but the vulnerable level within a flooding-induced area. The land-use change in the city was assessed by analyzing the previous situation, the current land use status in combination with the oriented plans issued by the responsible authority.

It is noticeable that land-use plan in the vision to 2020 was oriented by local government (approved by the central government), with the set objectives as achieving the national-level-city title, obtaining quick growth rate as well as being the urban center for the whole Mekong delta. The substantial transformation of land use then implements these goals.

The vast land portion of land groups transferred into non-agricultural land, while the vacant land and available water surface are considered wholly exploited.

Table 18 shows the transformation of land use in the past, in the current status, and oriented expansion of agricultural land and non-agricultural land via land-portion indicators for every five years (2005, 2010, 2015 and 2020).

	2005	**2010**	**2015**	**2020**
Natural Land	140,096	140,096	140,096	140,096
Agriculture Land Group	***115,676***	108,494	104,459	***97,009***
I – Agriculture Production Land	114,352	106,712	102,619	95,109
II – Aquaculture Land	1,097	1,550	1,600	1,650
III – Forestry Land	227	232	240	250
Non-agriculture Land Group	***17,069***	24,611	28,800	***36,250***
I- Special Used Land	11,109	16,536	19,990	25,550
II – Housing Land	5,960	8,075	8,810	10,700
Vacant Land and River, Canal	***7,351***	6,991	6,837	*6,837*
I – Vacant Land and Unused Water	321	154	0	0
Surface	7,030	6,837	6,837	6,837
II – River, Canal				
(Unit: ha)				

Table 18 Land Use transformation in the oriented plan
(Source: CTCPC, 2007)

There is a massive growth in the group of non-agriculture land, with a fast rate of transformation. The demand for non-agriculture land in the region will grow to 36,250 ha in the vision to 2020, so the need is planned growth rate (113%) within 15 years from 2005 (17,040 ha) to 2020 (36,250 ha). In detail on housing land, which belonged to the non-agricultural land group, the demand has been witnessed approximately two times growth as well (increasing from 5,960 ha in 2005 to 10,700 ha in 2020 – Table 19) (CTCPC, 2007; CTCPC, 2013).

The rapid land transformation is reflected within two main segments of the non-agriculture land group: specialized land and housing land. Missioned to 2020, in comparison to 2005, the housing land in urban districts is increasing 80% while the specific land segment is planned up to 130% — notably, the downtown district land planned with demand up to 147% (Figure 21 and Figure 222) during 15 years.

In the specialized land segment, the land for construction has been reserved to be growth approximately five times within 15 years, as the substantial land-use portion transformed into construction-using purposes (Table 19 and Figure 21).

	2005	2010	2015	2020	Increasing Percentage (2020 compared with 2005)
Non-agriculture Land Group	**17,040**	**22,080**	**28,800**	**36,250**	**113%**
I - Specialized Land	**11,109**	**16,536**	**19,990**	**25,550**	**130%**
- Construction Land	2,131	4,230	7,120	10,570	396%
- Transportation Land	2,038	3,065	3,780	4,990	145%
- Irrigation Land	5,328	5,658	5,410	5,370	1%
- Other Land	1,612	3,583	3,680	4,620	187%
II - Housing Land	**5,960**	**8,075**	**8,810**	**10,700**	**80%**
- Urban District Land	3,038	5,077	5,550	7,490	147%
- Rural District Land	2,922	2,998	3,260	3,210	10%
(Unit: ha)					

Table 19 Land Use Change in Non-Agriculture Land Group in 2005, 2010, 2015 and 2020
(Source: CTCPC, 2007)

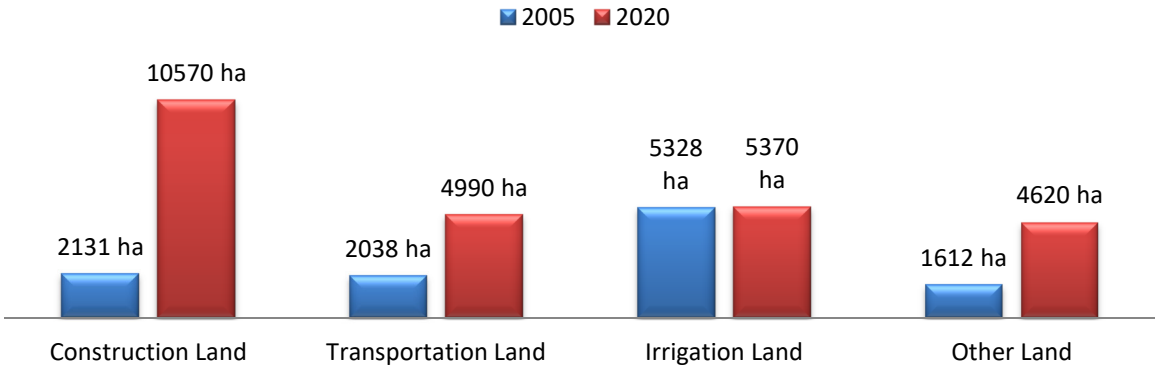


Figure 21 Specialized Land segment in the period of 2005-2020
(Source: adapted from CTCPC, 2007)

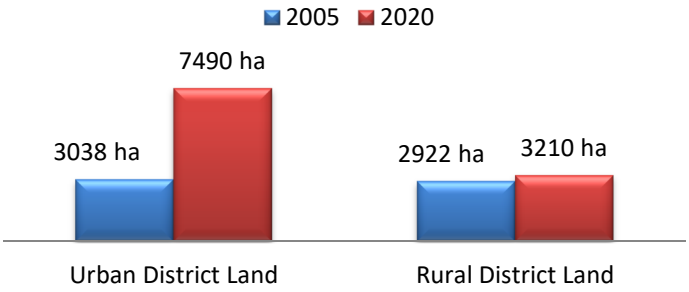


Figure 22 Housing Land segment in the period of 2005-2020
(Source: adapted from CTCPC, 2007)

The substantial transformation into non-agricultural land imprinted on the next decade of the land use plan from 2005 to 2020 (Table 19). In this group, the segments of specialized land and housing land have been envisioned continuously growing (Figure 21 and Figure 22). In 2030, the specialized land extends to 28,000 ha (from the planned proportion of 19,000 ha in 2020) while the housing land reaches to 14,500 ha (from the setting area of 9,000 ha in 2020) (SRV(a), 2013, pp. 2). Within the next ten years from the envisioned the year of 2020,

the rapid development from the two main segments of the non-agricultural group indicates the land-use change progress in the city, with high expectation from the land use driver as one of the primary interventions from the authority levels.

3.5.3 Urban expansion and the rising of imperviousness

Can Tho City represents for a typical growth pattern in the Mekong Delta. Being under the direct management of the national-level government brings opportunities as well as challenges in progress toward regional center-envisioned. The urbanization progress, which, based on the considerations in the multilateral sectors, puts pressures of many economic driving forces onto the city. The pressure on urban land could be an example to understand how rapid land transformation could motivate the encroachment in flood-prone areas, and result in more flood vulnerability within the city.

The examination of the relationship between urban expansion and the inundation phenomenon was recognizable by observation of the land-cover change in the city and the following time intervals. By employing satellite data and Geographic Information System, the historical data can be analyzed to reveal urbanization patterns.

In this investigation, the satellite remote sensing data has been used to extract built-up areas via setting periods. In the past 35 years, from 1972 to 2007, the rate of urban expansion has concluded as increasing in the fast pace, by 8.1%, 22.6% and 24.3% in three selective periods of 1989-1997, 1997-2002, 2002-2007 respectively (Pham Thi Mai Thy et al., 2010) (Table 20 and Figure 23). The high rate of increase in built-up areas through periods indicates the rapid growth of urban expansion, especially in the two last periods (1997-2002 and 2002-2007). The first 5-year period witnessed 22.6% of increasing each year; as the second period experienced, approximately 24.3% per year of the built-up area rose continuously within five years.

Year	1972	1989	1997	2002	2007
Urban area (sq.km)	6.1	2.59	4.26	9.07	20.11
Rate (%/year)	-	-	8.1	22.6	24.3

Table 20 Growth in built-up areas distribution
(Source: adapted from Pham Thi Mai Thy et al. 2010)

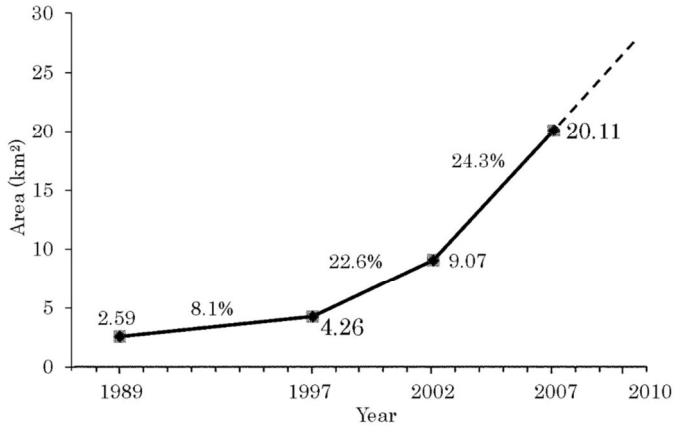


Figure 23 Accelerated build-up area growth rate within the city
(Source: adapted from Pham Thi Mai Thy et al. 2010)

The observed city growth has been examined by urban sprawl in many years, so suggesting the primary trend of expansion. William Veerbeek et al. (2011) concluded that urban sprawl was not only on the fast pace in the urban districts but the suburban development recorded in dense intensification. In details, the urban growth increased by

almost 50%, as the suburban areas rose 55.7% in 2006. In the next phase to 2035, the suburban expansion projected on the rise to 63.6% of suburban development.

The models have been initialized using land cover maps from the years of 1992 and 2006. Further, the short and mid-term periods of the city's growth (in years of 2035 and 2060) have been conducted to observe the potential of land cover and impervious area changes. The town almost grows double in size over the period. While urban center increases at a low pace from 2006, the suburban area witnesses the rapid growth in the same period. During the time from 1988 to 2006, the city saw the rapid expansion within the urban and suburban areas, the changes both over 50% from 44.5 square kilometers in 1988. However, the pace is still rising to 63.6 % from 2006 to 2035 in the suburban area, making a significant transformation within the suburban area. Estimated data applied to 2035 in the suburban area increase so high, while at that time, the pace of impervious urban area growth is in the low trend. It could indicate that urban expansion in the city is still going on in the potential.

Table 21 shows the increasing trend of urban extent area, metropolitan area, and suburban area in the documented period of 1988 – 2006, the estimated pattern of urban sprawl 2006 – 2035 and 2035 to 2060.

	Urban Extent		**Urban**		**Suburban**	
Year	area (sq.km)	Change	area (sq.km)	Change	area (sq.km)	Change
1988	44.5		19.4		25.0	
2006	68.1	53.2%	29.2	50.0%	38.9	55.7%
2035	95.7	40.5%	32.0	9.7%	63.7	63.6%
2060	106.5	11.3%	34.8	8.7%	71.7	12.6%

Table 21 Estimated growth on the urban extent in the period 1988-2060
(Source: William Veerbeek et al. 2011)

Build-up areas have been growing within the city center districts located along the riverbank, and this direction of development motivates challenges not only in socio-economy issues but environmental consequences. In years, the large-scale land conversion could contribute to the flooding-induce situation from the city's urban districts, with evidence of development expected for the next decades may increase more land conversion.

The rapid land conversion within urban districts in which located along the river with the high population density may exacerbate flood impact, with more associated damage. This riverine encroachment caused by urban expansion is not only increasing the flood exposure in the city core but also enlarging the vulnerability rate and affecting the other processes, which indicated as flood driving forces. The encroachment is typically present within urban districts.

Ninh Kieu urban district, as the hotspot of development, witnessed the rapid land transformation, dry vegetation to build-up areas, for instance. The particular portion of land has been changed within Ninh Kieu urban districts, recognized on 31,67 ha of land cover change (Pham Thi Mai Thy et al., 2013). These land conversions comprise mostly changes from dry vegetation (vegetation in dry soil) to built-up (residential, commercial, industrial, transportation, urban, built-up land, etc.), as dominated conversion; and the minor changes imprinted in bare areas (soil without vegetation and no concrete areas) to built-up, from built-up to dry vegetation, transforming from dry vegetation to water bodies (streams, canals, lakes, etc.,); and the other transformations (Table 22). The remarkable conversion from dry vegetation to build-up indicated the high speed of urban expansion — the changes recorded and examined from 2001 to 2008, with the percentage of 45.8% of changed areas reporting from dry vegetation to build-up land cover class.

No.	Land cover change Classification	Area (ha)	Percentage
1	Dry vegetation to Built-up	14.49	45.8%
2	Bare to Built-up	6.18	19.5%
3	Built-up to Dry vegetation	5.46	17.2%
4	Dry vegetation to Water bodies	2.88	09.1%
5	Others	2.66	08.4%
Total of the changed area		**31.67**	**100 %**

Table 22 Area of land-cover change in Ninh Kieu Urban district
(Source: adapted from Pham Thi Mai Thy et al. 2013)

The high rate of urban expansion is based on the transformation of land functions in the fast, and this rate accelerated by socio-economic development policy. The rapid development in center cores results in more severe impacts (e.g., changing the land cover in the area). The most developed urban district in the city core is Ninh Kieu district, with the high density and represented as a fast pace of urbanization, which has been experienced on substantial changes of land cover. It reported that 31.67 ha of cover land had converted into the district by examining the land cover categories in the year 2001 and 2008 (Table 22). The rising of impervious areas by land-use transform possibly affects the hydrological regime, resulting in urban inundation lately within the city core.

Urban expansion addressed increasing imperviousness on the land-use transforming mechanism in the city. The urbanization rate set at 70%, Can Tho City might witness unprecedented economic growth, and permeable surfaces narrowed considerably. By putting the pressure of city land extension, the development policies turn suburban areas into urban land, unoccupied land to imperviousness area, which means a large portion of green land has transferred into hard surfaces.

The formation of imperviousness within the city has evolved for years, and on prevailing potential due to the rapid urban expansion. Based on historical data and by using physically urban growth models or growth patterns, the current impervious area growth rate of the city can be revealed, so then forecast the next stage of urban expansion progress. In the city, there was an observation of the current urban extent towards the rivers from 2006 (Figure 24). In the estimated scenarios in 2036 and 2060, the impervious land cover may spread for the whole urban core. This situation is wholly exposed more damage to river flooding; and intensified the catastrophic impacts of monsoon-driven urban flooding.

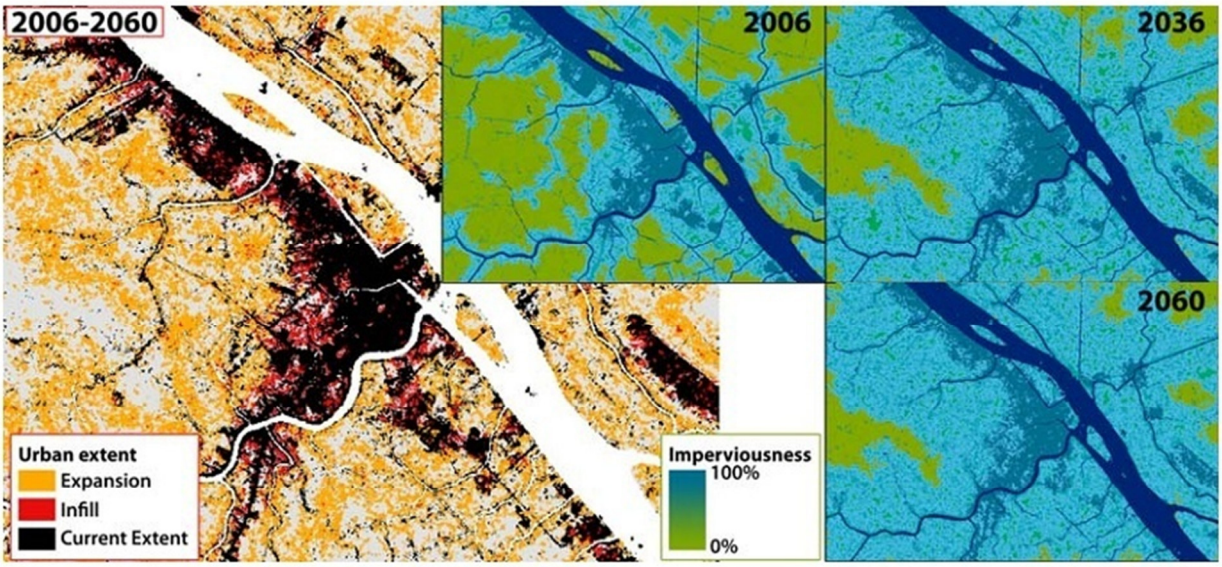


Figure 24 Expected urban growth and the distribution of impervious land cover
(Source: William Veerbeek et al. 2011)

Due to adversely affected by development decisions in the master plan, the implementation of urban expansion progress plays an essential role in food exposure in a specific area. In Can Tho City, the process of urbanization with a fast pace identified as a premier goal in the master plan, which envisioned to 2030. The urban extension, which was observed by the expansion of urban areas to adjacent rural districts and the rising of population density in the downtown core (urban districts), is under vigorously promoted policies.

The increase of imperviousness as the impacts of development policies made changes from the relationship amongst the canal system and road network, etc., which keeps a vital role in flood mechanisms in riverine regions. Following the master plan of development applied to Can Tho City in the next decade, the urban expansion is employed as the dominant forces to implement the socio-economic development plan. The rise of imperviousness as the result of rural land occupation presents high flood impacts. By intensifying the runoff as a result of the transformation to a hard surface within urban areas, the hydrological regime is an important issue that must challenge.

Urban areas become more expanding and denser, or more vulnerable to flood risk by increasing flood exposure. Despite the improvement of the infrastructural system and associated services implemented within the city to adapt to population pressure, the decrease of permeable areas due to urban expansion keeps enhancing flood vulnerability. In fact, in the city, in the current situation, there is easy to observe the inundation keeping track with the increasing of imperviousness, especially within the high-density districts.

How to tailor the development progress to reach the sustainable development goal within riverine regions must be put into careful considerations. The motivation of urban expansion could observe the current situation of flooding exposure and do more harm to city development. Although flood exposure comprising many driving forces, the rise of imperviousness or urban sprawl to the natural environment always keeps the main contribution to flood impacts by changes the hydrological mechanism and should be paid more attention to the flood issue in the river-characterized place like Can Tho City.

3.5.4 Drainage Capacity - Insufficient urban infrastructure

In urban infrastructure network and public facilities, the drainage channel system is an essential issue on the side of the conventional approach of the city; and on the other hand, it has been known as the significant measure to deal with the urban flood, with the universal

awareness of necessary infrastructure. Being an issue that attracted frequent monitoring and assessment, the city drainage system reported as an insufficient system to take the leading part in the role of flood management mechanism. As the main channel in flood management strategy, the drainage system (with the old installation from before 1975) still works insufficient, with inadequately estimated design capacity as well as keeping track of the city's development. The drainage system in the residential areas was reported as in unsatisfactory situation, addressed "a relatively completed" system existing only in Ninh Kieu urban district (WB, 2012, pp.47).

Drainage infrastructure keeps a crucial role in keeping the right track in urban activities, with the critical response to reduce severe flood impacts in the view of the urban hydrological regime. Deficiency of drainage and sewerage systems (e.g., clogged drainage, with the other development failures (e.g., poor building code, blocked riverways, etc.), may cause urban flooding and should be addressed as a priority in possible options for applied measures (Shah, F. and Ranghieri, F., 2012, pp. 34-84). Despite flood mechanisms depending on many aspects, drainage capacity is being noted as one of the leading causes of flooding. The drainage system comprises many components, with the primary responsibility of conducting stormwater into watercourses or storage areas. Hence, the precondition is a crucial requirement that the drainage channel worked in the appropriate capacity. Drainage system capacity includes meeting the technical design inflow density and properly working duration. The first capacity gets involved in the urban planning vision, and professional standard, as the regular maintaining and constant upgrading, completely fulfill the second one.

Notably, an inefficient drainage infrastructure enhances surface flooding by "extended surcharge conditions" (Schmitt et al., 2002, pp. 3); further, in case of flood-prone areas, the severe consequences are likely to be projected. The drainage system within a place, with expectation full of capacity, on the one hand, is a channel of a combination of many components of other networks. On the other hand, the proper running of the system depends on the different regimes such as hydrological regime in the region, in both groundwater mechanism and surface runoff, as well as the tidal regime in some riverine areas, etc. With that complexity activities, conveying the rainfall water from urban areas to watercourses drainage channel requires the combination with the other regimes (surface runoff reduce, non-structural measures, etc.,) to reduce to flood duration and impacts. The drainage system in an urban area is not in the excellent condition of working. Thus the threat of inappropriate systems could be claimed as a challenge.

The drainage system is not only responding to the primary role in reducing rainfall runoff but is a critical element of the city's strategy in terms of flood risk management. Shortly, the city may face a complex flood mechanism caused by riparian seasoning flood and the other associated flood-induced threats. Directly affected by the riverine flood, the whole city is in the flooding situation in the period from August to the end of the flooding season in November annually caused mainly by water exceeded Mekong River. The inner city part, including urban districts, primarily based on the existing drainage system, recently is observed often in inundation situations. On a high rate of development, Can Tho City's infrastructure networks must be projected in line with the pressure of contemporary urbanization requirements and on future demands, in particular with the drainage issue.

According to the Vietnam upgrading project (WB, 2003), Can Tho City in current employs the combined drainage system, with the same pipeline networks for both wastewater (encompassing industrial and domestic waste) and stormwater drainage. The primary mode is working based on 53 kilometers of sewerage and open ditches, which built along 46 main road routes during the three main phases (Table 23).

The phase of system building	Before 1975	1975 – 1993	After 1993
Built drainage system (Total 53 km)	23 km	8 km	22 km

Table 23 Built drainage system in Can Tho City within three main phases
(Source: WB, 2003)

The high urban growth rate of Can Tho City has put severe pressure on the city infrastructure, particularly in the drainage channel and sewer system. The current drainage networks are not only under-capacity to response to the demand but indicated on unable to keep pace with urban development. The delay in this service may result in more extended inundation and severe flooding, particularly in high rate precipitation and high tide periods. The inadequate and degradation drainage system has been assessed by WB (2003), with the top recommendations of important innovation on the system. The existing drainage networks are not in-line with current and future development (current accounts for 0.14 m/person – 2003). The overall system has been assessing degradation, overload, and mud sedimentation status.

The obsolete and downgraded circumstance may induce vulnerable spots within highly developed areas at flooding events. The failure of drainage capacity firstly claimed to "inadequate designing,"; and therefore, this may affect the routing ability of the system as well as release the long-term consequences on the working periods. The stormwater drainage capacity was designed on the standard of 20-TCN-51-84 in which employed the method of limited intensity and formula (WB, 2003). In the Ninh Kieu urban district's core assessment, the drainage system within an area of 125 ha bounded by Hai Ba Trung – Nguyen Van Cu – Nguyen Trai – Truong Dinh streets, has been reported that the practice drainage capacity performed at the under a half (less than 50%) of requirement (SIWRP, 2009).

The network was not only responding to the increasing demand for drainage, but also the existing drainage system is not on the excellent maintaining or system upgrading situation for many contributions. WB (2003) also presented that the degradation of the system, overload working capacity, and mud sedimentation are the most common failure in the imperfect system, associated without many maintaining activities. The next could lead to system failure may derive from the wrong gradient in the sewer in the installation step, leading to a high risk of sludge accommodation. Lastly, without frequent monitoring and upgrading as well as failure detecting, fixing activities, etc., are vital contributing factors to the degradation of the networks. According to Luis Neumann et al. (2011, pp. 23), the system's deterioration could be the pressure on the underground system caused by the expansion of wetting and drying of soil layers as well.

According to SIWRP (2009, pp. 20), the current drainage system in the urban core areas assessed a failure to meet the capacity demands. Ninh Kieu and Binh Thuy districts had a total length of approximately 127,000 m (2009) of pipeline networks of about D300 – D1000 mm in diameter, and this system focuses on the communities located along the central axis roads. These areas also equipped over 3,600 m built-drainage ditch system with 3-6m in width; and hundreds of meters of natural drainage ditch network located at some streets (Cach Mang Thang Tam, Xo Viet Nghe Tinh, and Ho Xuan Huong streets) and deep-alley households. Table 24 shows the existing drainage system within two central urban districts in 2009.

No	Dist.	Quan. of line (n.o.s)	Length (m)	Ferro Concrete Drainage Pipe (m)					Natural Drainage Ditch (m)
				D100 – D200	D300– D400	D500– D600	D800	D1000	W3-W6
1	Ninh Kieu	38	118,283	303	38,336	31227	38,698	6,775	2,945
2	Binh Thuy	3	8801	90	1830	3515	2620	16	730
	Total	41	127,084	393	40,166	34,742	41,318	6791	3,675

Table 24 Drainage system within Ninh Kieu and Binh Thuy urban districts (2009)
(Source: SIWRP, 2009)

The storm-sewer network (combined drainage system) has been developed mainly on strongly urbanized like Ninh Kieu and Binh Thuy urban districts where drainage innovation had been taking place. Nevertheless, the system capacity was inadequate on its primary task during long and heavy rainfall events. Due to the limited ability to collect both wastewater and stormwater, the greywater received and freely ran over surfaces. Further, heavy rainfall intensities in combination with high tide regime, the city's core may face dangerous flooding situation. In contemporary and envisioned development phases, the increasing of construction density quickly, regardless of the drainage network capacity, could exacerbate the risk in the inner core of the city.

Although the existing and potential failure of the system contributed due to many reasons, the rush of improvement of the network not only supports the ordinary working routine of the city but playing a pivotal role in flood consequences' relief. On the high priority demand of strengthening, the drainage system has been assessed of inappropriate status to address the flood challenge due to financial resources (WB, 2014, pp.43); furthermore, the inadequate condition may arouse the network's failure. Drainage network failure is on the high potential within the city in both of urban core and rural districts. The system, thus, requires more effort not only on more extend but frequent inspections and maintaining. The system must be evolved in combination with non-physical measures (e.g., buffer zone) in the manner of environmental aspect consideration, rather than purely treated on the financial account. Table 25 presents the potential failure of the system as well as suggested improvement.

No.	Network failures	Consequences	Possible improvement
1	A combined system (waste and stormwater)	Capacity overload	New separated system installation and clearance the existing networks
2	Insufficient in the sewer network, limited in certain areas (primarily developed in urban parts of the city, e.g., Ninh Kieu and Binh Thuy urban districts)	Increasing runoff load	New supporting networks in comparison with other measures to relieve the runoff
3	Waste accumulation	Increasing runoff	Frequent clearances
4	Deterioration of the structure induced leaking or stop working	Stop working and shorten life-span	Regular inspections
5	Future demand exceeding the designed networks	Longer inundation events	Planning system employment

Table 25 Drainage system failures and following flood risk impacts
(Source: author)

In the same circumstance with other infrastructure systems, drainage networks cannot adapt to current demands as well as the health status of development in the future, with the high recommendation from the local water utility provider (Luis Neumann et al., 2011). Therefore, the drainage system might be the real challenge due to transforming and increasing both risk components of flood risk, regarding high exposure to flood damage and flood vulnerable-spot forming.

Insufficient capacity and degradation potential on drainage systems are dominated highlight in the city's core as well as adjacent districts. These matters of drainage networks in the city have improved by the innovated initiatives focusing on the current system; however, the fibers are likely impossible to undertake the mainstream on urban flooding control in the long run. Although the authority's endeavor on this issue to find the comprehensive plan or groups of solutions, the in-line problems of future demand arouse the challenges of the flood risk damage relief. The longer flooding duration potential, therefore, would demand the new approach rather than the current investments.

3.6 Results and discussion

3.6.1 Results

The study findings present on revealing different facets of flood driving forces as processes or trends that contributed to the flood-vulnerability status, possibly increasing flood risk and forming the flood-prone area. An approach by data content analysis used here allows identifications of not only constitutive factors in which making and growing flood vulnerability but also providing pieces of evidence and assistance to flood risk responses that were based on the specific characteristics in Can Tho City.

The case study introduces the background of flooding's situation in Can Tho City and reveals the potential flood risk following a "Source – Pathways – Receptors" mechanism. Flood driving forces treat as developing processes contributing to negative flood risk consequences (Figure 25).

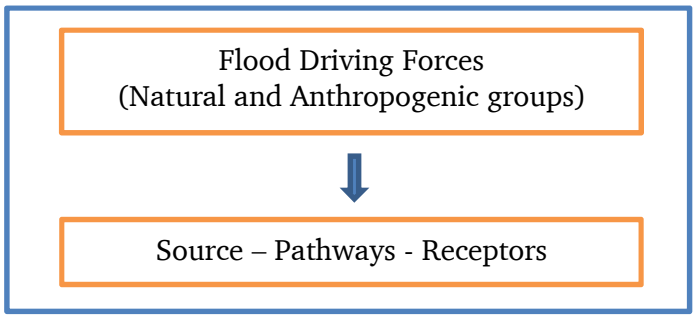


Figure 25 Flood driving forces as processes change the flood's state
(Source: author)

In this viewpoint, flood risk may comprise flood hazards and flood vulnerability components. Flood hazard, as the first component treated as a source, has been indicated by one group of natural driving forces and their associated inducements towards flooding potential. Flood vulnerability, as the second component in the model, responded as pathway - receptor, has been represented by a group of anthropogenic driving forces. Flood risk exacerbated by these driving forces in the study site are rising actively and triggering floods and more extended inundation events. Therefore, the natural and human-made driver groups fit explainable conclusion the city as the flood-prone area and at-risk situation by exacerbating the high flood potential driving forces.

The first group encompassed topography, precipitation, sea-level rise, and land subsidence driving forces, while the latter group introduces population growth, land-use change, urban expansion, and drainage network capacity drivers.

The natural drivers witnessed the disadvantaged of the current situation and high potential for growth. On the first two flood driving processes, plat topography dominated half of the city, with 67.1 % areas ranging from 0.5 to 1.0 meter; and land subsidence rate was at approximately 17mm per year. Both expose the high vulnerable characteristics to forthcoming flood events. The next two drivers, precipitation and sea-level rise, has been assessed through analyzing medium emission scenarios; however, both results of two drivers' scenario assessment presented a high potential for growth. Precipitation may on the top trend of rising, up to 6.1% to the end of the 21st century. Sea level rise could harm over half of the city in case of sea level actively increasing 1 meter, following the medium emission scenario analysis, while the city witnessed the approximately sea level rising 3 mm each year.

Similarly, the anthropogenic driving force group is presented by features that experience in a growing trend. In detail, the population is at a rapid rising pace due to the envisioned goal of pursuing a regional economic hub, pressing over 1.7 million inhabitants of envisioning a community in 2020, with 75% city population located in urban districts. The high concentration within urbanized and centralized areas triggers high loss potential of flood damage when population density may be doubled (since 2005 at 7,241 people per square kilometer in the Ninh Kieu urban district). On land-use change, the robust inversion from agricultural land group to the non-agricultural land one detected regarding not only rapid conversion trend on land use but the high potential risk at formation patterns resulting vulnerability. Within 15 years, the city land had been recognized the twofold growth on non-agricultural land from 17,040 ha in 2005 to envisioned towards 36,250 ha in 2020. The driver of urban expansion, further, presents the development of built-up areas or decrease of perviousness in the city. On the observation from 1972 to 2007 in which divided into main phases (comprising 1972-1989, 1989-1997, 1997-2002 and 2002-2007), the high rate of build-up area growth exposed. Within the city, the last stage was reported as the top rate at 24.3% each year of growth from 2002 to 2007. The activity of conversion into build-up discovered in the Ninh Kieu urban district, with dominated inversion from dry-vegetation to build-up areas. The last driving force, the drainage network, had been known as the primary

measure to relieve the severe flood damage; nevertheless, the system represented as insufficient and degradable networks. In high flooding vulnerable areas as centralized districts, Ninh Kieu urban district's drainage capacity reported undertaking at 50% demand (Figure 26).

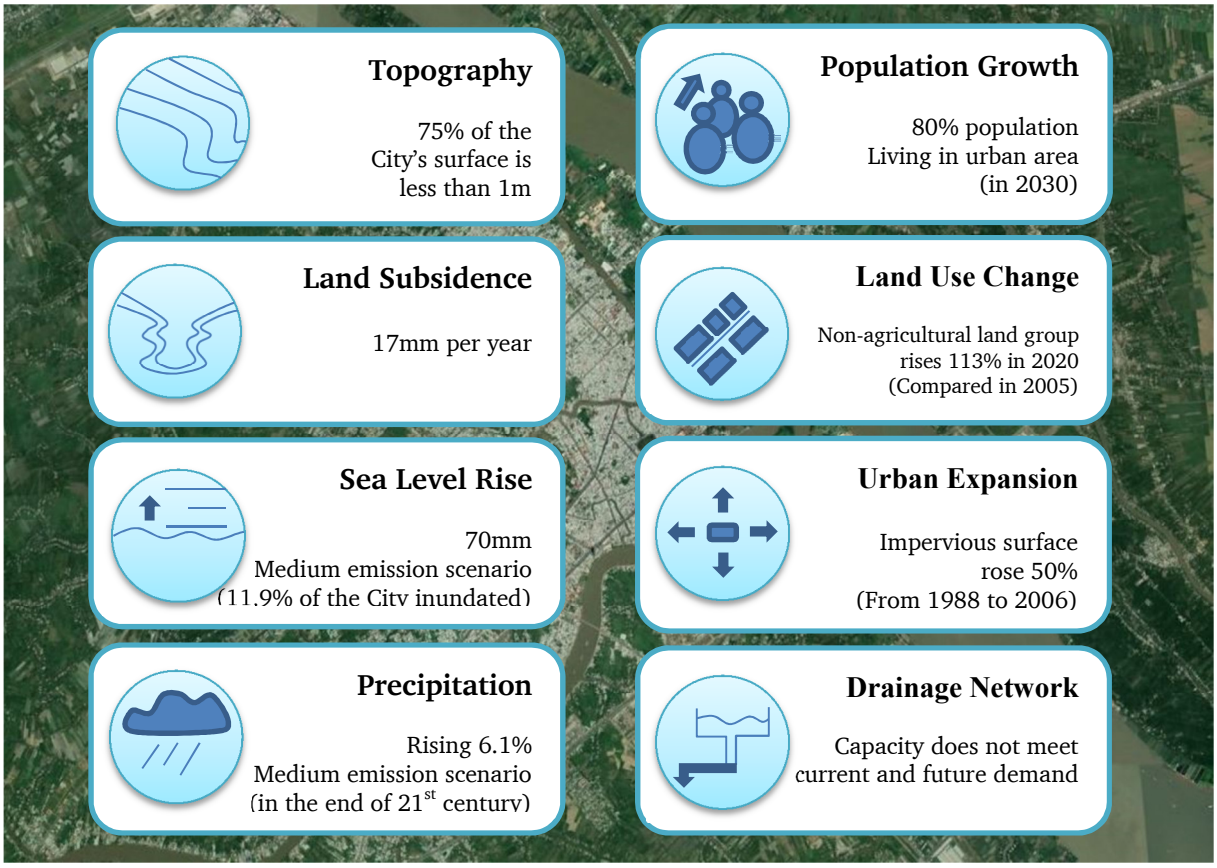


Figure 26 Flood driving forces influence the flood's state of the Can Tho City
(Source: simplified by the author)

3.6.2 Discussion

The above study approach, by selected and contextualized data, could assist local stakeholders and services as well as other agencies identifying and in preparation flood protection strategy in which based on the flood driving force identification. Choosing which aspects increasing flood vulnerability, visioning to active development within an area, requires the multidisciplinary approaches rather than observations from a barely single measure or group of standards, e.g., condense investment to physical actions or commercial setting regardless to other social aspects. Also, the riparian flooding issue is trans-boundary characterized matter; thus, it may make no sense at all that single flood drivers concentrated into a particular place (e.g., natural drivers). The possible measure approached through a broader range of effectiveness.

Flood state in this case study might be worsened due to two main groups of driving forces, and in the case of these groups increase, so does the risk. Both groups manifest processes increasing flood vulnerability. While the natural driving force group (topography, precipitation, sea-level rise, and land subsidence) influences the formation of flood risk, the anthropogenic driving force group might increase flooding consequences much more strongly. Therefore, the natural driving force group requires more urgent measures and efforts due to not only triggering the high risk of flooding but existing high uncertainty, with a high probability of unpredictably exacerbated growth. The anthropogenic driving force group indicated these features where improper policies and planning strategy assessed (e.g., land-

use change policy, insufficient drainage system, etc.). As a result, inappropriate measure uses, in this case, increase flood vulnerability in the city.

Flood driving forces are accelerated long-term processes. Therefore these issues demand adequate approaches to handle changes that are associated with the natural or human-made context. In general, policy measures and other instruments could help to decrease the flood impacts accelerated by the natural drivers; for instance, strict regulations on groundwater exploitation and expanding water supply network may stop the soil layer subsidence. The human-made driving forces, however, demand more attempts from authority and planning systems as well.

Driving forces can, in a single state or combination, generate and amplify flood damage where water level may rise above the average level and result in an inundated situation in adjoining areas. On the single or coincident combination, the issue demands more integrated, streamlined strategic planning. Planning in the flood-prone areas, in the manner of relevant party involvement, thereby, is not only starting from the local authority effort but requiring the strengthening process from the whole river basin as well. And, the comprehensive approach to improving flood management, from many viewpoints, conveying the necessary awareness of ecologically sustainable environment should be considered and implemented as soon as possible.

A single driving force was identified; however, the coincidence of many drivers considered in the manner of driver combination — the flood hazard that constituted by natural drivers regarded as the future threats; while the rapid urbanization in the urban cores and along the river overlay more anthropogenic challenges to flood risk. Thus, the future flood risk is likely to be higher even in the next forthcoming years in both magnitude and frequency as well because of combination.

For instance of combination, the rapid development within an area associated with the rising trend of inundation areas; and the increase of flooding duration and frequency also estimated with sea-level rise and other driving forces. According to Hiroshi Takagi et al., (2016), the expected duration of the inundated event could be revealed by examining the land subsidence and sea-level rise in the current situation. Frequency and inundation in years of 2050 in the central urban district as the Ninh Kieu urban district, within one year-based from 2009 to 2010 data, might be inundated all year round at the 90cm flooding depth. The result strongly recommended for the floodwater depth from 60cm to 90cm could be achieved over 300 days, no matter in dry or rainy seasons within the study area (Figure 27).

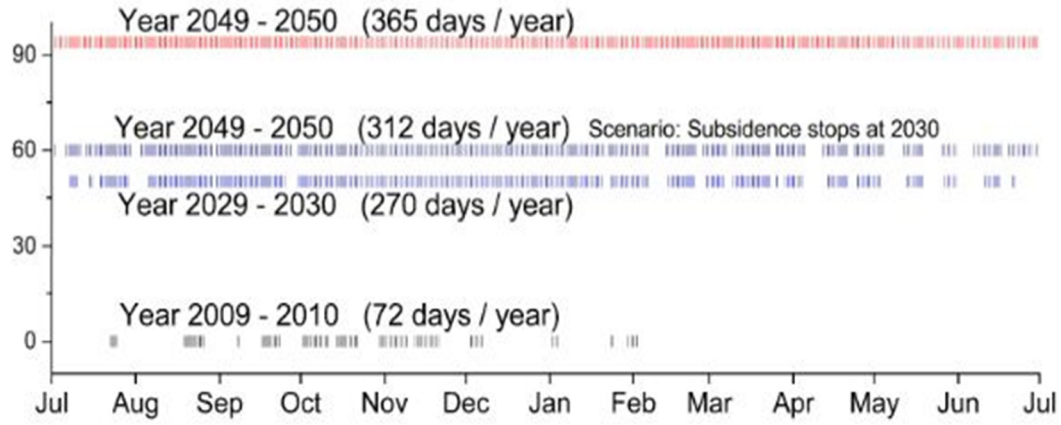


Figure 27 Estimated frequency and duration of inundation events of the Ninh Kieu urban district based on the fraction of the time in one year

Note: Vertical bar indicates the level (cm) of flooding depth

(Source: Hiroshi Takagi et al., 2016)

CHAPTER 4. EVALUATION OF CURRENT APPROACHES ON VIETNAM FLOOD RISK MANAGEMENT

An assessment of flood risk management schemes must be projected and developed in flood-prone areas to support the policy amendment or directions of policy adjustment. Flood risk response happens differently in a field, and the issue's judgment is necessary for further projecting strategy. There will be differences in urban areas such as urban size, natural and geography characteristics, disaster history, and land use, etc. This chapter expects the outcomes that are needed to reflect current approaches in-site study areas; these addressed the flood risk policy scheme to obtain the possible adjustment on management policy. Intended outcome information expectations come from the variety of involved data review and expert in-depth viewpoints.

4.1 Introduction and rationale

4.1.1 Introduction

Flooding is a global challenge not only developed countries but the rest of the Earth's regions, with the reported catastrophic damages on social and economic costs. The flood risk takes place with different types of the source of the flooding, whether rivers and lakes, urban stormwater, or combined sewage inundation.

People connect with the land as a natural process of development in nature viewpoint, and genetic damage term derived from the human encroachment beyond the natural balance line. The growth in a specific area changes the physical and functional characteristics of the land. For instance, the influx of immigrants into an urban area leads to changes in the vacant property at which embedded the natural functions (e.g., the natural drainage system of the city). In the riparian regions as Ho Chi Minh City and the Mekong Delta, the migration reported as responding to "economic situations" (Han Entzinger and Peter Scholten, 2016, pp. 35-37). The natural balance changed when the equilibrium influenced. And when the balance is touched, then natural processes have been judged as the catastrophic consequences. The circumstance becomes more serious when rapid urbanization pressed into many different urban themes (e.g., social justice, quality of life and sustainable development, etc.) as well as the responding from major stakeholders, with the inappropriate approaches. The relationship between human intervention and natural disaster damage is evident. The natural phenomenon should be acknowledged more broadly.

The changes in land functions were paved for the reasoning of damage existence, detailing as human and asset losses when the disaster strikes. The land pattern has changed caused by human interventions (Rajib Shaw and Michiko Banba, 2017). The demand for systematical allocation on land to achieve more safe development and facilitate the disaster consequences triggers the human effort on many challenging themes: the challenges counted as urbanization or sustainable urban development; and natural disaster management.

Land use planning or Land use management is emphasized as a practical measure on the Flood Risk Management scheme, especially in flood-prone areas by flood mitigation impact contribution (Howe, J., and White, I., 2004). As a reasonable measure on development control policy (e.g. on guiding the appropriate locations, population density or locally economic investments etc.), land use planning has been employed in regards of minimizing losses in flood high risk areas; keeping balance of needs and development control by integrating flood sensitive contents into the risk management cycle (UFCOP, 2017). The role of land use planning was recognized via international implementations and practices, especially in the countries being in the high natural risk (UNISDR, 2005; David King et al., 2016). The integration of land use planning into the planning process varies from country to country. In developing countries, the measure of land use planning is a false concept.

Acknowledged as the single measure to harmonize the land-use conflicts amidst strained committed party relationships, land use planning or development control paved a

corridor to keep the natural equilibrium. The role of land use planning in many specific contexts, hence, has been observed as useful measures. On flood risk reduction and in local initiatives, land use planning could contribute to the new approach to these most complicated issues in developing countries. Many aspects of this relationship have been rising recently. Local-level reacted as the last step of the policy process in which regulations would be implemented and evaluated.

Best practices have been applied to flood risk management and resulted in a good echo from the observatory researches; nevertheless, the measure applies to other cases should be taken into an adequate environment. In planning regulation and development policy, the consideration is a must and requires many raised assessments. In the theme of land use planning or policy application, the observations on the decision-making process are necessary to prevent overregulation, which happens on more policy demands to remove the regulatory barriers accumulated for years (Rachelle Alterman, 2014). The right cases potentially suggested to the policymaking process on disaster risk management, and this phenomenon varies from country to country. The objective of harmonization of land-use conflicts or social justice often puts the policy efficiency into the hard situation in which maximizes the benefit to as many stakeholders as possible. Therefore, investigation of precondition requirements and functional performance afterward requires more observations and discussions. This matter plays a significant role in developing countries where scarce of investment budget and poorly institutional cooperation dominated.

4.1.2 Rationale

Vietnam is on the real risk in general as well as a hotspot of climate change effect, and regarding the natural disaster, the flood is an issue that has a severe influence on people on lives and asset losses (WB(b), 2010). On the set of predictions of environmental challenges, the annual temperature and sea-level rise and then increasing heavy precipitation are the most causes claiming to strong influence on the Vietnam situation. The heavy rainfall may rise to 150% (Dang et al., 2016), harming directly to people's lives and livelihoods. Furthermore, precipitation is not only striking with high intensity in the potential but taken place in concomitance with other flood causes. It projected that catastrophic flood event might make many regions suffered from rainfall and tidal flood, especially riparian areas. The low-land areas have to be on flood exposure and then triggered the efforts of the structural measure employment to maintain the people's lives and livelihoods. The vacant lands, which have filled with residence and other urban infrastructure purposes, now are facing the high flood risk. The stakeholder, with an endeavor to control the flood risk, focuses on the useful measures to reduce the risk of disaster.

Like Ho Chi Minh City and many other large cities in Vietnam, Can Tho City is a waterfront city located in the center of the Mekong River Delta and lies on the downstream of the Mekong River. As many rivers of the world, the Mekong River altered from its natural state due to the rapid developments and human economic activities. Exceeded river water inundated adjoining areas and damaged infrastructure system, property and triggered other indirect losses (e.g., pollution, scare of drinking water supply); therefore, the city has suffered from the river flooding. Facing many flood exposure factors turns the city being a vulnerable spot of flood risk. Further supplement on management policies to combat the catastrophic flood consequences in the short as well as extended terms could lessen the risk impacts.

However, even though the endeavors on the policy-making system have been reported to connect flood risk management with development controls, little attention is being paid on the causes to explain the trend of policy domination. Sharing many similar development characteristics of transitional countries, Vietnam could be a relevant case to find the appropriate explanations for the disaster risk management theme. Vietnam reported as taking considerable efforts on disaster risk management in general and on flood risk management in detail, with recently integration the disaster risk management policy into the national legal framework. Amongst the efforts to facilitate the severe damage of disaster risk is the rapid

urbanization in Vietnam's large cities in which located near Rivers and unpredictable activities of extreme natural events (climate change's consequences, e.g.). It, thus, seems essential to as whether the long-term government vision to this climatic – strategy for management with which appropriate measure utilization and whether trans-boundary cooperation pushed into consideration for long-term flood risk management.

This chapter addresses the gap by collecting the expert knowledge and viewpoint of the urban flood risk management in the Vietnam current situation in order to investigate the flooding issues and describe the convoluted picture of primary tools on municipal flood risk control firstly, especially on riparian low-land areas; and then examine involved trans-boundary flooding issues in these high-flooding exposure regions. It gathers the opinions from various ranges of experts who directly are in charge of flood control themes in urban areas or researchers with key activities getting involved in flood risk management strategies in large metropolitan areas in Vietnam. The primary outcomes of this expert's opinion collecting include the reasons for a physical measure used in the flood control theme in cities and the domination of the structural measure role in comparison with non-structural ones. Moreover, the results have been analyzed to figure out the overall challenges and possibly arising issues for the land use planning integrated into the mainstream of urban planning to reduce flood impacts in large cities, focusing on river-based economic regions in Vietnam.

4.2 An overview of recent strategies and main approaches to flood risk management theme and land use planning in the Vietnamese legal framework

From the mainstream of legal framework and instrument analysis in the Vietnam situation, the regulated regimes to flood risk management divided into two main fundamental approaches: on the inbound lands; and the trans-boundary regions. The Vietnam institutional frameworks tracked as developing on these approaches.

In the notion of term's differences, the spatial planning may have the same meaning of land use planning or other definitions of planning laws (Rachelle Alterman, 2014), in terms of "a set of instruments utilized by government and its organs in order to steer or control the development based on setting objectives". Also, the Vietnam government has been maintained the endeavor on legal architecture to enhance the natural disaster management on the reality of being one of the most vulnerable regions directly affected by the disaster, especially of flooding.

In the field of flood risk governance, a measure referred to as "land use planning" in this study has many same concepts, with overall meaning use of land on a useful method to serve the development control in a particular area. The ideas are urban planning, spatial planning, etc.; therefore, terms used as the interchangeable meaning. The land-use plans are the appropriate instruments in the workplace, as defined on planning progress's objectives.

4.2.1 Flood management policies in the Vietnam context

The Vietnam legal framework on flood risk management can be summarised as a management theme, which is adjusted to adapt to increasing flood state. Figure 28 introduces the chronologic timeline of Vietnam flood risk management policy from 1993 to 2013

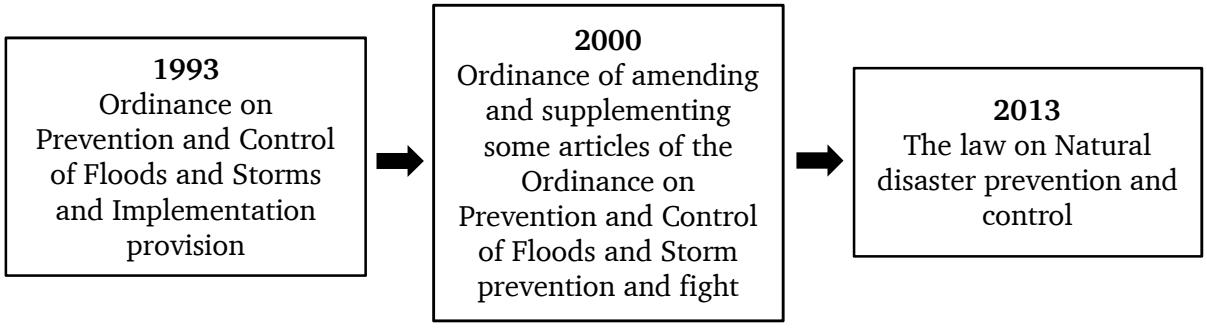


Figure 28 The chronologic timeline of Vietnam flood risk management policy

The policy has evolved as an increasing attempt to minimize flood damage content. In-line with previous official ordinances, current flood risk management is implemented within the legal framework of the law on natural disaster prevention and control (2013) presented as the binding law on the effort integrated many important natural disaster prevention issues to keep up with sectoral development or socio-economic changes. Flood response is described through the Vietnam policy scheme, as shown in Table 26.

Legal measures	**Flood response's descriptions**
The Ordinance on Prevention and Control of floods and storms and Implement provisions (1993)	Strengthening building facilities to serve the prevention and control of flood objectives
	Enhancing the quality of flood forecasting and warning
	Protecting and planting the flood prevention forests
	Flood and storm resistance standard for construction
The Ordinance of amending and supplementing many articles of the Ordinance on flood and storm prevention and Fight (2000)	More decentralized responsibility by unified management based on national and local interests
	Practicing flood prevention planning and norms
	Planning the projects on dike construction, on river bank clearance and riverbed dredge
	Protecting and planting water head forests in combined with wind-and sand shielding tree lines
	Population and infrastructure consideration in flood-prone areas
	Implementing a commanding committee on warnings, alarming and appropriate measures
	Initiation of the control steering committee for storm and flood prevention and fight
The law on natural disaster prevention and control (2013)	Maintaining structural measure application is a long-term concentration
	Regulations of structural and non-structural measures
	Flood risk prevention integrated into natural and local socio-economic development master plans and sectoral development master plans and plans
	All contents of flood risk management towards protecting the environment and ecosystems and adapting to climate changes
	International cooperation in training, scientific research, and technology transfer in flood prevention and control strategy

Table 26 Flood response through legislation framework in Vietnam
(Source: simplified by the author)

Responding policy at the national level on flood risk reduction has a critical milestone focusing on the integration of measure employment. A long-term vision, the combination of structural and non-structural on the national law at the long-term view in the manner of an environment-protection trend, has highlighted. Further, flood risk-related content integrated into socio-economic development master plans.

In flood risk management schemes, nevertheless, current flood response through legislation framework is hard to adapt to the present and potential flood-related threats, especially in flood-prone areas. Main driving forces in flood-prone areas, often taking place at riparian urban regions due to high-rated economic growth, challenges the governance on

flood-related issues. Natural and anthropogenic drivers may be the leading causes of flooding situation as well as exacerbate the flood damage by fail on decrease flood vulnerability; furthermore, the inadaptable policy can continuously challenge the flood risk management via these viewpoints:

- Promoting development policy increases the sensitivity of flood-prone areas; and
- Fail on control role of national response on flood-related issues.

4.2.2 Flood risk management: towards an approach to integrate flood risk management into the legal framework

Towards a method integrated flood risk management policy into a legal apparatus faces institutional challenges. One of the most challenging problems in the situation might be institutional cooperation, with having multiple and conflicting criteria for the multi-level collaboration on the common theme. Transforming and renewing the legal framework could be sufficient support to the system, may advocate evidence-based and robust decision-making, and then guide appropriate policies in flood risk management. Examining these changes may answer the reasons for the insufficient strategy and identify the Government status on the management tasks and then revising the justification on the holistic flood risk management strategy.

Vietnam is one of the most disaster-prone countries in the world, and water-related disasters took significant consideration of the Government of Vietnam (Huu Ninh Nguyen, 2007). On the flood risk management scheme, the national regulations have been issued and then clarified afterward by the other guidelines. Providing the legal framework, the "Ordinance on Prevention and Control of floods and storms and Implementation provisions" (SRV, 1993) soon paved the corridor to enhance the Government responsibilities on reducing natural disaster impacts in general and then on flood risk management theme in details. The critical strategy on this Ordinance (1993) focused on "prevention and control flood" with the primary role of management distributed to the governments of all levels.

On the prevention instruments and control activities promulgated by the Ordinance, the main actions pointed on protecting people and economic assets from losses by employed range of operations "for strengthening building facilities, to preserve and reinforce dikes and exploitation of reservoirs" and "issues warnings on floods and storms" (SRV, 1993; Articles 10, 15 and 19). The critical theme of flood risk management on this ordinance is preventing and controlling the flood risk and then mitigating consequences by implemented the concepts of physical measures strengthening and early warning interventions. The centralization of the government intervention and physical measure employment dominated in the Ordinance of flood risk management theme. In the trans-boundary or trans-national issues are on cooperation limited at scientific and academic exchanges on flood forecasting and other minor activities (SRV, 1993; Article 5 – Chapter 1).

The amendment issued afterward; nevertheless, the adjustment efforts were still on the utilization of structural measures as the mainstream of interventions on "the Ordinance of amending and supplementing some articles of the Ordinance on flood and storm prevention and fight" (SRV, 2000). On the long-term flood and storm prevention, the regulation concentrated on "making plans and investment in the construction of flood and storm prevention and fight projects, on dike construction, repair, and protection." On the trans-boundary flood risk issues, there are no changes in government policies.

Although the foundations of flood risk management policy date back to the Ordinance 1993 (Ordinance on Prevention and Control of floods and storms and Implement provisions), the current activities are based on the law on natural disaster prevention and control (issued by the National Assembly) (SRV(b), 2013), which was later supplemented and modernized. The strategy on flood risk management is gradually transformed into the law with many remarkable changes in justifying the institutional frameworks to deal with natural risk consequences. This law explains Natural disaster prevention and control as "a systematic

process involving the prevention of, response to, and remediation of consequences of a natural disaster." Flood, flash flood, and inundation are content included and take effect with other types of a natural disaster. The integration implemented in three central schemes: i) the long-term objective provisions, ii) the main contents on natural disaster prevention and iii) the trans-boundary flood risk management issues.

On this binding law, the national strategy addressed and integrated many essential issues to keep up with socio-economic changes within many large urban regions on flood risk management themes. Flood risk management actions are embedded in spatial planning activities, with the recognition of a combination of structural and non-structural measures as the basic principle of natural disaster risk management theme. Table 27 presents the primary integration of planning policies into National risk management by the law on natural disaster prevention and control (2013).

No	Regulation themes	Articles	Detailed regulations
1	General Provision	**Article 4.** Basic Principles of natural disaster prevention and control	**Clause 4**. Natural disaster prevention and control contents must be integrated into national and local socio-economic development master plans and plans and sectoral development master plans and plans. **Clause 6**. Natural disaster prevention and control activities must be based on scientific grounds, combining traditional experiences and scientific and technological advances, combining structural and non-structural solutions, protecting the environment and eco-system, and adapting to climate change.
2	Prevention of natural disaster	**Article 13**. Contents of natural disaster prevention	**Clause 2**. Integrating natural disaster prevention and control contents into national and local socio-economic development master plans and plans and sectoral development master plans and plans.
		Article 15. Natural disaster prevention and control plans	**Clause 3**. A district-level natural disaster prevention and control plan has the following principle contents: • **Point dd**. Integrating natural disaster prevention and control contents into socio-economic development master plans and plans. **Clause 4**. A provincial-level natural disaster prevention and control plan has the following principle contents: • **Point d**. Identifying methods of integrating natural disaster prevention and control contents into socio-economic development master plans and plans. **Clause 5.** Administerial level natural disaster prevention and control plan have the following principle contents: • **Point d**. Identifying methods of integrating natural disaster prevention and control contents into sectoral development master

			plans and plans. **Clause 6**. A national natural disaster prevention and control plan has the following principle contents: • **Point d**. Identifying disaster prevention and control contents to be integrated into national socio-economic development master plans and plans.
3	Prevention of natural disaster	**Article 16**.The integration of natural disaster prevention and control contents into sectoral development or socio-economic development master plans and plans	**Clause 1**. National and local socio-economic development and sectoral development master plans and plans must have natural disaster prevention and control contents suitable to the characteristics of natural disasters in each region and locality to ensure sustainable development.
4	International cooperation in natural disaster prevention and control	**Article 38.** Principles of international cooperation in natural disaster prevention and control	**Clause 4**. Priority for international cooperation in training, scientific research, and technology transfer; sharing the experiences and coordination in search and rescue; investment, construction, and upgrading of natural disaster prevention and control works.
		Article 39. Contents of international cooperation in natural disaster prevention and control	**Clause 4**. International cooperation in training, scientific research, and technology transfer in natural disaster prevention and control.
		Article 40. Focal point and agencies in charge of international cooperation in natural disaster prevention and control	**Clause 1**. The Ministry of Agriculture and Rural Development shall act as the focal points answerable to the Government for international cooperation in natural disaster prevention and control and has the following responsibilities. • **Point d**. To propose the conclusion of, or access into, treaties on natural disaster prevention and control.

Table 27 The central planning integrated policy dimensions into National disaster prevention and control contents
(Source: SRV(a), 2013)

Minimizing flood damage content requires the integration of flood sensitive materials into the risk management cycle (UFCOP, 2017). The transformation process of a combination of flood risk management policies to the national legal framework (law on natural disaster

prevention and control) is the time-taking process, and tracking these changes requires classification of these regulatory instruments. Table 28 reflexes the progressing integration of flood risk management policies into the national legal framework.

First (1st) layer of policy integration: the measure concentration

- Strengthening building facilities to serve the prevention and control flood objectives;
- Reinforcing dike system and reservoir exploitation, and conducting other facilities related to the prevention and control of floods;
- Reservoir exploitation and holding the facilities associated with the prevention and control of floods;
- Enhancing the quality of flood forecasting and warning;
- Protecting and planting the flood prevention forests;
- Flood and storm resistance standard for construction; and
- No concert to river basin management and transboundary flood risk management.

Second (2nd) layer of policy integration: the amendment and supplement

- More decentralized responsibility by unified management based on national and local interests;
- Practicing flood prevention planning and norms;
- Planning the projects on dike construction, on river bank clearance and riverbed dredge;
- Protecting and planting water head forests in combined with wind-and sand shielding tree lines;
- Population and infrastructure consideration in the flood-prone areas;
- Implementing a commanding committee on warnings, alarming and appropriate measures;
- Initiation of the control steering committee for storm and flood prevention and fight; and
- No mentions of river basin management and trans-boundary flood risk issues.

Third (3rd) layer of policy integration: new approaches to non-structural measure application and international cooperation

- Maintaining structural measure application is a long-term concentration;
- Regulating structural and non-structural measures;
- Flood risk prevention integrated into natural and local socio-economic development master plans and sectoral development master plans and plans;
- All contents of flood risk management towards protecting the environment and ecosystems and adapting to climate changes; and
- International cooperation in training, scientific research, and technology transfer in flood prevention and control strategy.

Table 28 Layers of integration progress of Flood risk management into the national legal framework
(Source: author)

4.2.3 Urban Governance on the issue of strengthening institutional capacity

The overall co-ordination of flood management activities treated as the vital principle for strengthening flood risk management capacities regarding the government's roles on the flood risk issue. In spite of the national government's functions universally accepted, the focal point dropped into local government activities, with many controversial and problematic matters on flood risk management policies (Ivan Andjelkovic, 2001).

The critical role of local-level governance on flood issues pressed as the mainstream of policy enactment and interaction. As a level where flooding took place, the local degree

prepares and then implements plans which binding for the stakeholders. The method is an excellent measure to reduce flood consequences by identifying and integrating specific components on flood risks. Nevertheless, the governance of this level adopted the primary administrative matter at which the differences between administration boundary and river basin boundary; hence, the aftermath of a vague line from this level observed as poor co-ordination is a significant issue to secure policy efficiency. Investigating this matter, therefore, is necessary to prevent i) inappropriate policies become regulatory barriers for the strategy and ii) requiring more plans on the attempt of policy remove (Ivan Andjelkovic, 2001; Rachelle Alterman, 2014).

4.2.4 Land use policies on flood risk management theme through International initiatives

Urban centers, especially in riparian areas, are under threat of flooding by maintaining the effort gaining development while trying to reduce the adverse flood's consequences. This matter stems from the fundamental question of which extent of flood-prone areas should be protected and developed. According to Penning Rowsell et al. (1986), the floodplain encroachment causing losses was observed in many countries, although more attempts were released focusing on protecting floodplain and then increasing losses afterward by intensifying land uses. The ground, therefore, should be kept free from the encroachment rather than protection from the flood risk. Though which causes promoting land invasion and utilizing issues requiring more investigation (Burby and French, 1981), land use policy employment is being assessed as an efficient approach regarding flood risk-reducing. Land use planning reduces the fundamental causes of flooding and controls development while minimizing flood risk losses in combining with other conventional measures (UFCOP, 2017). As one of the most promising approaches on vulnerability to the natural hazard (Burby et al., 2000; GIZ 2011; UN, 2005), land use planning has been recommended should be integrated flood risk reduction issues within planning procedure by international initiatives and through global practices (GIZ, 2011).

Globally, the two central themes of urban center threat include: reducing flood risk and continuing development. Many international initiatives addressed these directions, like The Hyogo Framework 2005 – 2015 (UNISDR, 2005) and Sendai Framework for Disaster Risk Reduction 2015-2030 (UNISDR(b), 2015). This mainstream pressed the benefits as well as the necessity of including disaster risk reduction contents into the land use planning scheme under the pressures of two central themes of urban threat mentioned above. Table 29 presents the main contents of disaster risk reduction inclusive in land use planning on these initiatives.

International Initiatives	Priorities	Details of identified tasks
Hyogo Framework for Action 2005 – 2015: Building the Resilience of Nations and Communities to Disaster	**Priority 4**: Reduce the underlying risk factors	**Point iii:** - Incorporate disaster risk assessments into the urban planning and management of disaster-prone human settlements; - Mainstream disaster risk considerations into planning procedures for major infrastructure projects; - Develop, upgrade and encourage the use of guidelines and monitoring tools for the reduction of disaster risk in the context of land-use policy and planning; - Incorporate disaster risk assessment into rural development planning and management; and - Encourage the revision of existing or the development of new building codes, standards; rehabilitation, and reconstruction practices at the national or local levels aiming to make them more applicable in the local context.
Sendai Framework for Disaster Risk Reduction (2015-2030)	**Priority 3**: Investing in Disaster Risk Reduction for resilience	**Clause F**: (At National and Local levels) -To promote the mainstreaming of disaster risk assessments into land-use policy development and implementation, including urban planning, land degradation assessments, and informal and non-permanent housing, and the use of guidelines and follow-up tools informed by anticipated demographic and environmental changes.

Table 29 The integration of Disaster Risk Reduction into Land Use Planning addressed in international guidelines
(Source: UNISDR, 2005; UNISDR (b), 2015)

Within these global initiatives, the integration of disaster risk reduction into land-use policy development has defined. By reducing flood exposure and then minimizing flood vulnerability in the flood-prone areas, the stream of land use planning recognized as a useful measure in incorporating other tool employments. Land-use planning may be one of the available approaches in the manner of including reducing risk contents as well as development control in the application of policies.

A change from the traditional measure implementation to isolate water out of private places to the integrated flood risk management paradigm yielded as the global trend, with the fast-moving pace within vulnerable regions. Vietnam government has shifted the paradigm towards disaster prevention and control strategy lately and on the pattern of employment of comprehensive flood risk management. By integrating the two main directions on development control in flood-prone areas as well as international cooperation in the river basin scale, the integrated approach is taking place in the national legal architecture as above discussion.

Besides the benefits from the integrated approach on the national legal framework, the measure implementation on the lower level of governance raises the crucial matter involving effectiveness as well as the long-term maintaining flood risk management measures. Therefore, observation and analyzing the regular measure employment reflect the current situation, essential aspects as well as may foresee the probability approaches on the central theme of flood risk management in the Vietnam flood-prone areas. By figuring out the most challenges and shortcomings from the current legal architecture, the possibility of employment the flood risk-inclusive land use planning could be identified, as the critical non-structural measure on flood risk reduction.

4.2.5 Positioning urban land use planning in Vietnam planning framework

Vietnam's urban planning constituted from three elements, including socio-economic development planning, land use planning, and construction planning. These elements integrated into three types of urban planning types: general planning, zoning planning, and detailed planning (Table 30) (SRV(b), 2009, Article 18). According to Matsumura S. (2013), the formal planning legislation comprises three planning systems and organized by two primary laws (Law on Construction and Law on Urban Planning) as follows:

Planning level	Planning organization
National planning system	Socio-economic development, land use, and construction plans: 1. Socio-economic development strategy (10 years revised) and two socio-economic development plans (5 years revised) – Issued by the Ministry of Planning and Investment 2. Land Use Plan – Issued by the Ministry of Natural Resources and Environment) 3. Urban Construction General plan - Issued by the Ministry of Construction.
Urban planning system	1. General Plan (or Master Plan) 2. Zoning Plan 2. Detailed Plan.
Development control system	1. Zoning plan (Scale of 1:2000, 1: 5000) 2. Detailed plan (Scale of 1:500).

Table 30 Vietnam formal planning legislation by planning level and organization
(Source: adapted from Matsumura S., 2013)

Addressing and reducing the flood vulnerability should be integrated into the planning process, embedded in the urban planning and development control system. In the manner of flood vulnerability reduction, the zoning and detailed plans could be addressed flood vulnerability issues in the directions of development regulation (UNISDR, 2013). In detail, zoning plans keep the role in identifying high exposure regions, while detailed plans address vulnerable objects located in high flood risk areas. Mitigation measures should be applied based on the identified exposure within these plans. If the banning development or partially-incentive policies decided in the zoning scale through development techniques (e.g., infrastructure relocations, zoning regulations in the manner of land-use types); the more detailed standards or building codes might be issued to reduce the flood exposure in the detailed plan scale (e.g., building codes, floodproofing measure recommendations).

Land use planning and land use control recommended as the appropriate measures applied in Ho Chi Minh City by "directing changes in ways that minimize environmental impacts and risks" (Harry Storch and Nigel Downes, 2012). The integrated contents of flood risk reduction covered main issues on development control by using development and land use policies in combination with other mitigation measures (Ivan Andjelkovic, 2001, pp. 38-41). The approach directions of development control policy grouped into these leading possibly applicable solutions, including i) protecting existing development; ii) removal or conversion of existing development; iii) discouraging development, and iv) regulating floodplain use. The level of integration of flood risk inclusive into land use planning based on land use planning environment (S. Prashar and M.A. Rahman, 2017) in which promoting efficiency, equality policies.

4.3 Vietnam flood risk management strategy: potential applications, land use techniques for flood risk governance in Ho Chi Minh City, and Can Tho City case studies.

4.3.1 Overview of flood risk management themes

Ho Chi Minh and Can Tho cities are being largest urban areas in Vietnam, directly-controlled by National Government and steered as economic hubs for the entire country and the Mekong Delta region. Witnessed as rapid development hotspots, however, both places have been alarmed on the threats of significant natural risks, especially riverine flooding.

These urban hubs are on the pressure of development and highly exposed to the flood risk derived both natural and anthropological reasons — both cities located in the river basin (the Dong Nai and Sai Gon river basins; and the Mekong river basin). Ho Chi Minh City is on high flood exposure (Han Entzinger and Peter Scholten, 2016), and Can Tho City has been depressed with severe urban flood inundation (Thy T. M. P et al., 2011). Pressed by interlinked-drivers as in both natural and human-made schemes, both cities were emerging as flood-prone areas and suffered from urban flooding events in the rainy season or combination with tidal water regime.

Stakeholders' roles and attempts in the mainstream of flood risk management on these flood-prone areas suggest a study case to investigate into the real reasons of the insufficient and ineffective development control policies and for what extent the risk, as well as the possibly attentions, mitigation measures, can improve the situations.

Following the national strategy on natural disaster prevention, response, and mitigation with the long-term vision for the next decades, the milestone of progress is claimed as the recognition and implementing a range of measures on the flood risk management schemes. The unification of both approaches, engineering technical and non-structural measures, marked a distinction from the authority interferences on balance, keeping the theme of development pressures and environmental issues. The movement of adapted policies has been prepared and integrated into the planning system through layers of integration to adapt to the socio-economic demand for development. Nevertheless, significant drawbacks on flood management remain.

Vietnam exposed to natural hazards, especially floods and storms. In urban areas, flooding is a real threat with the unpredictable trends on consequences and uncertainty. Similarly, urban centers in Vietnam exposed to flood risk due to developing along the riverbank and low-lying lands. Ho Chi Minh and Can Tho cities represent the cases of development issues on the threat of losses caused by river flooding. Examining the cases by identifying the reasons and attributes of interlinked-drivers may support the clarification of Vietnam flood risk management schemes and how the implementation phase is keeping tracks with the development control policies.

4.3.2 Flood risk management measure application: reasons and tendency

4.3.2.1 On the 1st analysis criterion: explanatory rationale on the priority of physical measure employment in riparian urban areas

The domination of measure use investigated with reflexes by putting on the literature and policy implementation. The first aspect of current approaches in flood risk control context as well as from the experts' observations and viewpoints, the joint agreements on the dominated role of structural flood control measures have emerged, with many reasons supported to these views.

The interview results suggest that the structural measure employment development explained with development, including three phases, and every development segment supported by fragmented reasons — the development process described in Table 31.

No	Stages of measure development	Stage's characteristic	Degradable factors
1	*Domination stage*	Forming and being dominated measures	-Focusing on event control rather than large-scale risk management; -Interactive response from authority to cope with the temporary event; -Potential of resolving arising problems; and -No consideration of other measures, regardless of non-structural flood management measures.
2	*Adjustment stage*	Adjusting to deal with Flood risk uncertainty and other natural risk drivers	-Identifying the urban inundation causes; -Considering other measure employment due to financial scarce; -Adjusting on urban development policies to adapt to urban development; and -Considering non-structural measure application concepts.
3	*Adaptation stage*	Integrating with other mitigation measures to adapt to uncertainty situations	-Integrating specific non-structural implementation into practices, with limit applications; and -Frequently revising appropriate management policies to incorporate mitigation measures into development plans.

Table 31 The measure employment development following phases
(Source: author)

The domination of structural measures on the urban flood risk management has been explained with totally agreement consensus from experts concerning aspects reasoning the dominant roles of the physical means. The measure employment analyzed from the reasons for the emerging role, the development of the application as a trend, and the potential of an alternative.

The analytical reasoning described; and fundamental reasons shared by the same viewpoints. The leading causes of the prevailed role derived from these aspects presented as follows:

(i) Enhancing the employment feasibility due to full legislation support: fundamental aspect to explain the dominant position of physical flood management measure in Vietnam flood-prone areas. Based on the long-time development, the action supported by the national legislation to guarantee for the implementation feasibility at the local level (e.g., the available price-unit on project finance approves) or the critical aspect counted, including the legal arrangement paving the corridor for conventional measures.

(ii) Supporting the instant reaction in urgent case of flooding (by visible short-term efficiency): as the most advanced factor inducing the application of physical measures and those results in the development in different scales.

These concerns are captured in the following quote by an experienced official in the field of measure implementation when he said about the facilitation on structural measure application in practice:

"Currently, the prevention measures have applied in urban areas. It means the flood phenomenon had happened, then these measures have a task of reducing the event's damage, for instance, lowering the flood's peak or backfilling the ground floor, etc., […]. In general, the Vietnamese policy focusing on inundation events (more than the damage caused by inundation), hence this approach leads to the "unconnected situation" among the official departments or units. And these official departments tend to resolve the risk effects, instead of finding the inundation event causes." ***(Expert 1)***

Other experts shared the same view on the single situation-based in the resolving approach:

"In general, within the riparian areas in South Vietnam, the current approach in the flood risk matters is "resolving the arise problem"; and it means inactively resolving and situation-based solutions." ***(Expert 3)***

"The flood risk management measures applied to the specific areas, like Ho Chi Minh City or districts of the inner city. Can Tho City had such a same plan focusing on specific urban districts." ***(Expert 7)***

The additional aspect claimed is the limited ability to planning to contribute to structural measure domination. The planning goals are set with inappropriate or insufficient visions to the urban development, environment protection issues, and on the socio-economic master plans, for instance, on the large-scale risk management or reducing the trans-regional impacts. The interview suggests that:

"In case of Ho Chi Minh City and other southern urban areas, although being riparian characteristics, Ho Chi Minh City and other riparian urban areas still miss the characteristic-based urban development plan, especially in the surrounding urban core (e.g. in the city North East region like Thu Duc, 9 and 2 districts located near the Dong Nai River). Although Ho Chi Minh City has published the regional master or spatial plan, the plan has a missing approach. Embedded the Ho Chi Minh City economic corridors (Ho Chi Minh City's four corridors), the master plan neither disconnected with environmental matters nor flood risk management. For example, Ho Chi Minh City development orientation (Vision to the year 2020) expanding to the Southwest area is the "low -lying-land area," with vulnerable flood risk characteristics." ***(Expert 3)***

"In short words, the right solutions have been employed, with no consideration of the large-scale area flood risk prevention (e.g., the whole Mekong Delta or Dong Nai River basin)." ***(Expert 7)***

The massive application of structural measures is not only traditional reasons but also existing factors keeping the rapidly utilizing within large urban areas. The measure implementation decision should be considered as an interdisciplinary matter and analyzed under many aspects (e.g., technical and socio-economic issues, local authority, etc.).

In summary, the structural measures applied in the flood risk management mechanism assured in large urban areas. Maintaining the dominated role in risk management schemes; however, the enforced action shows the downside associated with long-term and sustainable development goals. The replaced approach is a must, but the alternative is on the delayed pace. Finding hindering aspects accelerating methodology toward integration on structural and non-structural instruments may reveal the appropriate and efficient methods on flood risk management in flood-prone areas.

4.3.2.2 On the 2nd analysis criterion: explanatory rationale towards integrated approach progress

Towards a more sustainable methodology on flood risk management is received the same response from most of the interviewees. Despite presenting some differences on experts' views, the consensus has emerged amongst viewpoints. The conflicts in the current circumstance that non-structural measures applied at a low pace despite considering advanced responses explained then. The agreement from interviewees based on three main aspects:

i) The challenges on the legal and institutional arrangement;
ii) The motivations for the potential and
iii) The current measures applied to worksites.

4.3.2.2.1 The problems on the legal and institutional mechanism

From the international legal framework and national legislation system, the existing legal support for the non-structural employment can be found through identified actions as well as the national strategy on risk reduction associated with cooperation commitments. Although the advantages of non-structural flood risk management had been recognizable, the employment of these measures has been limited or stopped at the concept stages. The interviewees offered agreements on the reasons hindering the local and large-scale implementation possibility; and shared the potential in the future as a sustainable and long-term process.

In this viewpoint of hindering and challenging of non-structural measure applying, it found serious challenges on regulatory schemes. Most of the officers, bureaucrat, experts, a planner in the responsible city department and institutions critically noted in more details:

"The current Vietnamese legal system lacks appropriate policies to support non-structural measures. […].The non-structural measures lack the supporting policies in reality in Vietnam. Thus the difficulty of measure applying to the Vietnam situation is understandable. The institutional obstacles to fix these troubles could be last about five to ten years of policy adjustment and amendment. Hence, the solution feasibility is a real problem of applying non-structural measures." ***(Expert 1)***

"Non-structure measure application is involved-firstly to law-makers. The non-structural projects (e.g., underground water tank or reservoirs; green top building) require the law support (public participation; project investor meetings), and the legal system identifies the project scale and level of investment amongst stakeholders." ***(Expert 4)***

"The non-structural measures application does not meet the expectation because of lacking sufficient policy system or not mentioned in the law system." ***(Expert 5)***

"The non-structural instrument application is on the first phase of the planning process and has not yet supported by law system" ***(Expert 9)***

On a local authority level from the legal arrangement, the institutional arrangement barred the integration of non-structural measures into a risk management theme. The poor situation on administration cooperation (either on local government level or the implementation process followed the higher institutional level) surfaced in many interviews. Reflections on this issue, the interviewees include the following:

"Next example about the solution feasibility lack is when the local government building the Flap Valve system (Flood-control purpose) to adjust the flood water level within Ho Chi Minh

City and part of Long An province, the Ho Chi Minh City local government cannot cooperate with the Long An province authority. Each local government has their interest." ***(Expert 1)***

"[…]The first is planning ability (or institutional ability) is weak, it means it is easy to decide of drainage system upgrading project while in non-structure measures, the measure's effectiveness is not visual and immediate recognition (or expected objectives)." ***(Expert 4)***

"The causes for retardation of non-structural measure implementation claimed to the poor cooperation amongst involved parties. Non-structural measures are not only requiring the trans-sectoral organization cooperation but also the high consensus and support from the community side. […]." ***(Expert 8)***

4.3.2.2.2 The motivations for the potential

The argumentation accelerating the merge of non-structural measures into flood risk management schemes has raised from the financial and environmental sides. These reasons have been stressed in involving regards that:

"The non-structural measures are more suitable from the economic viewpoints of the public investment by two points of investment efficiency, with the economic and environmental views. The first counted as the reduction of direct structural measures budget; hence, the public investment in engineering equipment would be reduced in the financial resources. The latter, in the later period, the structural measure investment harms the social-economic development (by affected people's awareness, etc.) and environment protection (by changing the river regime, etc.)." ***(Expert 2)***

"Structural or engineering measures are an option of temporarily circumstance where impossibly applied the non-structural measures. The engineering measures, with the instant and recognizable functions, are easy to utilize; the environmental impact, however, by measure applying always requires careful consideration. Engineering measures may fit for the urgent situation of flooding, but completely miss the urban ecosystem impact or "water sensitive urban design." Therefore, structural or non-structural options depend on the decision maker's ability and the recognition of flood risk. In the long term, the transfer into non-structural measures is a must, although it arises controversial matters by applying non-structural measures between the planners and government agents." ***(Expert 3)***

"On the potential to measure employment, the non-structural measure concept dominated as the common acknowledge in many places. Non-structural measures considered sustainable instruments because of cheap cost and long-term efficiency. […]. The physical measures, on the practices, required a massive budget; however, the efficiency of the instruments is not meet the expectation (e.g., on the maintaining and expanding of measures afterward)." ***(Expert 9)***

4.3.2.2.3 The current measures applied to sites

The interview data reveal the hesitation towards more integrated direction on non-structural measure employment in large cities. Interviewees have mentioned reasoning for measure employment's efficiency:

"[…]. The non-structural measures could be applied in Vietnam; however, the researchers should present more proofs of effectiveness. For instance, the exceeded water quantity for every rainfall within Ho Chi Minh City (based on the current drainage system capacity) must be shown and then suggesting the appropriate non-physical measures to retain or store the exceeded stormwater." ***(Expert 10)***

Additional obstruction on non-structural measure applying identified with regards to the requirement for more "proof of efficiency" and that explains the current implementation is on standstill of the concept phase and the limitation of wide-open employment. The experts have pressed on this issue:

"*In my opinion, the non-structural measures could be developed more in the next years, following the sustainable development theme. Incentive policies should be integrated into the social-economic development theme in the flood-prone areas. […]"* ***(Expert 2)***

"[…]. In the long term, the transfer into non-structural measures is a must, although arise controversial matters by applying non-structural measures between the planners and government agents. Lately, the government convinced by the advantages of non-structural applications. Nevertheless, the short-term efficiency from the structural measure dominated." ***(Expert 3)***

"In my viewpoint, the water reservoir or stormwater detention tank is currently non-structural measures applied in Vietnam." ***(Expert 4)***

"The efficient non-structural application counted weather forecast; even the "high flood risk maps" have been drawn to support the flood prevention plan. The other group of non-physical measures is supporting retention spaces; this approach integrates flood prevention into surrounding spaces." ***(Expert 7)***

"In Ho Chi Minh City, recently, the reservoirs have been considered as a non-structural application. There was an approved reservoir project in Hoang Van Thu Park in the city center, with the expectation of stormwater retention function. However, there is no information about the other non-structural measure will be implemented in Ho Chi Minh City for further application regarding flood risk management. […]. In my viewpoint, the non-structural measure application in Can Tho City is still limit; […]" ***(Expert 8)***

"Vietnam government has implemented this concept on the step by step principle by applying increasing infiltration surface and reservoirs (or rainwater harvesting) as well as standardized construction level on a large scale. […]." ***(Expert 9)***

4.3.2.3 On the 3rd analysis criterion: explanatory rationale on Land Use planning roles in riparian areas

There are general expectations that land-use planning would play a crucial role in flood risk management schemes, especially in the flood-prone or riparian-characterized urban areas with many reasons and potentials. The interview data suggest that land use planning, as a useful measure, is an essential tool not only affecting flood risk reduction but also keeping a crucial role in socio-economic development. The informant's stress:

*"As far as I am known, land use planning is an essential tool, especially affected by socio-economic development and environmental protection. […]."****(Expert 2)***

"Land use planning plays an important role in the urban planning theme. The riparian metropolitan regions have their characteristics. Thus land use planning narrows down the scale of work by pointing out the functional areas compared with other urban areas. […]." ***(Expert 3)***

"The land-use planning entirely is a substantially important measure with many potential applications; […]." ***(Expert 4)***

"[…].On the vulnerable or sensitive areas with natural disasters (e.g., flooding), the land use planning plays a more critical role. Because following the land use planning is including preventive and protection measures; thus, land use planning is a more substantial issue." ***(Expert 7)***

"Land Use Planning certainly is an important measure. For instance, we need to point out green space ratio, space for water discharge, etc. […]." ***(Expert 8)***

"[…]. Urban land-use planning, thus, is an important task, with the role of urban drainage. […].Land use planning is just a fundamental base, which identifies the urban area, and the urban land use planning keeps the leading role on flood damage prevention, with the long-term visions considering the inherent risk for the next many years. […]." ***(Expert 9)***

The viewpoint exposes that while the strongly expected the crucial role on flood risk management theme, significant drawbacks confirmed by informants. The reduced ability regarding planning capacity and thus, the local level of flood risk management may not be in line with the national flood risk management strategy. Lacking appropriate aspect considerations as well as concentrating on a prevailed-single aspect (e.g., economic aspect) on the planning process could release the ineffective development control plans and policies. Interviewees have shared this concern:

"[…]; however, the current approach of Vietnam land use planning has many controversial issues. The planned use plan had been expected and applied regardless of essential factors. The land-use plan has been processed and designed with a geographical viewpoint. The method is not merely getting involved in technical matters; also regarding political will as well. In some cases, the political expectation dominated. […]." ***(Expert 4)***

*"[…]. In the current, the suggestion issued in the urban areas (e.g., high-rise buildings in plot A and terrace houses in plot B) and planners try to draw a beautiful picture, then that is all the plans. Urban planning must consider the involving factors within the planning process (e.g., natural resources), and this means what resources are based on serving the economic development. […]."****(Expert 6)***

"[…]. In Vietnam, the land use planning and urban spatial planning possess dynamic characteristics and then legalized on the legal framework. The plans, which conforming regulation, must be revised for five years, and thereby, the adjustment approved then. Therefore, the planning process depended on the political terms and rapid development within large urban areas (e.g., Ho Chi Minh City and other megacities). […].The planning objectives must be maintained for decades, while Vietnam's rapid development situation induces the plan to revise for every five years to keep track of urbanization pace. […].On the urban flooding issues, the design, build, and system maintaining works implemented in the district levels without cross-reference in the project execution phase. Thus, urban flooding is difficult to improve with such cooperation. […]. In my viewpoint, the local authority vision on contemporary climate issues dominated by short-term objectives (5 or 10 years of view) rather than the long-term consequences causing by climate issues (e.g., clean water scare, adaptation with sea-level rise, etc.). Sum up, the expert or technical views cannot be received instant responses from the authority because of the view gap amongst these sides; thus, the decision-makers' actions often based on the current situations without consideration of expert's recommendations. […]." ***(Expert 10)***

4.3.2.4 On the 4th analysis criterion: explanatory rationale on River basin issue on flood risk management theme

The flood risk issue has confirmed as no longer constrained by the political-administrative boundary as well as a single hydro-geographical mechanism within the specific areas. Along with this recognition, river basin management has been subjected to undertake more than traditional expectations on related-water resource management. Adapted with the trans-boundary flood risk reduction theme and internationally adopted commitment, the attempts to integrate flood risk reduction into trans-boundary related policies have been considered.

The interview explains the current situations, and main drawbacks of approach on water-related trans-boundary management, and these complex issues raised in the discussion and the data suggests *the water resource management* is the mainstream of management policy, regardless to flood risk management aspects in the Vietnam river basins management scheme. The experts gave the main drawbacks as the poor coordination or negotiation-related matters possibly hindering the integrated flood risk management in river basin areas. The following quotes illustrate these points from the interviewees:

"[…]. Once, I attended the manual Dong Nai river basin meeting; then I realized that the authority staff approaches the water resource management instead of developing towards reducing flood risk for the along-river-urban areas*.[…]."* ***(Expert 3)***

"As far as I concerned, the basin management in Vietnam operated and reported as quite good management*. […]."* ***(Expert 4)***

"There is an information exchange mechanism within river basins. For instance, Dau Tieng and Tri An reservoirs exchange the operation activity information each other or the operation activities referenced while two reservoirs' operation activated. […]." ***(Expert 7)***

"[…]. The catchment management is on the consideration of water quality management rather than flood impact deduction […]." ***(Expert 9)***

The viewpoints present real disadvantages and challenges on the flood risk management theme in the river basin scale. The problems have been claimed as the leading causes delaying the integration of flood risk reduction aspects into the current legal framework. The first shares from participants' opinions in this point comprise of: i) The coordination problems with inter-regional river basin or the issues of negotiation on river resources' sharing, and ii) The insufficient support from the legal framework on implementation.

"[…] In a small river basin, for instance, the Dong Nai river basin, there are two tributaries (the La Nga River and the Dong Nai River) surrounded by many provinces (Binh Duong, Long An, Ho Chi Minh City, Lam Dong, and Dak Nong Provinces, etc.,) and the Dong Nai river basin commission has been set, with the "changing role annually" regime. However, from the formal setting up, the achievement of the commission is less, and there were no signed agreements because of the "conflict of interest" amongst parties for more than ten years. […]." ***(Expert 1)***

"This action could be a good effect of approaching the trans-regional river basin management. However, we must wait for the trans-regional administration initial, with the following lacking of financial support. The approach of the grand project, with the detailed content and sanctioned by the Parliament, can assure the project's outcomes. The trans-regional matters recognized, but the government has hesitated for the next stronger actions. The issue is related to institutional conflict, or there is a requirement of the regional institution within the river basin, supported by the state budget. […]." ***(Expert 6)***

"[…]. For instance, the situation of Ba Bo stream basin could illustrate the complexity of the trans-boundary issue. The stream starts from Binh Duong province and flows into Ho Chi Minh City, as the downstream area. The impacts of stream activities considered within many meetings and negotiations between administration authorities. Some conclusions declared with the responsibility of two parties. However, some issues were being still (flooding, pollution issues, etc.)." ***(Expert 8)***

4.3.2.5 On the 5th analysis criterion: explanatory rationale on Trans-boundary flood risk management issue (a contemporary situation, current approach on legal framework and practices)

Addressed the central role on water resource management and on reducing downstream damages, the trans-national or trans-regional flood risk issues raised the most challenge on coordination mechanism due to the differences of the Member states' viewpoints on political and economic interest. The coordination mechanism influences the integration of flood risk management into international recognition and flood risk reduction schemes. Vietnam government concerned water-related disaster as crucial issues and showed attempts to promote water resources management and to enable good cooperation in the field of sustainable development, including flood control of the Mekong River Basin (Huu Ninh Nguyen, 2007).

The views showed that *the ineffective coordination* within the Mekong River Basin is hindering the flood risk management by postponed shifting the international matters, like flooding, into the national concerns, although the official presentation of Basin member states has been set up on the Mekong River Commission.

"[…]. The countries within the basin keep going on "the best developing strategy." Therefore, the matter of River basin management is, in my opinion, a rare successful case within a couple of groups. The Rhine river commission, for instance, could be observed as a successful practice because of some actual reasons. The concession has been made among parties because of the conflict of interest negotiated. The water quantity matter decided by the official German and the Netherland authorities; however, the issue could be difficult within the Mekong river basin between Vietnam and Laos's government. The reason for that problem claimed into the concept of water's value, and water just can be traded between the two countries. Or, the negotiation made

with the economic interest. The river basin management is possibly successful as if the agreements based on the economic stance." ***(Expert 1)***

"In my opinion, that is necessary to manage flood damage in the manner of trans-boundary or trans-regional flood risk management, because this approach of management addressed the water resource management within an area of many regions or nations. […].This policy framework is the endeavor of the expectation of reducing downstream damage. However, the water resource management addressed many economic and political themes within the member states; and thus, it is hard to harmonize the multilateral interest. […]." ***(Expert 2)***

"[…]. The call for the prevailing legal framework is always on the authority meeting, but the most strong appeal for the context is still from the lower Mekong countries (e.g., Vietnam); the other Member states (Laos PCR or Cambodia, etc.) feedback the adverse effect ignorantly. […]." ***(Expert 3)***

"Member states within the area have been pursuing their main interest rather than River Basin common interest, with the dominance of core national interest in this river basin. It is hard to implement the policy that decreases Laos' profit in the basin, for instance, because of Vietnam's interest. Laos' government could not accept to sacrifice the national advantage for many reasons because of a national decision based on the political advocate. […]." ***(Expert 5)***

"In the Mekong River Basin (or trans-national level) and on the official representative by the Mekong River Commission, there were two agreements that have been signed. The first is in 1957, and this is a formal agreement, with the consensus within the Member States for the Mekong river involved actions (e.g., the Can Tho Bridge project required the approval of the Mekong River Basin member states). The latter is the substitute of the first agreement and approved in 1995. This recent agreement was signed by four Member states instead of six members for the whole basin (China had not recognized the Mekong River Basin at that time, and Myanmar was in the political crisis), and this agreement issued with no international legal binding. […]." ***(Expert 6)***

"In the larger scale of the river basin, for instance, the Mekong River Basin, the Mekong River Basin agreement which approved in 1995 the trans-boundary issues have been mentioned the consideration, however to the trans-boundary cooperation is weak. All the involved nations agreed on some river mainstream management principles; however, the attention to river basin management is rare. […]." ***(Expert 7)***

"In the Mekong River Basin, there is The Mekong River Commission includes four Member States. The organization does not include all countries within the Mekong River Basin that participated in the Mekong River Commission. Some other upper countries kept the observation stance and refused to join the Commission. However, the role of the Mekong River Commission is still on sharing information because the Mekong River Commission can access trans-boundary gauge station data within the basin. […]." ***(Expert 8)***

"That is a big challenge of The Mekong River Commission. On the legal framework or institutional corridor of the lower river basin protection, there is no sufficient agreement from the State members. […].The legal framework based on the multilateral negotiation amongst the Mekong river basin member states to keep the balance of the national interest; however, the consultation is still going on. […]." ***(Expert 9)***

4.3.2.6 On the 6th analysis criterion: explanatory rationale on Land Use Planning as the comprehensive potential on supporting flood risk management

Integrating flood risk issues into formal policies is not a new concept, and the interview data suggest that the shift towards integrated land use planning prolonged due to focusing on development aspects, regardless of disaster risk management in Vietnam economic engines. The shares from informants implied the difficulties must be overcome to achieve the set objectives (including integrated land use planning into the legal architecture). Therefore, applying land use planning in flood risk management is standing as in the concept

phase and requires more efforts from multidisciplinary approaches on collaborations rather than the traditional and passive paradigm from the government agencies. Reflecting on these issues, the experts concluded the following:

"The trend of land use planning employing as a non-structural measure is, in my opinion, is the right approach in developed countries, and this does not mean that approach could not be applied in developing countries like Vietnam. However, in the case of Vietnam, financial resources always are the biggest challenge for every project that getting involved in flooding risk management, especially the project applying the long-term vision like non-structural measures. […].The priority projects are economic-interest-based programs. These economic-based projects considered with environmental protection factors; however, the priority decisions still favor the economic aspects. […].The agricultural land includes lake, stream, storage areas, etc., and cultivation land takes 65% agriculture land, and the economic factor of cultivation land should be considered, with the tourism and service factors increasing financial interest. […]." ***(Expert 2)***

"[…].In general, most of the urban planning addressed the flood risk management factors in the detailed plans." ***(Expert 5)***

"[…].However, the main problems are coming from the plan implementation. In other words, the implementing capacity of plans should be the critical consideration within the planning process (e.g., the new policy demands 30% vacant land for green space is difficult to attract new investors. Thus, the idea could be failed in the implementation because of scare financial support). Therefore, the plan without considerations from many viewpoints limits the possible implementation ability. Also, without assessments could add the plan more troublesome. […]. For example, the development's direction heading to the sea may take risks, with the high awareness of sea-level rise. However, the investors were attracted to these areas because of the upper housing demand. The local government keeps the top recommendation of these risk regions, but the investors, as well as the customers all, accepted the flood risk. Therefore, in this situation, the local authority has no actions because of missing a precise assessment. There are no wrong or right sides to this situation because the land has potential development, and there is a risk acceptance from the stakeholders. […]." ***(Expert 8)***

"Land use planning plays an essential role in many urban management issues, including flood risk management. However, there is a gap between the long-term vision objectives and the plan implementation to keep up these set goals. Via adjustments on detailed planning for every five years caused by the previous plans had no considerations to climate factors or concentration on socio-economy changes; the general ideas could be torn down by changing the long-term setting goals. […].For example, in the general plan, there is 100 ha assigned as a private function in a particular area within Ho Chi Minh City's districts. However, the decision-maker (in the five years of the political term) expects more development in the pointed area to increase economic growth and local budget. Thereby, the local leader urged on demand to the higher responsible authority for changing land use. Therefore, in people's expectation, the land use planning could take a prominent role; but in reality, the plan implementation often breaks the approved general plan and then, changing the previous plan's set objectives." ***(Expert 9)***

4.4 Results and discussion

The assessment on setting criteria conducting through expert viewpoints' investigation supports educational aspects and explains the current as well as substitution measures at the national level and the governance arrangements in the Vietnam context. Setting criteria comprises:

- Priority measures and their roles in the National legal framework, planning plans, and practices.
- An integrated approach addressed non-structural measures in the legal framework and practices.
- Land Use Planning roles in riparian areas.
- River basin issues on flood risk management theme.
- Trans-boundary flood risk management issue.

- Land Use Planning as a comprehensive tool, supports flood risk management.

The overall scenery exposed from this survey is that the necessary measures used to deal with the flood-related issues in the urban theme are increasingly being recognized in their roles. Structural measures are implemented, but at the same time, there is a shift towards non-structural measure use. The case study's results reveal land use planning might be the practical approach in both floodplain and trans-boundary flood-related issues. A discussion of reflection on assessment is given.

4.4.1 Priority of physical measure employment in riparian urban areas

i) There are similarities in two cities cases; Ho Chi Minh and Can Tho cities as large riparian areas under flood exposures and vulnerability. In these flood-prone areas, the domination of structural measure employment connects short-term reaction to deal with arising flooding situations rather than sufficient measure arrangement in line with a national legal framework to reconcile long-term urban development control and flood risk issues.

ii) The existing gap between structural and non-structural measure employment is not vague. By identifying the underlying causes contributing to the prevailed role of physical flood control measures, the finding raises two necessary attributes that should consider: the legal framework supports and employing as a measure to react with short-term cases by adapted with acceptance from the community and local capacity.

iii) The findings expose that the structural measure employments have been evolved and would keep a stable role in flood risk prevention and control strategy. Similarly, utilizing physical measures as a conventional solution would be dominated in flood risk management scheme in a flood-prone area in the current and next decades by many explanatory causes.

iv) Reducing flood risk consequences based on single-based measures is impossible. In case of regional economic hubs (e.g., Ho Chi Minh City or Can Tho City) concentrating on structural measures, results in present drawbacks more than short-term flooding situation control:

- It has proved through many good practices in flood risk management schemes that physical measure employment reveals many drawbacks and downside of measure employment (by applying a single measure).
- Flood risk is a result of poor development control rather than the climate-driven event causes. A reasonable development control may improve the flood risk situation afterward, then possibly applying in other natural disaster mitigation initiatives.
- Development control is a multi-disciplinary matter; therefore, the approach must be considered in a multi-disciplinary manner and frequently revising on the feasibility aspects of development plans (e.g., lacking community involvement inducing the community adoption on necessary components).

v) The traditional measure of employment has still played an essential role in flood risk management at the local level and maybe kept going as domination on reality, although the measures exposed downsides of this employment in the long-term supported consideration. The disadvantages of these legislation incentives on structural measure implementation are varying rather than bringing benefits. These negative points include:

- Hindering the alternative options for more sustainable measures by creating the institutional momentum in the physical structure implementation at the local level;
- Enhancing the development as well as the expanding development scale that results in the broader investment for the next stage of urban development (by increasing safety feeling from communities); and

- Promoting the habit of maintaining the spontaneous reactions from the local authority to cope with the natural hazard when events strike in the short-term.

These unrecognized disadvantages on structural measure employment in this case study could pave the corridor for measure applying instead of enhancing non-structural standards by identifying the engineering measure damage created by risk governance intervention or legal initiatives, in the manner of sustainable development.

vi) The investigation into the public policy field to support the appropriate instrument applied in flood risk areas sheds light on the current situations and interactions amongst institutional capacities at different levels. The shift from flood risk control mechanism into natural disaster prevention, response, and mitigation of National framework highlight the movement of flood risk-sensitive into public policy at National level; nevertheless, this shift is not kept up by local public policy scheme. The investigation from the expert viewpoints exposes the gap between national and local levels, although the top-down planning mechanism dominated in the Vietnam planning system confirmed in many studies.

4.4.2 Integrated approach, addressed non-structural measures in the legal framework and practices

vii) The low-pace shift from structural action applying into new method of land use planning on the manner of integration of flood risk reduction contents, on the one hand, reflects the government attempt in the delayed pace; on the other hand, hinders the considerations and applying other non-structural measures as mitigation measures in local levels.

viii) On the stages of development, non-structural measures considered in integration manners. However, which group of the non-structural actions in the main focus on flood risk management applying in the flood-prone areas is in standstill situation. Flood risk management policy requires not only authority efforts but also interdisciplinary supports (legal arrangement, community adoption, etc.).

ix) Despite flood risk mitigation measures firmly integrated into the National disaster prevention and control policy scheme, local government takes part in slowdown progress of non-structural measure employment on flood risk management in the manner of both local flood risk management and trans-boundary flooding arrangement. Therefore, the ineffective coordination or existing hesitation on decision-making process shown in these critical aspects:

- Lacking sufficient legal supports or instructions from the higher-level results on weak planning as well as development control policies; and
- The short-term reaction from the local apparatus results in poor planning derived from political pressure as well as a regional financial shortage.

Therefore, further align policies on a local level focusing on strengthening the responsible actor cooperation is the more primary mandate of the local governance apparatus.

x) Globally, applying the non-structure measure is the trend of urban areas on pursuing the sustainable development under threats of climatic-driven events via good practices and international guidelines; nevertheless, the experts surprisingly shared the scarce of the budget on physical measure investment as the leading cause pushing the consideration on non-structural measure employment. The non-structural measures, hence, are being applied at a very limit extent. In the study case, the non-structural measures implemented with limit roles of flood prevention. The approach of integrated risk-sensitive into land-use policy adopted as the potential in the context of flood-prone area development control; however, the limited extent of strategy at the local level reveals the challenges and demands more assessment.

4.4.3 Land Use planning roles in riparian areas

xi) Vietnam flood alleviation and land use planning have significant innovation, as well as some shortcomings. An innovative momentum is recognized flood risk issues and gradually integrated risk contents into the planning system. Without this reorganization, the flood-prone areas' driving forces remain major threats on region development not only in urban areas but extending to other places, especially accompanied by unpredictable consequences derived from the progress of climate change. The investigation into spatial planning on flood risk management analyses the interlink between the current flooding situation and potential of mitigation measure employment in the context of Vietnam riparian urban areas; by identifying the motion of policy innovation in this field and most challenges are hindering flood alleviation progress in these flood-prone areas.

xii) The matters of flood risk alleviation identified as a necessarily crucial issue in flood-prone areas, compared with maximum using of conventional measures to keep people away from flooding as its motto. The spatial planning in the flood-prone regions is the approach of land use planning on two main themes: development control and flood risk reduction. Land-use planning has been recognized as a useful mitigation measure in many international initiatives by integrated risk-sensitive considerations on all levels of legal architecture.

xiii) Land-use planning may be a potential approach to flood risk management. Based on the comprehensive planning process (regarding multidisciplinary approaches), land use planning could be used to deal with two main challenging issues in flood-prone areas: flood risk reduction and development control by appropriate policies. Although supported with the national initiatives as well as an international commitment by the government's attempts, land use planning performed as the concept or ineffective non-structural measure in the workplaces or local level.

4.4.4 Trans-boundary flood risk management issues

xiv) Regarding trans-boundary flood-related problems, the flood risk on this field has been figured out and required more supports on national public policy as well as international efforts. The intervention from the public policy scheme urged as the necessary efforts to reduce disaster risk consequences. The international attempts via initiatives have been set up (e.g., The Mekong River Committee); nevertheless, the role of these actions is still limit and challenging to be more extended. The long-term primary objectives addressed under dominated water resource management associated with economic aspect-based priorities. Further, the current international cooperation reveals the drawbacks of the multi-lateral negotiation mechanism; and causes insufficient binding policies within the Member States. Therefore, long-term visions to anticipate flood sensitive contents must be the priority and consensus on regulation regarding flood risk reduction in the international legal framework.

xv) On the international river basin scale, the failures on trans-boundary co-operation and co-ordination are the prevailed causes hindering the progress of transboundary flood risk management. The factors contributed to poor trans-national coordination may:

- Uncommon views of natural resources' share within the Member States; and
- The economic aspect plays the priority consideration based on the multilateral negotiation in many involving controversial issues; hence, that results in water-resource management being the central scheme of current river basin management rather than risk-sensitive matters.

xvi) The call for equilibrium persists on international cooperation mechanisms is urgent to adapt to trans-boundary flood risk. The delay on the issue is not only maintaining the current controversy on disputed flooding matters, but also exacerbating the other water resource management by an emphasis on traditional measures as well as implementing the

measure adjustment that may harm to other countries, and result in different trans-boundary tensions.

CHAPTER 5. SPATIAL PLANNING IN FRANCE AND GERMANY: A COMPARATIVE ANALYSIS IN THE CONTEXT OF FLOOD MITIGATION

The major theme of this part aims to figure out how flood-related issues integrated into spatial planning within the European context, based on a comparative case study focusing on two adjacent countries France and Germany. The comparison was set in the context of flood risk management policy and systematic attention to the integrated operation of flood issues by reviewing the process of spatial planning in both countries and remarkable milestones of policy evolving when flood damage and disruption emerged as the adverse impacts within the region.

Traditionally, France and Germany both countries shared the experiences of dealing with the increasing potential of flood damage as well as good practices on flood management. In France, floodplain encroachment has been shown with a high possibility of development pressure growth (Pottier, N. et al., 2005); and adverse damage is considered in the same place with big floods of past centuries due to high-value asset and compacted population (MESDE, 2011). In Germany, growing flood damage was counted by "the number of people who live in exposed areas and accumulated value there" (DKKV, 2004, pp.16). Hence, they both implemented approaches aiming to flood risk reduction initiatives and policy. The policy arrangements are different due to each approach case applied to specific situations embedded localized characteristics; nevertheless, lessons might be learned from the comparisons' reflexes.

The evolution of flood risk management policy in both countries could be described around the legislative and administrative systems. France and Germany are the State Members of the EU, and in current, flood risk management legislations were aligned and balanced in both schemes of national flood risk management and trans-boundary flood-related policy. At first concern, France historically performed a planning system concentrating on using of land that addressed being prone to natural disasters (Pottier, N. et al., 2005, pp.5), and current policy implementation laid on flood risks as the priority (DGPR, 2014, pp.4). Germany, similarly, implemented spatial planning as a binding measure to reduce flood risk in flood-prone areas (DKKV, 2004, pp.16) and reported achieving improvement on flood damage reduction (Thieken, A. H. et al., 2016). The latter concern on international flood-related issues, German government enhanced transboundary cooperation in water sector as the priority within four levels (multilateral dialogues at the international level, cooperation fostering in regional water collaboration, supporting basin organization through institutional and sector-specific technical advice, and financial resource provision at the local level)(BMZ, 2006). In France, the cooperation regime was established at the river basin within the six basin agencies covering basin-scale as well as trans-boundary flood-related issues. On the river basin level, both countries formulate structural cooperation through the International Commission regime aiming to the solution of trans-boundary problems (e.g., formulation, management, and provision of information systems and models) (Frijters and Leentvaar, 2003).

The implementation of flood risk management policy in France and Germany outlines valuable learned lessons and provide guidance that aims to deliver flood risk reduction in flood-prone areas. Therefore, it may be possible to reduce flood vulnerability in the floodplain by clarifying the advantages of current approaches in the specific comparison:

- What are the significant measures that shape specific flood risk responses?
- How can land use planning be involved in the current flood risk management framework? and
- How can trans-national flood-related issues be addressed in international river basin institutions?

This part, therefore, is organized as follows to outline the differences and common viewpoints. The examination of the national institution and planning system in both countries is the first part's portion. The planning system structures may reflex the patterns contributing

to factors that shape risk responses. The second attempt of investigation concentrates on planning as processes in both countries, with the particular focus on whether or not national strategies on flood-related issues are converging. The last portion points out the trans-boundary flood-related arrangements in the shared- river basin and brings elements contributing to both countries meeting their flood-related challenges.

5.1 National institution and planning system

5.1.1 France

The France Republic possesses approximately 544,000 square kilometers, with a population of about 66.32 million inhabitants. The country administrative organization includes three levels of authorities: Municipalities, Departments, and Regions. The country comprises 26 Regions (including four overseas), 101 Departments (with 5 Departments in overseas), and 36,783 Municipalities. The Decentralized Unitary States presents the French administrative structure in which was formed by the decentralization Law of 1982.

The State Government is a democratic parliamentary State with separated powers divided in Executive, Legislative, and Judicial powers, and the powers embedded Deconcentration and Decentralization principles. The state government's representatives distributed at the departmental and regional levels as the Prefects. The Department Prefect and the Regional Prefect undertake the State's representative roles as deconcentration, and the Prefects have responsible for deconcentration services (e.g., law and order, law enforcement matters, or advising to support local authorities).

The deconcentration and decentralization characteristics also found in the water management field (Noel, C. 2009). While administrative levels have a direct role in water management, the Prefects at all levels undertake the responsibilities of coordination, such as coordinating the deconcentrated services of the State (e.g., Basin Coordinator Prefect roles; Water development and management plans adoption and approval).

Institutions imply the decision-making process, policy guidance to the adopted issues. The government structure, thus, contributes and decides the effectiveness of the policies. On the planning, in general, and on the policies towards flood mitigation, in detail, both systems state the flexibility in the decision-making procedure by the distribution the powers within actors. The French government structure recognized by two groups of forces: the State and the local authorities. The decentralized characteristic in the French institutional framework indicated under the power contribution between two main branches (the State and the Local authority) of the system through the integrated role of State representatives at local authority levels.

The State responsibilities are undertaken and implemented by the Prefects of Region and the Prefects of Department. The Prefects of Region has fixed with the role of national and community policy implementations, while the Prefects of Department responded for "territorial level for implementing national and community policies" (EC, 2000, pp.24). The Prefects of Department is under the competence of The Prefects of Region on the socio-economic development and territory development (aménagement du Territoire). Outside the dependence, the Prefects of Department takes the same hierarchical relationship with the Prefects of Region, reflecting the decentralized structure between these two main branches on the central government level (Figure 29).

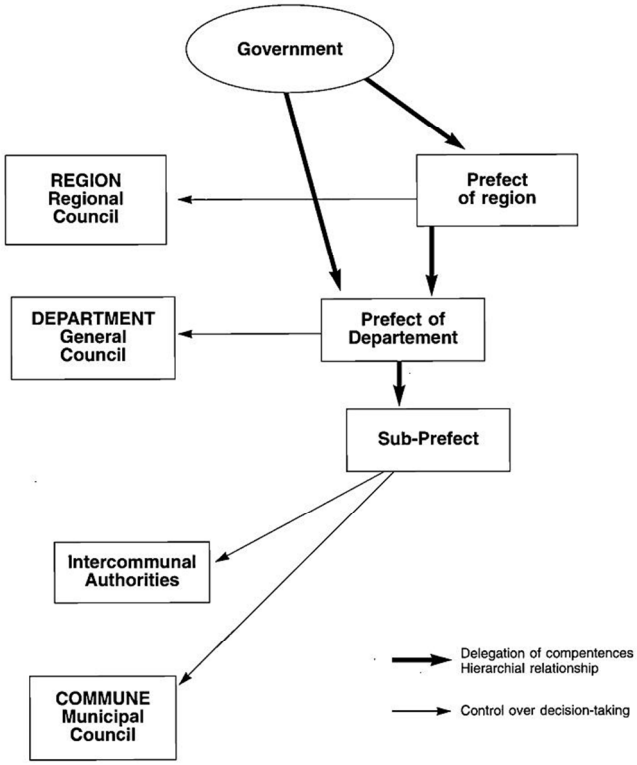


Figure 29 The French administrative system at the central government level
(Source: Adapted from CEC(b), 2000)

The local authority structured by three primary levels and formed the self-government structures; consist of i) the communes; ii) the departments, and iii) the regions. Divided into two groups with the functional criteria, the first group - communes (36771 communes) - is defined as the basic unit of residents, with the non-functional definition, while the second group (110 départements and 26 régions) was known as functional units.

The communes use the joint communal authorities as competence representatives, with the inter-communal cooperation principles. In the economic development and planning, the competences and cooperation amongst local authorities based on the competition principles. Table 32 introduces the powers of different local authorities in the planning fields.

No	Local Authority	Competencies
1	The Région	- Response to regional planning, economic development.
2	The Département	- Response to coordination and cooperation between communes; and - Implementing natural environmental protection policies and rural development.
3	The Communes	- Steered to multi-functional cooperation (by the State authorities); - Represented by joint communal authorities undertake land-use issues, land use intervention (acquire lands on behalf of its members for urban development projects, etc.); - Response for local infrastructure facilities, majority infrastructure provision and public services; and - Carrying out planning and economic development functions (The Act of 6 Feb 1992).

Table 32 The local authority competence in development and planning fields
(Source: Adapted from CEC(b), 2000)

5.1.2 Germany

The Federal Republic of Germany is a country of 80.275 million inhabitants and situated in an area of about 356,733 square kilometers. The country has a Federal state administrative structure comprising 16 states (Länder) (CEC(b), 1999, pp.39).

The German planning system presented as close cooperation among three tiers: the federal state (Bund), the local states (Länder) and local municipalities (Gemeinde); and determined by the principles of "subsidiarity," "municipal planning autonomy" and "mutual influence."

The system of spatial planning is based on close relationships amongst three levels, and the spatial co-operation presented within three-level activities. This system structure includes:

i) the federal level (Bund) guides the spatial planning, in general, and cooperates with the regional level;

ii) the regional level (Länder)is responsible for spatial planning at first state spatial planning and the regional planning (at this level, the preparation of the State development plan suggested to adapt with federal level's guidelines; and then the regional planning with the binding legislative competence to public administration); and

iii) the municipal level (Ständte and Gemeinden)prepares and exercises land use plans from preparatory land-use plans to binding land-use plans. The structural cooperation among levels summarized as in Table 33 (CEC(b), 1999, pp.19).

Government level	Type of planning	Plan title
Federation (Bund)	Federal spatial planning	Guidelines for spatial planning.
States (Regions)	State spatial planning Regional planning	State development programs. State development plans. Regional plans.
Municipalities (Local level)	(Local) land-use planning	Preparatory and binding plan use plans.

Table 33 Structure of spatial planning in the Federal Republic of Germany
(Source: adapted from CEC(b),1999)

Flood risk management centers also active cooperation nationally and internationally, embedded the excellent coordination amongst levels. The federal-level keeps key roles in issuing regulatory instruments, policy amendment, and improving problematical issues. For instance, the Federal State issued the Federal Water Act (Wasserhaushaltsgesetz), then sanctioned and transposed this Federal Water Act into German national law in which mainly providing to improve preventive food mitigation (UBA, 2010, pp.106; LAWA, 2010). Regarding national as well as trans-boundary cooperation, the national framework on flood risk management thus has been combined with the EU floods directive (2007). The primary reference was based on the EU floods directive; and legal actor (e.g., The International Commission for the protection of the Rhine - IKSR) as a vital role in coordinating of the main river basin on the inter-government cooperation issues.

5.1.3 Reflections

On political and administration systems, institution establishment outlined differences and common similarities to the main concerned issues. According to the national legal and institutional framework of spatial planning between France and Germany, the role of spatial planning system presented as a practical approach for the fundamental goals of national strategy: dealing with challenges that were raised by the quick changes in post-war ages. On the European scale, the premier goal of achieving regional cohesion was affected by every single State Member, and the similarity in national development strategies of each country is explainable and predictable.

High decentralized power and autonomous planning regime at the local level recognized at the institutional framework. Embedded self-government structure, the French planning system was based on the communication mechanism between two groups of power: the state government and local authorities. The state government representatives paved the corridor of communication as the Prefects on local authorities' functional units (Regional Prefects and Department Prefects), and this keeps the necessary coordination for the planning system at any level via joint powers. Further, the decentralization law (1982) was the essential foundation providing a formal framework and cohesion within the system. On similarity, the German planning system was established on three tiers of cooperation to guarantee federal cohesion structure. The system has also rooted in-laws and regulations in flood risk management robustly motivating the effectiveness on many crucial flood-related issues on both national and international scale (e.g., the Federal Flood Control Act and the EU Flood Directive).

The highly autonomous local regime is being the most crucial factor in both planning schemes through effective coordination amongst administration levels by opening the communication corridors on related issues. Addressed problematic issues, French local municipalities (Communes as the basic unit of residents) have empowered by national legislation through cooperation mechanisms to ensure to implement and control the detailed policies or instruments. Via the strict cooperation between the government's representatives at the county prefect and city mayor, the local government roles have involved through communication schemes from both sides. The county prefect's tasks at the level are not only implementing the public policies but leading the emergency organization through the operation center of the county (MESDE, 2015, pp. 8). Similarly, the German pattern in this stage embedded a self-administration regime in which institutionally guaranteed. The German municipality level possesses local self-government tasks on a local basis (e.g., local administration; local finance and taxation; providing local public facilities; health policy or local land use planning, etc.) and performs its rights and duties in the manner of coordination with higher administration level (The Länder) via the counties (The Landkreis) (CEC, 1999). The local authority also performs duties in an associated manner with other associations which supported from both technical and financial viewpoints. These associations keep specific roles within assigned tasks that addressed water resource management-related issues (Bartel H. et al. 2010).

5.2 Legal amendment on national flood risk management

5.2.1 France

Towards sustainable water resources utilization, flood risk management in France witnessed the changes as wells as adjustments continuously in the institutional framework; especially, the national policy in flood risk management had been affected by the application of European Directives and embedded itself majority principles in action framework to achieve the national strategic objectives and internationally common goals. The policy adaptation process on French water policy described through two main phases. The first phase counted from the year of 1964 to 2010 with the establishment of the National Water Committee in 1964 (Noel, C. 2009, pp.9). The second one was performing after 2010 marked with the initiative of the new national flood risk management (DGPR, 2014, pp.3; Larrue, C. et al., 2016) as transposition from the EU FD (2007) into French law in 2010.

The Law of December 1964 witnessed the first phase of French institutional adjustment on flood risk management, addressing two critical principles of water management: the initiation of basin catchment committees and the independent financing of water policy. Early, the French water policy, the basin management has been taken roles as a primary impetus in the flood risk management. In the current, thirteen hydrographic districts divided between France, including eight districts in continental France and five districts in overseas territories (Noel, C. 2009, pp.8) (Figure 30). Each basin or hydrographic district has its basin catchment committee or parliament, with the responsibility of adopting the detailed plan of the development and management of water resources. The plan covers the main objectives, directions, and implementations. Further, the basin catchment committee sets up and adjusts the administrative and planning process to serve the committee activities to adapt to the adopted blueprint.

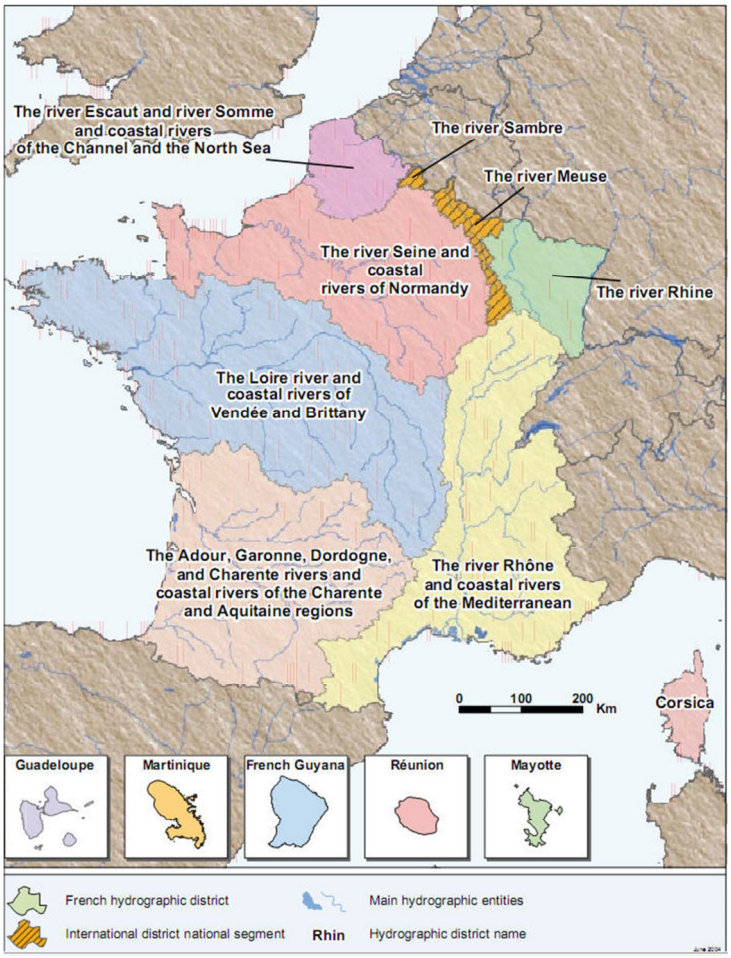


Figure 30 The French hydrographic districts
(Source: adapted from Noel, C. 2009)

The next advanced step in the first phase was the "Policy adoption" in flood risk management schemes, for instance, the implementation of the Natural Disaster insurance system (CAT-Nat, compensation system based on private-public sector cooperation in the Natural Disaster Scheme) in the law of 13rd July 1982, which expanding the economic-loss prevention and cost reduction (DGPR, 2014). Larrue, C. et al. (2016) expressed that the so-called "flood policy" should be counted from the 1980s towards causing general reform processes of the administration to the decentralization of powers and resources.

Following the next ten years, the law of 1992 (so-called "Water Law") adopted the proposal of implementation of planning instruments for catchment areas, focusing on restoring the resource and flood protection. According to MESDTH (2012), based on the Water law, two planning instruments had been introduced for basin-scale (the SDAGE – Master Plan for water development and management) and sub-basin scale (the SAGE - Water development and management scheme).

The French government afforded to address flood issues by the law and following circular in the years 1994, 1995, and 1996. These national legal acts including:

i) Two circulars comprising of flood prevention and flood-prone management (January 1994) and urban development control in flood-prone areas (February 1994);

ii) The law of 1995 – Banier Law –carrying out the Prevention of Natural Hazards Plan – PPR (MESDTH, 2012, pp. 18; Arellano, A. V, et al., 2007); and

iii) The law 1995, which accompanied by the circular in April 1996 on building and existing engineering works arrangements in flood-prone areas created the system to protect against floods (Arellano, A. V. et al., 2007).

The following step in the first phase indicates the redistribution of power and resources or local governance domination, and this stage marked by the adoption and implementation of the action programs for flood prevention (PAPI) in 2002 (Larrue, C. et al., 2016). The PAPI considering as a measure with tasks of introducing the concept and principles of "integrated flood risk management" to local authorities, has put the milestone of the redistribution power and resources at the local level.

The second phase of policy adjustment was the remarkable milestone of French water policy adapted to the EU floods directive (CEC, 2007), as the French bill of 2010. This new French national flood risk management policy, which had been called the law of 12th July 2010 was a national commitment to the environmental issues (LENE), mainly the new French initiative from the EU floods directive 2007 (DGPR, 2014). Concentrated to French policy n flood management schemes, the French bill of 2010 confirmed sustainable development by comprehensive risk management and planning, in detail with the removal of population development in floodplains or reducing the population exposed to the flood. Further, the bill marked new integrated directions on coordination in both national and international floor-related issued.

5.2.2 Germany

National flood risk management framework in Germany embedded the evolution of the Federal Flood Control Act within the primary two phases, from 1957 to 2009 and the period after the year 2009. According to Hartmann, T. et al. (2014), the first phase could be described by the domination of Federal states concentration to flood protection by infrastructural measures from 1957; while the second phase witnessed the decentralized process on flood risk management strategy for more integrated policy in the German system since 2009. This paradigm shift was supported by the initiatives as the guidance of the intergovernmental working group of water minister of the German "Länder" and the Federal Ministry responsible for water issues (LAWA); and the European Floods Directive.

The shift from flood protection to a more integrated flood risk management policy was assessed and considered as the most critical direction of the German legislation and planning system. This shift was embedded in the development of regulations for flood protection in the German Federal Water Act (Gesetz Zur Ordnung des Wasserhaushalts - Wasserhaushaltsgesetz - WHG). The first version of the German Federal Water Act adopted in 1957, and then several amendments were developed (in 1996, 2005) and expanded to the latest version (in 2009). In this phase, the paradigm shift of change from flood protection to flood risk management recognized. Hartmann, T. et al. (2014) also stated that the adoption of the German Federal Water Act 2005 opening new initiatives and putting the foundation to the substantial reform on flood risk management systems by introducing some minor amendments in the German Federal Water Act 2005 contents (Table 34).

No	A brief description of new introductions addressed in the German Federal Water Act 2005
1	General and universal principles for flood protection and instrument of the flood control plan.
2	Amended flood-prone zone definition.
3	Official recognition of two types of the flood-prone zone: - Inundation zone (flood-prone zones occurred less than once every hundred years); and - Amended flood-prone zone definition (be inundated due to the failure of flood control facility)
4	Requiring Flood control plan issued by water management agencies.

Table 34 New initiatives introduced in the German Federal Water Act 2005
(Source: adapted from Hartmann, T. et al., 2014)

The second phase of German flood policy movement distinguished by the form of the amended version of the German Federal Water Act 2009; and this change could be considered as a significant transformation and innovation of the German flood risk management, by transposing the European floods directive into German law officially – the Federal Water Act (LAWA, 2010).

The amendment of the Federal Water Act from the EU floods directive allows more effective approaches in international flood-related issues, by setting the common interest amongst the European Member States and non-member states as well as other neighbors. Furthermore, the amended version of the German Federal Water Act 2009 reflected much meaningful and vital recognition of flood related-issues within the German legislation system. Advanced recognition counted at two essential movements. The first superior moving dropped at the integrated policy methods by transposing the European policy into the German Law implies the new approach to deal with the international issues by aiming the common objectives amongst nations. The second is that the amended version of the German Federal Water Act creating an international institutional corridor on disputed points; and supporting new concept motivation on other disaster-related issues by clearly and comprehensively identifying the movement and transformation of flood risk management policies, good practices, and effective legislative initiatives.

5.2.3 Reflections

Both countries approached to flood risk management and performed a long-time evolution of legislation reform on flood risk management theme; however, on flood risk viewpoint, the coordination principle has been affirmed being the critical factor. Two typical stages of flood risk management found in both systems. The first stage in both legislation systems concentrated on solving disputed flood-related issues within the countries. In France, the considerable improvements observed through continuous transformation of flood policies, in particular on “water policy” in 1980s (with Nat-Cat regime introduction in 1982) to “the water law” (with measures e.g. SDAGE and SAGE in 1992) as well as the following “the Banier law” (1995) and the PAPI in 2002 (Action programs for flood prevention). In Germany, the first stage marked by the movement of the German Federal Water Act as the primary scheme of legal reform and revision. The second stage witnessed the integration of national law into the European legal system in both countries through the adapted process to the EU floods directive (2007), with the outcomes of the French Bill (2010) and the German Federal Water Act 2009.

Flood recognized as the international issue; therefore, the trans-boundary cooperation must be put into account in the common and shared interest of the European stakeholders (e.g., the Member States and riparian neighbors). Nevertheless, the trans-boundary problems demand approach in many settings from national governments to governance mechanisms. The EU floods directive may address shared goals and pave the corridors on disputed issues, but trans-national co-operation is always vulnerable by interdisciplinary challenges in particular in flood risk management schemes.

5.3 The national strategies on flood-related issues

5.3.1 France

The French government established and implemented the flood risk management strategy on six separated river basins. The establishment, namely the 3P approach, includes prediction, prevention, and protection strategies. These strategies were based on the political shift of adoption from flood hazard reduction to flood damage reduction (RIZA, 2004). Following adopted contents, the appropriate spatial measures and instruments applied to these central basins.

“The protection strategy” aims to flood’s impacts reduction by protecting the existing development and discourage future growth in specific flood-prone areas. The protection

focuses on two groups of measures: spatial measures and planning instruments. The spatial approaches aim to floodplain restoration and creating retention areas; while planning to pay attention to restrictions to urbanization (RIZA, 2004).

The protection's first group of measures concerns spatial measures. Floodplain restoration has been distributed and implemented in large-scale basin districts (the Rhine international basin district, for instance), and these measures recognized as the essential tools for flood alleviation. The increasing storage capacity of French's part in the Polder Erstein (The Erstein polder) located in the Rhine international basin and supported by the French-German Treaty reported as the active bilateral cooperation to deal with the 200-year floods (RIZA, 2004). The restoration of the river and its tributaries is the practical measure not only to adapt with the reduction the flood damage but the necessary step to implement the next stage of protection measure by establish the new retention areas as well as adding the new tools of protection (Santato et al., 2013). As a traditional structural measure, the creation of retention (e.g., reservoirs) still keeps a critical role within the flood protection theme in French rivers. These protection measures cover the application and implementation of retention areas within a specific river basin. The second group of this strategy embeds a planning scheme by creating sufficient spaces for sustainable urbanization.

"The preventive strategy" concerning river basin management has supported by the integrated multidisciplinary approaches on the flood risk management theme. These approaches embedded three main objects, according to the international office for water (Noel, C., 2009) comprising i) flood vulnerability reduction, ii) reducing flood's impacts or flood seriousness, and iii) Informing flood risk to the people. Planning instruments play an essential role in long-term development to achieve the sustainable development goals of flood risk management within the river basins. In detail, water management plans and hazard zoning regulations contributed to preventive strategy are the remarkable instruments.

The Laws of 1992 marked the two essential planning tools by introducing the SDAGE (Schema Directeur d'Amenagement et de Gestion des Eaux - Master plan for the organization of the development and management of water resources); and the SAGE (Schema d'Amenagement et de Gestion des Eaux – Water development and management scheme).

The first tool aims to cover the whole water-related issues in the basin-scale, and the second instrument concentrates on water management at the local level and applies specific programs to the 6 French river basins (RIZA, 2004). SDAGE strategic plans covered many water themes such as water quantity, water quality and water use within the river basin scale and on flood risk management theme; and concentrated to "reducing runoff, controlling flow rates in rainy weather, increasing storage capacity in major floodplains and improving the functionality of environments" (Agence de l'eau Rhin-Meuse, 2015). The combining of flood risk management theme with the other different water management issues creates the multi-disciplinary approach for flood risk management. By communicating and sharing the benefits with the many aspects of water-related issues, the SDAGE plans to set the juridical framework to implement, for instance, the flood risk management plan (PGRI) in the scale of river basin district (MESDTH, 2012, pp. 13).

Within the specific river basin district as the Rhine international district, the SDAGE applied as one of four main planning tools resulting from the EU water framework directive. The French part in this international district prepared and submitted the SDAGE to other Member states (within the Rhine international district).

The SDAGE of the Rhine basin district covered approximately six important themes (including water and health; water and pollution; water, nature and biodiversity; water and scarcity; water and land use planning; and water and governance). The two last themes (water and land-use planning; and water and governance) that concentrated on flooding risk reduction and water-use issues left the harmful footprint to the environment. Flood risk reduction in these themes is involving to reducing run-off; controlling the flow rate in the rainy season as well as extending the storage capacity in flood-prone areas within the Rhine international basin (Agence de l'eau Rhin-Meuse, 2015).

SAGE established in the manner of local level and project approach by conveying the SDAGE's supports to local levels (CEC(b), 2012); and SAGE programs were created and supported by the cooperation amongst local water commissions (representatives come from the Communes, different local stakeholders and the Departement). According to RIZA (2004), SDAGE and SAGE constituted the French water management planning instruments in the river basin districts and more local level approaches; whist, the hazard zoning, and building regulations formed the historical instruments besides the planning tools.

Hazard areas and building regulations are implemented by identifying the specific zones applying the rules, and an approach described by the introduction of the Zoning Hazard Exposure Maps – PER (Plan d'Exposition au Risque d'Inondation) in 1982. The PER separated the hazard areas into red and blue zones, with the high (banned spaces) and medium flood hazards (building regulation applicable), respectively (RIZA, 2004). Continuously, the PER was then replaced by the Preventive Plans foreseeable natural risks – PPR (Plan de Prévention des Risques), with stricter zone classification and regulations. The PPR regulates three planning zones: the red, the blue, and the white zone. The red zone indicates the strictly banned areas, the blue regions present the permission zones with conditions, and the white zones are the areas of obeying the local regulations (Santato et al., 2013). The PPR, according to Noel, C. (2009), also aims to two premier objectives of controlling the rapid development in flood-prone areas and supporting more space for flooding.

"The prediction strategy" has been presented by the system of flood forecasting, ranging from precipitation observation to fast flood forecasting (Noel, C., 2009). The precipitation observation and real-time monitoring tasks responded by the network of meteorological radars (ARAMIS) and the 170 weather stations. In some flood plains facing severe flash floods, the Southern France areas, for instance, the Central service of hydrometeorology and support to flood forecasting (SCHAPI), took the mandate of the flood forecasting services and flood map publishing.

5.3.2 Germany

German flood risk management embedded with flood risk phases; therefore, strategies have been planned to reduce losses and objected to direct and indirect flood adverse consequences. According to Thieken, A. H. et al. (2016), the German flood risk management interpreted into risk reduction strategies that encompass before, during, and after flood events. These themes of flood risk management include flood protection, flood adaptation, and flood preparedness strategies.

"The flood protection" or flood control strategy embedded the principle of avoiding inundation in certain areas. Although the changes in the definition of flood protection in time, this strategy has been considered as an essential consideration in the German regulation system on the flood risk management system, from the dominated instruments to deal with river flood to the adaptation of the river basin-wide flood risk management. The shift from predominantly focusing on technical measures to the holistic approaches which embedded the avoiding inundation principle observed in the process of transformation of regulations for flood protection in the German Federal Water Act (Wasserhaushaltsgesetz). The German Federal Water Act (from 1957 to 2009 versions) covers many different topics of flood protection regulations (e.g., spatial flood control, precautionary risk prevention, flood risk planning). The milestone of transform towards holistic flood risk management approach, according to Hartmann, T. et al. (2014), has triggered the German Federal Water Act 2005 to the German Federal Water Act 2009. While the Water Act 2005 recognized the general principles of protection of inundation zones (Article 31a (1) of the German Federal Water Act 2005), the German Federal Water Act 2009 adopted the preservation and restoration of inundation zones as a general recognition (Article 77 of the German Federal Water Act 2009).

Structural or technical measures still play an essential role in the flood protection theme. The technical standards have been implemented in an integrated manner, instead of making the leading role the flood risk management schemes (Thieken, A. H. et al., 2016). In combination with other means of instruments, control measures (e.g., natural water retention

or decentralized flood control measures) have been assessed, bringing effective use in small catchments. Nevertheless, according to RIZA (2004), in many largest river basins, the technical tools in the role of maintaining the retention and restoration capacities have kept the central purpose in catchment areas (e.g., appropriate 60 retention areas along the Upper Rhine). The artificial reservoirs have been planned and contributed to a decrease in floodplain development and to reduce flood levels in the design. In the urban scale, the infiltration measure as a tool of urban retention has been introduced and projected in many German urban areas, based on the benefit of reducing water treatment by rainwater draining in the combined sewer systems. Technical measures gradually shift towards a less critical role in the scheme of flood risk management by integrated their parts into the other non-structural measures to maintain the principle of avoiding the inundation of areas.

"The adaptation strategy" marked the vital role of spatial planning in the German flood risk management scheme. By adoption of the EU floods directive in 2007, spatial planning has taken responsibilities on supporting flood damage-reducing in the local river basins as well as applying to the whole international river basins within the directive's competencies.

Adaptation viewpoints conveyed through the legal policy domain. Within river basin regions, spatial planning forms the legal framework and institutional management within three primary levels: the federal government, the federal states, and the municipalities. RIZA (2004) and Thieken, A. H. et al. (2016) noted that adaptation strategy in flood-prone areas encompassing three themes of measures' employment: (i) flood-adapted land use planning, (ii) focusing on owners' responsibility and property's contributions; and (iii) strengthening the community's risk awareness.

The first theme of reducing flood impacts addressed flood-adapted land use planning in which supported by the Federal Water Act (2009). The adaptation utilization of flood-prone areas, embedded with the risk prevention than the post-disaster response by implementing the land use regulations, could be observed by the incentives for relocation and reduction of new development within the flood-prone areas.

The second theme focused on owners and assets in flood-prone areas. The mitigation measures on contributions of property owners and the implementation of property-level have been introduced and amended by The Federal Water Act in 2009. The Water Act regulated on specific contributions of property owners, that including preparedness for respond and flood insurance; and then, this Water Act introduced a new approach in obligation to implement property-level mitigation. Generally, the path to owners' responsibility and property's contributions require many revises, assessments, and improvements. The new proposition as "flood passport" has been developed, with the main tasks on supporting "a systematic object-specific risk assessment and reduction." The flood passport was expected as an effective instrument to concentrate on the business sector, the specific flood-adapted buildings, etc. to strengthen the responsibility and contributions of asset owners in flood-prone areas.

The last theme was planned for public flood risk awareness and concentrating on strengthening flood awareness, flood risk information, and risk communication. According to Thieken, A. H. et al. (2016), rising flood awareness was through implementation campaigns, and available risk information published to the community, e.g., hazard and risk map access. Risk communication has been set up as a public information command supported by the federal government, the federal states, and the insurance sector. After being applying to pilot regions, this theme has been revised to adapt with a variety of information need from many different groups of people and further, connecting effectively available information to the right time comprehensively.

"The flood preparedness strategy" has been adopted as the pre-flood damage-reduction strategy, encompasses two tiers of preparedness: (i) flood warning and emergency response; and (ii) risk transfer and recovery measures.

Flood warning and emergency response system considered as a useful measure to allow adequate flood - addressed preparations (evacuation, proper actions in retention areas,

appropriate measures in building scale, etc.). The German weather service compasses four different levels with specific hour alert regulations (comprising early, advance, weather, and storm warnings). The federal-state supports flood forecasting, flood warning, and emergency response, while the German Weather Service (DWD) provides extreme weather situation warnings. Although time-consuming matters were challenges limiting flash flood forecasting capacities, the flood warning system has been improved by applying new advanced technologies as well as investigating into the management system. Upgrading of models and improving numerical forecast simulations are the main focus of flood warning research while guaranteeing the proper staff to deal with the cross-departmental and trans-boundary collaboration is the mainstream of improving management system (DKKV, 2004; Thieken, A. H. et al., 2016). The results of applying flood preparedness measures after the 2002 and 2006 flood events recognized significant improvements in the emergency response (Kreibich et al., 2011). The remarkable improvement in emergency communication and management assessed on residents (e.g., the sharp increase of private households understanding how to protect themselves, 14% in 2002 to 46% in 2013), businesses and authorities during the 2013 flood event, in comparison to 2002.

The other tier comprises risk transfer and recovery measures — a risk transfer mechanism based on the principle of mutual help to distribute financial relief after extreme events, with the usual offers by volunteered property insurance (Thieken, A. H. et al., 2016). The loss compensation focused on insured holders, with the range of private households, commercial enterprises, and industrial companies. Flood insurance coverage in Germany mainly is provided by private insurance suppliers and other sources of public compensation (e.g., governmental funding and public donation). RIZA (2004) noted that approximately 35 private insurance suppliers were offering flood insurance coverage in Germany and managing insurance premiums (the premiums are formed by flood hazard or by an obligatory in combined with other insurance forms). Although the federal government and State government (Bundesländers) cannot directly compensate flood losses, the recovered work in the aftermath takes part in the flood damage compensation under federal funds (e.g., the federal flood victim assistance act) and the European Union structural funds, etc.

5.3.3 Reflections

Strategies on flood risk management, in both France and Germany, explain the insufficient approaches by applying conventional measures in flood-affected areas in the current situations and future development. The traditional methods investigated into structure measures resulting in more bad consequences than expectations. Both countries realized the sustainable and holistic flood management within pre-flooding, during-flood, and post-flooding phases may be appropriate action programs, and lesson-learned shows the specific roles of traditional measures. UNECE (2003) stated that the basic principles of the approach to sustainable flood prevention, protection, and mitigation admitting the vital part of structural measures focusing on the protection of men's lives and property. Nevertheless, the contribution of flood protection measures, e.g., engineering equipment is “never absolute” because of residual risks (more development caused by safety consciousness, the potential failure of structural measures, etc.)

Both systems pursued comprehensive approaches reflecting in the manner of integrated management, developing non-structural measures in combination with the current structural tool. Both strategies, through measure implementations, witnessed three principal directions that their applications could be the representatives for the flood management initiatives. These directions of flood risk management emerge as the standard on a national scale. First, that is flood forecasting and warning scheme which employs to prevent damage in the attempt of prolonging the preparedness time. This direction has mobilized advanced forecasting technologies and information sharing. Second, restriction to urbanization scheme applies within the flood-prone areas. This direction addressed the fundamental role of legal instruments within the complex situations of urban development. And, the third scheme aims

to restore the river channels; this scheme allows the creation of planned space for rivers and its tributaries by employing spatial measures.

From the French experience, the 3P strategy (prediction, preventive and protection measures) presents the fundamental acknowledgment covering above-mentioned schemes within 6 central river basins; and this advancement is a good starting point strengthening the international cooperation for the European Union flood-related issue disputes as well as maintaining the effective flood risk management in the river-basin scale. Compared with French strategy, German flood risk management response (protection, adaptation and preparedness approaches) embedded three similar schemes through the evolution of national backbone policy (the German Federal Water Act). The German response through backbone policy is not only necessary for national cooperation on the water management contexts, but the first precondition towards international participation in adapting to the European Union regulations.

5.4 Trans-boundary flood risk management framework – international cooperation regime

5.4.1 Introduction

Trans-national or trans-boundary flood risk management recognized as a cardinal direction concerning international cooperation from an early age. EU governments favored the legislative framework support towards planning, implementing, and supporting at the local or regional level and different sectors (EEA, 2016, pp.8). The trans-national coordination paves the way to adaptation action on reducing climate change impacts and on mitigating the flood damage. The approach has undertaken by protection programs within the comprehensive river basin management. Nevertheless, cooperation includes inter-governance endeavors, a multidisciplinary approach, as well as the involvement of several sectors.

The French government has initiated basin catchment management from 1964 by dividing into thirteen hydrographic catchments and set basin catchment committees, as well as built the independent financing framework of water policy (CEC (b), 1999). Similarly, the river system in Germany initially has separated into six river basin systems, including the Rivers Danube, the Elbe, the Ems, the Oder, the Rhine, and the Weser; and then these German river basins have been rearranged and divided into ten river basin districts following The Water Framework Directive (CEC (a), 2000) which adopted in 2000. The current river basin districts of Germany comprise the Rivers Mass, the Rhine, the Ems, the Weser, the Elbe, the Danube, the Schlei/Trave, the Warnow/Peene (Kampa, E.; Kranz, N. and Hansen, W. 2003).

Focusing on playing the main aims in the risk management theme regarding the trans-boundary watercourses and international lakes, the flood impact reduction and avoiding have pressed on the context of sustainable flood prevention (UNECE, 2000). The early years of the 21st century witnessed the trends of applying the holistic approach in the international scale of flood risk management, especially after the awareness of negative impacts of structural measures in the flood management strategy in most of the European member states. The holistic approach covers “the whole river basin” for the protection and the use of water. This approach mainly addresses and includes multilateral co-operation, and opens “legislative corridors” to implement the interdisciplinary co-ordinations for the whole catchment regions.

The trans-national and trans-boundary water management policies have implemented in two main stages through the adoption of two essential directives. The first stage established a framework for community actions in the field of water policy by the passage of “the EU water framework directive” (CEC(b), 2000) and the second stage was the initiative the implementation of the assessment and management of flood risk by the adoption of “the EU floods directive” (CEC, 2007).

The EU water framework directive (2000) established a framework for community action in the field of water policy, which officially required the cooperation and coordination of administrative management within river basins. Under the EU framework directive, the

European Union member states identify their national territories and assign them to river basin districts. By designated individual river basin districts, the EU water framework directive initiates the remarkable point of internationalization of trans-boundary issues and subsequent political solutions. The EU water framework directive implements the concept of international cooperation on protecting and enhancing the European Union water systems in both groups of the member states and the related non-member states. Thanks to the internationalization of the affected countries' territories, this directive paves the way to widen river basin cooperation.

The EU floods directive (2007) indicated and specified the reference framework for flood risk management in both the national legislative system and international or trans-boundary cooperation amongst the member states and their neighbors explicitly. This adopted directive raises the main objectives on the prevention of flood risk by using the appropriate tools as well as coordinated measures, which aim to vertical approaches (i.e., the European Union trans-boundary central governments – national governments - the region authorities – the local governments or the communities); and horizon levels (i.e. the multidisciplinary and involvement of inter-sectorial actors). This approach also links the inter-disciplinary coordination by approved two leading national and international aspects in the flood risk management plans, comprising national flood risk management policies and trans-boundary flood management plans. These plans will be reviewed and updated every six-year cycle).

Supported by the recognition of a mono-disciplinary approach from the engineering measure employment, the river basin flood management has been promoted as a holistic approach regarding flood risk management. Based on bilateral or multilateral agreements, the trans-boundary flood management creates the flood management regimes to implement the more effective flood risk management strategy: river basin management as a whole.

Being the EU's Member States and sharing river basin of Rhine river, France and Germany find themselves common interest as well as the adverse flood's impacts in the catchments. On the trend towards integrated flood management applied in the trans-boundary area as the Rhine river basin, the spatial adaptation policy between two related parties promotes the integrative approach by practicing, justifying, and amending legislation frameworks at the catchment scale. The political efforts are still on implementation phases, and the outcomes' assessment requires long-terms of observations. The trans-boundary cooperation regime is undertaken on the main channel of the European flood risk management theme on the catchment scale.

5.4.2 The European Union trans-boundary cooperation regime

European Union legislation regulates trans-boundary co-operation in international waters by introducing the international river basin management regime. Expected as a significant aspect for flood risk reduction, trans-boundary management regime or management "as a whole region" builds up the cooperation mechanism covering the binding water policies within the European Union member states and the neighbors. According to Raadgever, G.T et al. (2005), the most essential and mandatory directives concerning water management and flood risk management are the EU water framework directive (2000) and the EU floods directive (2007).

Albeit the integrated flood risk management approach has been employed and demanded to be assessed and revived frequently from involved parties, the concept of promoting transnational collaboration raised by the EU water framework directive to the EU floods directive paved the necessary framework on the most complicated flood-related issue within The EU community. The regime officially recognizes the Member States' roles in the implementation of a holistic flood risk management strategy within the European Union.

The EU water framework directive (2000) mentioned the "special formulation in river catchment conflict resolve"; and then promoted the new approach by establishing the international river districts in the cross-boundary territory between the European Union member states. Based on the international river district establishments, this directive sets the common objective reaching and promoting "good status" of water management within the

European Union territory as the significant concentration; nevertheless, the flood mitigation plays the minor role of risk reduction states in the EU water framework directive (in detail, contributing to relieve the effects of flood – Article 1).

The most influent legislative framework for flood risk management regarding transboundary water management is the EU floods directive (2007). The measure set up the co-ordinations through various dynamics and incentives of vertical as well as horizon policy directions. The decision-making process has been modified vertically at all levels, from national to community levels, while horizontal affected water-related bodies and individuals (Santato, S. et al., 2013). At the national level, the assessment and management of flood risk were bindingly transposed into national legislation systems and required of the 6-year cycle of review and updated policy within the European Union territory. The EU floods directive, therefore, may synchronize to the Member States' flood risk management policies and disputed flood-related issues in cross-boundary watersheds' areas into the communication corridor effectively.

5.4.3 The International Rhine River basin

The Rhine River basin covers the areas of 195,000 square kilometers. Amongst other shared countries, German and French shared 55% and 13% basin areas, respectively (Wolf, A. T. et al., 1999) (Figure 31 and Table 35).

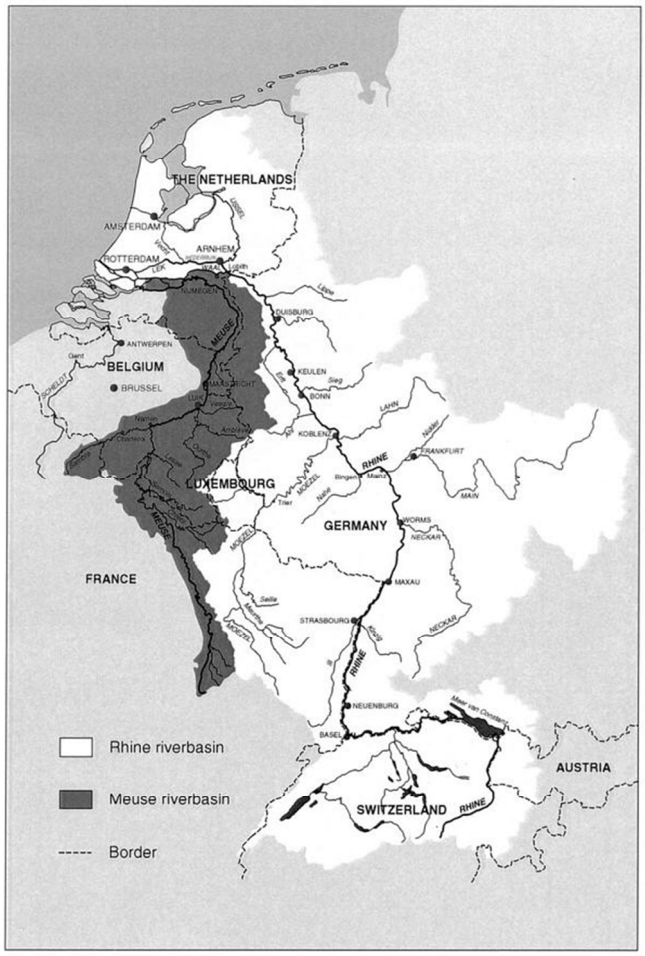


Figure 31 The Rhine international river basin
(Source: adapted from Huisman, P. et al. 2000)

Basic features	Descriptions
Surface	App. 195000 sq.km
Inhabitants	App. 60 million
Important use	Navigation, domestic water supply, agriculture water supply, use of hydroelectricity power, industry, wastewater disposal, fishery, local recreation, and other purposes.
Mainstream (length)	Rhine (1320 km)
Important rivers	Rhine (Alp Rhine, High Rhine, Upper Rhine, Middle Rhine, Lower Rhine, Delta Rhine), Aare, Ill, Neckar, Main, Moselle, Sarre, Nahe, Lahn, Sieg, Ruhr, Lippe, Vechte.
Important lakes	Lake Constance, Usselsea.
Countries concerned	The European Union State Members (5 countries possess small parts) Liechtenstein, Italy, Belgium, Austria, Luxemburg, and (Other four countries) Germany (55%), Switzerland (18%), France (13%), the Netherlands (6%).
Co-coordinating the EU water framework directive implementation	Coordinating Committee Rhine in cooperation with the International Commission for the Protection of the Rhine.

Table 35 The Rhine river basin
(Source: adapted from ICPR, 2004; Raadgever, G.T. 2005)

The trans-boundary cooperation in the basin also has been established from the demands for disputed issue arrangements, e.g., pollution-related issues in the 1960s and 1970s, and the lately flooding concerns (Raadgever, G.T et al., 2005). The international cooperation triggered as benefits sharing and disaster catastrophic impact reducing when the cross-border risk occurs, and global effects arouse the concentration. Sadoff, C. W. et al. (2002) noted the benefit-sharing yielded from a better ecosystem's management (environmental benefits), the core interest of river's productivity (direct economic benefits), the multilateral tensions making costs decrease due to political shift to reduce tensions (political gains) and more integrated into other economic sectors among cooperation actors (indirect commercial interests).

The international cooperation regime has been formed and involved by the contributions of the elements, and the occurred changes (Raadgever, G.T et al., 2005). On the Rhine River basin, international cooperation has been established and operated through the formal actors and guiding policies. From the early time, the free navigation dispute to pollution-related issues within the Rhine River basin supported the official actor forming. The initial of the Central Commission for the Navigation on the Rhine in 1815 was the first establishment of international cooperation at the basin level. In 1963, the International Commission for the Protection of the Rhine established by the five first formers (France, Germany, Luxemburg, the Netherlands, and Switzerland) was an international organization based on a multilateral convention regime and actively worked on different topics. Flood risk management is an important topic that was covered by the binding mandates of the commission.

According to WMO (2013), the main goals of flood prevention and protection (within cross-border territories) focused within the convention on the protection of the Rhine (1999) through guiding of the two crucial directives on water framework (the EU water framework directive in 2000) and on flood management (the EU flooded directive in 2007), with legally binding for all the European Union member states. Concentrating on flooding risk assessment and management, the EU floods directive, thus, was adopted as the primary guiding policies of the European Union cooperation regime in the flood risk management field. The EU floods directive, officially comprising three steps of approach, with the specific scale of implementation and periodically reviewed and applied to the European Union Commission (Table 36) (The EU floods directive, Articles 4-5-6-7).

Phase	Descriptions of steps	The detail requirement
Phase 1 (Dec 2011)	Preliminary flood risk assessment	Assessment of flood risk in all areas; then identification of the flood risk area
Phase 2 (Dec 2013)	Flood Mapping	Flood hazard mapping; then Flood risk mapping
Phase 3 (Dec 2015)	Flood risk management plan	Objectives for flood risk management then measures to achieve objectives

Table 36 Three main phases of the EU floods directive (2007)
(Source: adapted from Santato et al., 2013)

Being the Rhine River Basin's two main formal actors as well as sharing the responsibilities of the Rhine River basin's member states, French and German established the national flood risk management strategies, not only adapting with national flood risk management goals but confirming their willingness to reinforce cooperation. The national plans hence, were being adjusted and transformed to suit the European Union cooperation regime as well.

5.4.4 Co-operation mechanism on flood risk management in the International Rhine district

The international cooperation in the Rhine basin witnessed the long historical process, covering a wide range of disputed issues from navigation, fishery to pollution, and the cooperation mechanism has been established and evolved from bilateral to multilateral cooperation. Historically, legislation initiatives on transboundary river basin management from the economic interest to environmental protection have been developed.

The international cooperation at first focused on the economic benefits in the Rhine by the support of the Center commission for the Navigation on the Rhine and the Salmon commission, and then the noticeable flooding in the 18^{th} and 19^{th} century (e.g., in Austria and in Switzerland) added more attention to international cooperation by applying the International Rhine Regulation. The initiative of the commission at the beginning objected to dealing with the problematic pollution situation of the Rhine (e.g., the Rhine action plan approved in 1987 to cope with the critical pollution situation of the Rhine). However, the official establishment of the International Commission for the Protection of the Rhine then strengthened the cooperation, especially in the context of flood risk management (e.g., overall flood prevention and environmentally sound flood protection) and other environmental protection targets. It concluded that the international cooperation regime has transformed from the economic benefit concerning the environmental protection and disaster management regimes, especially the adverse consequences landing for the whole basin region from upstream to downstream areas.

Fundamental promotion of coordination enhanced from the establishment of the EU water framework directive (2000) in which embedded international cooperation on flood risk management therefore transformed into institutional collaboration, especially in flood-related issues within the European Union member states. The binding river basin management legal framework and legislation initiatives affected national and international flood management strategy in France and Germany.

As high awareness about the increasingly severe floods in the basin (e.g., catastrophic floods in 1995 and 1998 within European Union countries) and rising harmful effects from upstream to downstream, the trans-boundary cooperation triggered new stages, especially on binding instructions of the EU floods directive. As large territory-shared countries (e.g., France and Germany, 13% and 55% shared parts respectively) initiated the national legislation and international riparian cooperation regime to deal with the adverse effects causing from the interaction of upstream and downstream measures and to reach "the common view" of flood risk management for the whole basin subjecting to "adaptive management" in the universal language (Raadgever, G.T, 2005).

The prevailing view has been set on the adaptive management manner, which based on the common concerns and interests within the relevant upstream and downstream countries to develop and share the core interests regarding mutually beneficial share. Both countries, like other members as well, adopted and implemented the setting cooperation regime in which based on i) interdisciplinary cooperation on flood management; and ii) coordination of the implementation of the EU floods directive (2007).

Interdisciplinary cooperation embedded the working groups, as well as the expert groups in different sectors, involved stakeholders, and public participation. From the integrated various range of involved stakeholders, the cooperation addressed the universal principles that enhance solidarity in order to avoid the raising issues of interest's conflicts amongst members, in the manner of sharing a common viewpoint on targets of the flood risk management (Schmid-Breton, A., 2016) (Table 37 and Figure 32).

No	Adopted flood risk management principles
1	The cooperation on flood risk management based on adopted responsibility, solidarity and proportionality; and on the support of other European Union policies (e.g., The EU water framework directive, Natura 2000, etc.)
2	Flood risk management embedded the holistic and sustainable objectives by requiring members' security levels must be ecological, economically, and socially acceptable.
3	Flood risk management approach to community tasks.
4	Tasks are carried out by the distributed tasks throughout all decisional levels (International, national, regional, and local levels).
5	Flood risk management adopted no full security on the optimal combination of employed measures and existing residual risk.

Table 37 Adopted principles of flood risk management in the context of international cooperation

(Source: adapted from Schmid-Breton, A. 2016)

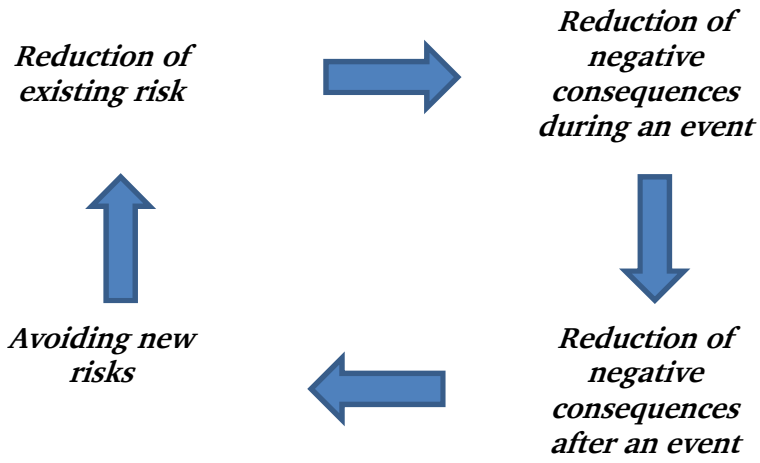


Figure 32 The four overriding targets on the risk management cycle
(Source: adapted from Schmid-Breton, A., 2016)

The trans-boundary cooperation mechanism in the International Commission for the Protection of the Rhine was based on a holistic approach through specific measures. According to Raadgever, G.T (2005), the "adaptive initiatives" were implemented via five groups of tools, including i) actor's networks; ii) the legal framework; iii) policy and implementation; iv) information management; and v) financial regulations.

The first initiative mentions to networks of involved riparian parties, comprising both formal and informal methods concerning to flood risk management in the river basin. The interdisciplinary efforts in different groups (working groups, e.g., water quality, ecology, emissions with permanent activities, or project groups with occasional meetings) build cohesion and trust amongst parties (Figure 33). The interdisciplinary structure of the International Commission for the Protection of the Rhine supported not only disputed issues in the basin-scale also being essential preconditions for flood-related issues, especially addressing upstream-downstream problematic matters in the standard framework instead of solely governmental actions from the involving parties. The interdisciplinary approach of the commission organization allows stakeholders, the public and the scientific community communicating; while the federal government keeps the leading role in trans-boundary decision-making and other administrative levels take more contributions to the disputed trans-boundary issues, e.g. initiative of Arbeitgruppe Hochwasser between Dutch province and German state (Raadgever, G.T., 2005). Therefore, actors' networks in the commission organization establish the "communicating and feedback on both sides" through integration between actors supporting cooperation in the basin.

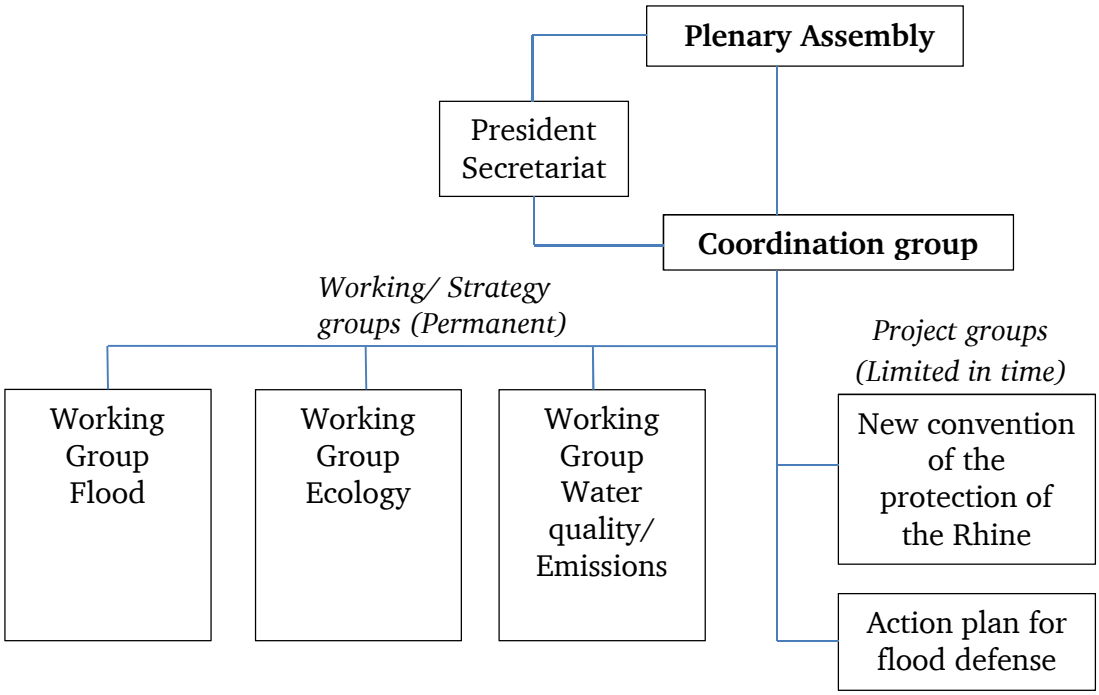


Figure 33 Organization structure of the International Commission for the Protection of the Rhine

(Source: Huisman, P. et al. 2000; APFM, 2013)

The European Union legal setting makes trans-boundary cooperation in the international Rhine basin more supportive and expanding. Trans-boundary flood-related issues were strongly affected by the guiding from the European directives. The flood-related legal framework at the European level, including the EU water framework directive (2000) and the EU floods directive (2007), set the fundamental framework for the international co-operation within the basin. The first directive (the EU water framework directive 2000) established the basis towards international coordination and cooperation by identifying the international river districts; and promoting the coordination amongst the European Union member states. Then the following directive (The EU floods directive 2007) established a binding strategy on flood risk management and introduced the reference framework for the prevention of flood risk within a 3-phase approach: preliminary flood risk assessment, flood mapping, and flood risk management plan (Table 35). This binding strategic framework forms the legal setting for international cooperation in the Rhine basin in the manner of sharing common interests amongst parties.

The flood policy scheme in the International Rhine district has set in the policy development and implementation, embodying a wide range of structural and non-structural measures. The comprehensive knowledge and information established in the first phase. The necessary knowledge and data have been collected through the identification of potential flood risk assessment, drawing the flood risk maps, defining appropriate measures (including structural and non-structural of small and large scale). In the second phase, flood risk management plans and plan implementation set with the enforcement of involving stakeholders of the basin's parties (APFM, 2013).

Trans-boundary information management strongly supports cooperation and harvests win-win results by addressing the exchange information mechanism amongst participating countries. Via information exchanging procedure, the shared data could be useful for flood risk management activities (APFM, 2013). The main actors in information management were governmental actors by supporting accessible information to communities through a variety of channels (national campaigns or social media channels). Other social organizations (e.g.,

Non-governmental organizations) have taken roles in increasing people's awareness of flood risk as well.

Financial-related issues regulated within contracting countries. All related states contributed to the measure's planning and implementation in the fixed scale in which based on the countries' capacities (APFM, 2013). The contracting parties kept the individual financial task on trans-boundary cooperation and responded to the shared-cost by regulating policies within territories. French government imposed taxation on users and polluters on discharges (abstractions and polluted issues). German policies addressed the same taxation regulations to bear the cost in the manner of 'polluter pays' principle; and managed the insurance scheme for the flood damage reduction to all citizens (Raadgever, G.T., 2005).

5.4.5 Reflections

Flood results in interregional damage and the trans-boundary flood impacts required transnational co-operation; and demanded political solutions to produce voluntary awareness for the cooperation amongst actors. Therefore, the internationalization of flood-related issues may take the next stage of flood risk management to meet development goals. Based on implementing policies employing from the point of catchment-wide management (The EU water framework directive 2000) to detailing the specific binding action programs (The EU floods directive 2007), the trans-boundary cooperation became a feasible and common language, regarding of the complexity of political policy for the whole European areas (amongst the Member states or between Member states and non-Member states).

Interregional and transnational co-operation embed the long-term setting process of transforming from voluntary cooperation to force cooperation (by binding agreements) due to disputed issues falling to multilateral matters through institutional change. The disputed concerns have been raised in the Rhine and lead to the establishment of an international cooperation regime within the region at the Basin level scale by the founding of the Central Commission for the Navigation on the Rhine in 1815. The commission cooperation regime then evolved to the International Commission for the Protection of the Rhine that based on the dialogue on pollution. In 2000, the EU water framework directive established new stages of international cooperation in the Rhine basin by designating this region as an international river district and applying binding policy framework in the water resource management issues (establishment of cooperation bodies and cooperation procedures). In the next seven years, the EU floods directive (2007) was approved as the next stage of binding agreement within the European Union member states on flood-related issues, with specific management strategy through 3 phases (Assessment, mapping, and management plan).

The co-operation in the international Rhine district witnessed the interdisciplinary approach within different levels of co-operation (Haupter, B. et al., 2007). Interdisciplinary and trans-boundary working groups initiated in the European Union levels, with goals towards strengthening cooperation between the water management sector and other related sectors (spatial development, housing, agricultural and forestry, etc.). Adopted programs and policies considered and implemented at the lower levels; the users can equip their precautionary measures (Raadgever, G.T., 2005). The cross of integration fundamentally supported cooperation regime in the international Rhine districts.

Political solutions have been identified in the trans-boundary region as the Rhine basin through an adaptation strategy. The strategy addressed cooperation measures within five groups of tools: actor-networks, legal framework, policy development, and implementation, information management, and financial regulation.

5.5 Results and discussion

Like many other problematic issues, flood risk management strategy evolves from the inside out to the outside boundary in both countries. Each approach also addresses national responses as well as international co-operation within the river basin in which the river resource exploitation and bad damage existing within basin-shared parties. In response to flood-related issues, France and Germany pursuit flood risk management based on the

communication and cooperation strategy in which essential embedded factors ensure that objectives achieved in both national and international scales. These include a planning system, a national legal framework on flood-related issues, a national strategy on flood-related issues, and international cooperation regime in trans-boundary regions.

French and German planning systems shared the same viewpoint of opening communication channels by implementing decentralization and autonomous local regimes, although implementations are different due to national administration structures. From the French practices, the government's representatives (the Prefects) have been placed and aimed at maintaining and improving the corridor of communication as well as co-operation. From the German experiences, three tiers of co-operation can keep the coordination of all levels of federal structure: the federal level issues general guides; the regional row suggests spatial and regional planning in adapted with federal's guidelines; and the municipal level undertakes the detail and binding land-use plan.

Both countries followed the amendment process legally on national flood risk management, then converging to the standard European Union regulations. The French government has practiced the water policy since 1982s nationally; until the French bill 2000 marked the internationalization of flood-related issues by the integration of national laws into the European system to adapt to the EU floods directive. German flood risk management witnessed the same rout of the legal amendment. The first version of the German Federal Water Act sanctioned in 1957 and the next versions amended; then, the release in 2009 described as transposing the EU floods directive into German law. National policies evolve towards the European Union regulations in the manner of internationalization the trans-boundary flood-related issues as a potential finding the common language on international disputes.

France and Germany kept similar viewpoints of the national strategy on flood-related issues. Both systems implemented integrated flood risk management, with a wide range of measure employment (structural and non-structural instruments). Adopted the non-absolute protection from the conventional measures as well as regard to the whole cycle of flooding (pre, during, and post-flooding phases), the principal directions addressed the integrated management: flood forecasting and warning; restriction to urbanization; and restoration of river channels.

International cooperation evolved based on long-term trust-building. In the Rhine river basin, trans-national co-operation on disputed issues is a time-consuming process due to different parties' approaches from interest finding and sharing on river resource management issues. Voluntary co-operation at first is necessary within trust-building attempts, then to transform into force co-operation through multilateral negotiations and the European Union legislation platforms.

Cooperation on transboundary flood management is envisioned in the progress of continuous stages. Via stages, the appropriate cooperation platform is established, in details:

- Flood catastrophic damage with international impact spectrums raises the demand for an internationalization of disputed issues and on the initiation of trans-boundary cooperation or improves the existing coordination amongst actors.
- On the shared-portion of riparian interests, decisions on one party could harm others' attention; therefore, the long-term international cooperation based on voluntary choices amongst parties.
- Voluntary decisions toward force cooperation embed on mutual trust. Mutual trust building consumes time, especially on upstream-downstream solidarity.
- The international legal framework implements trans-boundary issues embedded in force cooperation through constructive initiatives and detail activities.
- Frequent monitoring of measure employment activities maintains mutual trust and creates necessarily updated situations for amended legal instruments.

- Time-setting assessment and evaluation of spatial measures and on implemented plans consolidate the aftermath reduction objectives, as well as revises the late goals in the changing contexts.

Envisioning to interregional and transnational co-operation within the river basin is the appropriate and useful approach to the shared-river basin parties. Keeping the balance interest status amongst actors finds itself sustained improvement through process requires not only necessary concessions but also cohesion willingness from involved parties, on flood risk and other water-related management issues.

CHAPTER 6. CONCLUSIONS

This research attempts to describe spatial planning as a measure that could be applied in flood-prone areas by conducting a series of study phases. The process is implemented by identifying the main flood challenges and evaluating the current situation of governance arrangements in riparian areas, thus shaping the spatial planning that may play a useful reference viewpoint derived from European spatial planning.

Following the research questions, the conclusions show that these main processes influence flood vulnerability in flood-prone areas (6.1); framing fluvial flood risk, including responses and changes in Vietnam flood risk management schemes (6.2); evaluation of Vietnam policy schemes for flood risk management (6.3); and lessons on how European flood risk management practices and policy schemes can contribute to the directions of Vietnam policy's alignment on improving fixed situations (6.4).

6.1 Flood driving forces in flood-prone areas: contexts and challenges from the high trend of growth

Flood-prone areas experience flood consequences annually, nevertheless, flood losses of life and assets have increased due to many processes. These processes change the state of the flooding system. In particular, Can Tho City witnessed catastrophic flood damage in the year 2000, and more significant flood events probably would strike, resulting in more adverse losses. The state of flood in Can Tho City might be changed due to processes such as flood driving forces.

These flood driving forces fit to flood risk mechanism embedded in the "Source-Pathways- Receptors" concept. These forces are classified into two main groups: natural and anthropogenic driving forces. Natural driving forces, including topography, precipitation, sea-level rise, and land subsidence contribute to flooding hazards as the "Sources" component in the concept. Natural driving forces play a role in triggering catastrophic flood consequences. Similarly, human-made driving forces have been identified (comprising population growth, land-use change, urban expansion, and drainage capacity) as processes that influenced flood vulnerability in the increasing trends; and therefore, these driving forces are conveyed through the "Pathways-Receptors" in flood risk mechanisms with rising potential on for their presence. These processes were present in the big trend of growth in urban areas in two different main ways of expansion: single driver effect and coincident combination.

The examination of main processes affected by flood risk confirmed existing flood driving forces. The flood risk concept is identified as a combination of components such as flood hazard and flood vulnerability, and main driving forces in flood-prone areas promote the flood's state. These are determinants triggering and increasing flood damage (see Chapter 2 and Chapter 3).

The results indicate that flood driving forces tend to grow quickly, and demand more efforts on flood risk governance. The magnitude of the existing and potential of driving forces in flood-prone areas are exaggerated. Flood risk status might be affected by socioeconomic factors and thus require more time for recovery in direct and indirect flood damage. The analyses concentrating on flood risk components may suggest directions of improvement by selecting appropriate measures to reduce current and future flood event consequences.

6.2 Framing the Vietnam flood risk management situation: responses and arising problematic flood-related issues

Adopted as the dominant measures employed in flood risk management in Vietnam, structural measures emphasized the fundamental backgrounds of being main influence measures: fast and short-term reactions to deal with the situation, available legal framework supports, stable and crucial roles in flood risk prevention and control strategy, etc.

While considered to be an additional attempt on flood risk management, the non-structural measures have been showing a problematic shift towards an integrated approach,

unclear concentration on investment, role recognition on a local level and trans-boundary flooding arrangement, limit extension, etc.

A land use planning role has adopted as a potential application or manifested mitigation measure, but this approach was an ineffective measure in the workplace and at the local level.

Reducing fluvial flood risk must be seen as a complex issue not only because of demanding national efforts on building effective flood management regimes but also because of international cooperation attempts and coordination as well as multilateral consensus on many crucial flood-related issues from the basin-sharing parties. These problematic issues within the Mekong River Basin have identified as the historical matters that still have current controversy:

- Unshared viewpoints of natural resources' interest and exploitation within the related parties;
- The primary long-term objectives addressed under the dominant water resource management associated with economic aspect-based priorities;
- Ineffectiveness on multi-lateral negotiation mechanisms may result in an insufficient binding policy.

6.3 Evaluation of policy schemes for disaster and flood risk reduction in Vietnam

6.3.1 Framing failures and constraints on government arrangements to adapt to flood risk schemes

An approach of flood response or governance arrangements is to decrease the sensitivity of the flood-prone area, where flood driving forces are considered and governed by codes and regulations. Flood driving forces in the area linked the relationship between flood risk and modified natural state due to increasingly developed activities. Such development activities trigger flood vulnerability in riparian regions; therefore, the flood risk reduction policy is in the manner of enhancing coherence between flood risk and development activity.

Knowledge of relevant literature supports limited data on government arrangements concentrating on flood risk management, and the identification of policy implementation in the setting context requires a practical assessment to frame the effectiveness and impacts of governance arrangements regarding flood responses.

The assessment on study sites frames the failures of authority's responses regarding their current approach, constraints towards non-structural measure implementation, poor land-use planning in flood risk contexts, and insufficient strategy on the river basin as well as trans-boundary management.

6.3.1.1 Failures on current approaches

In Vietnam, flood risk response is conducted on the priority of physical measures with fragmented characteristics, as follows:

- Focusing on event control rather than large-scale risk management;
- Interactive response from authority to cope with single flood events;
- Potential of resolving arising problems; and
- No consideration of other measures, regardless of non-structural flood management measures.

Employing physical measures or flood risk management is no longer recognized as a good strategy in a long-term vision regarding unexpected flood hazards and other climate-based planning. The arrangements or structural measures with adopted advantages (e.g., event control, reacting fast to arising problems, coping with the single situation, etc.) not only result in increased gaps between structural and non-structural measures but also create unexpected consequences. In the Vietnamese context, the consolidation of measure dominance and unintended consequences on related doubts about the possibility of intentional advancement from other options are the current primary failures.

6.3.1.2 Constraints on approaches towards non-structural measures

Non-structural measures are recognizable as a useful concept; however, this approach has limited applications. The drawbacks are assessable on three main aspects: the challenges to the legal and institutional arrangement, consideration as the potential, and the current measures applied to worksites.

- The challenges to the legal and institutional arrangement:
  - The current legal system lacks supported policies on the non-structural application in levels, especially project scale; and
  - Poor local administration cooperation hinders non-structural measures integrated into the risk management scheme.
- Consideration as the potential:
  - Non-structural measure application acknowledged as a high possibility, with the reasoning based on the financial and environmental ineffective aspects (massive budget, urban ecosystem impacts, etc.) from structural measure disadvantages.
- Limitation of non-structural measure applications on worksites:
  - Demanding "proof of efficiency" in limited employment situation on worksites; and
  - The non-structural measure bound as the concept of limited types of intervention (reservoirs, increasing infiltration measures, etc.).

6.3.1.3 Failures in the land use planning roles in flood risk contexts

An approach to reduce flood risk by land use is expected to have an important role in embedded flood prevention and protection contents; nevertheless, the failure of stepping as a vital role in flood risk management scheme revealed fails on aspects as follows:

- Poor planning or planning in the piecemeal fabric (political term visions or land use planning towards new development rather than protecting existing development).
- Vertical integration of local development control in practice is not in line with national guidelines.

The integration of land use policy into the national legal architecture has been set as a significant shift into integrated flood risk management and focused on land use planning roles. The integration has, however, proceeded at a plodding pace due to the following failures:

- Identifying the financial capacity for the long-term measure's employment;
- Conducting an appropriate assessment of protecting-high-demand areas and implementing detailed plans (due to high economic-interest potential and scarcity of available lands); and
- Maintaining the long-term vision and setting plans that included flood risk management (flood risk factors) due to increasing economic growth and local budgets (resulting in five year-adjustments on detailed plans).

6.3.1.4 Constraints on the river basin management issues and the trans-boundary flood risk management

River basin management issues are based on the notion of water resource management, regardless of flood risk management schemes. Major failures on integrating flood risk management issues into river basin management are based on this reasoning:

- Poor coordination or negotiation-related issues;
- On the focus of water quality management without the notion of flood risk;
- Insufficient mechanisms for inter-regional coordination and river resource sharing negotiation; and
- Inadequate legal support for policy implementation.

Trans-national flood risk management fails on coordination mechanisms by using ineffective coordination amongst parties, and on internationalization flooding issues in trans-boundary institutional initiatives.

- Common interest cohesion and issue negotiation (upstream-downstream issues) to harmonize multilateral interest amongst parties;
- Relieving economic-based development domination in the decision-making process; and
- Issuing a cooperative framework and binding legal initiatives on flood-related issues.

6.4 European spatial planning: A reference for Vietnamese institutional development on flood risk management

6.4.1 Restating the spatial planning role via comparative analysis

Although the same effects of good practices in specific places could not be expected to manifest in other regions through the transferring process, the advanced of European spatial planning can be a useful reference for the Vietnamese case within two knowledge transfer viewpoints. The comparative analysis firstly supports knowledge of particular problems according to similar situations. For instance, the introduction of national institutional and planning systems may help to identify the preconditions and main principles of how both France and Germany deal with flood risk schemes, a process that collects guidance and actions for future development effectively. The second contribution is the shape of significant factors reflected in a particular planning system, and that draws good reference points to other countries in the manner of improving and supporting adaptation policy. For example, the European spatial planning system may fix and enhance the Vietnamese planning system through primary reflections shaped by the comparison of French and German planning systems. Also, the European international cooperation regime could increase knowledge for the Mekong River Basin cooperation.

6.4.2 Spatial planning applied to flood-prone areas: A adjusted policy towards flood mitigation and trans-boundary flood-related issues

Within the conceptualization of spatial planning and then adopted officially by the European Union, the term's definition is proposed as "*the methods used largely by the public sector to influence the future distribution of activities in space*." Spatial planning, which "encompasses elements of national and transnational planning, regional policy and detailed land-use planning," can be interpreted into the regime as "…the various institutional arrangements for expressing spatial planning objectives and the mechanisms employed for realizing them" (CEC, 1997: pp. 23-24).

Spatial planning includes methods encompassing various institutional arrangements used by the public sector to achieve setting spatial planning objectives. *Spatial planning has performed as the appropriate land use planning method* in the flood risk management context by addressing contributions to flood mitigation and flood-related interregional issues. *In flood-prone areas, spatial planning may include the methods used by the public sector to encompass national and transnational, regional, or local policies to reduce flood risk components and to achieve the set objectives of flood risk reduction.* Land use planning for flood risk reduction is, therefore, based on the idea of employing various measures of regulation and development control to deal with flood driving forces for long-term and sustainable development goals.

Spatial planning comprises a range of policy schemes that may reduce flood risk damage in an area; in this view, land use policy may fit spatial objectives through regulation and control of development issues to reduce flood vulnerability as well as to adapt to trans-boundary flood-related problems. Flood vulnerability is a flood risk component that includes flood determinants as population growth, land-use change, urban expansion or imperviousness issues and drainage capacity; and in the long-term perspective and sustainable development view, regulation and land use policies may include an appropriate approach to

trigger an adaptation strategy towards flood risk reduction. Spatial planning should be perceived as a range of measures or institutional arrangements, in combination with other fixed measures such as traditional measures, to form a comprehensive approach to flood risk management theme in flood-prone areas.

The concepts of spatial planning provide guidelines for adjusted directions of flood risk reduction policies. Results in expert's viewpoints and common points in German and French flood risk reduction programs can show how effective policy schemes are implemented in flood mitigation and trans-boundary flood-related issues. Using a spatial planning approach, the main focuses of flood mitigation and trans-boundary flood-related issues in flood-prone areas include i) protecting existing development, and ii) new development discouragement.

On the former pillar, flood mitigation measures towards protecting existing development can serve as a general framework concentrating on flooding early warning systems and flood-proofing measures. The latter pillar, regulating on flood-prone area uses, can be implemented as helping not only development protection policy schemes and discouraging malfunctioned development but also intervening in trans-boundary flood-related issues in adjacent or river basin-shared areas.

In compliance with the theoretical understanding regarding the spatial planning role of flood-prone areas, the adjusted policy toward flood mitigation and trans-boundary flood-related issues might be formed as an integrated approach for addressing existing development and restricting new development concerns.

6.4.3 Regulating and protecting existing developments

6.4.3.1 Flood early warning systems

Flood early warning systems mitigate losses by presenting advantages if the measure is properly implemented in the flood-vulnerable communities. Reliable and timely warning programs are necessary for minimizing flood loss of life and property damage.

a) Reaching broader flood mitigation within communities on a local scale

Existing communication infrastructure and public utilities can assure the effectiveness of preparedness for residents. Public agencies maintain and distribute information to communities regarding flash floods and temporary evacuation.

b) Supporting communication schemes under early warning policy guidelines

Unlike structural measures, flood early warning systems target community-based reactions; therefore, residents, on the one hand, could actively reduce loss by flood preparation and keeping communication channels open during emergencies, and on the other hand, increase people's awareness of flood loss within communities.

c) Sustainable measures that balance community development and economic resources while maintaining community-based tools

People's safety or community development must be supported sustainably. Flood early warning systems were being utilized in the manner of the mass budget investigation of physical measures and required an effective policy scheme that supported good coordination of public agencies to reduce flood damage. As a result, this measure became a high priority because it boosted people's self-protection and participation.

6.4.3.2 Floodproofing

Floodproofing standards are found and implemented under guideline policy schemes that target community-based tools to reduce typical flood damage on the building or project scale. Mitigation guidelines on floodproofing, therefore, can be evaluated as effective means by modifying people's awareness and participation on a community scale by counting on property owner's efforts.

The technique can be presented as property-based to reduce flood damage, with advantages for protecting flood-prone property. The option's effectiveness are based on a) implementing building-scale measures of consulting building or project code requirements; b) reducing flood damage by bringing flood-vulnerable structures into compliance with

standards of flood-prone area use, and c) directly reducing flood loss by modified flood vulnerable subjects actively.

6.4.4 Regulations on restricting new development

6.4.4.1 Zoning

Zoning is the most likely application on a local scale to manage growth in flood-prone areas. Due to the necessary control of the flood-prone area uses, this measure is useful to mitigate flood damage for a long-term vision at the local level. Thus, this institutional arrangement supports effective techniques to adapt to flooding situations not only in current circumstances due to limited investment resources for implementation of expensive budget measures but opening the coordination channel for trans-boundary flood-related issues.

Zoning regulations are in place to limit and to implement policies for restricting the use of structures and a variety of resources (e.g., land, water, air), resulting in dual benefits for the mainstream of flood-prone area use management. The interest, on the one hand, it is restricting the expansion of existing development of vacant or use-transformed land by implementing material resource efficiency standards; on the other hand, in the regulations of zoning limits connected to new development expansion or unexpected future development. Further streamlining of this institutional arrangement could ensure more effective limitations on flood damage reduction in trans-boundary flooding areas.

a) Limiting future growth of vacant or used-transformed lands

Zoning regulates and restricts new growth by applying land use patterns, which are considered to be the public interest rather than oriented toward economic interests. This technique establishes restricted areas governed by the public sector to implement objectives, including i) decreasing damage potential in the managed zone and ii) delineating potential damage-zones in trans-regional or in adjacent areas.

b) Limiting the connection of existing development by the expansion of new construction in flood-prone areas

This tool also plays a vital role in damage zone delineation in adjacent regions, especially in the trans-boundary areas. Zoning limits new growth in governed and restricted land; furthermore, the device prepares for compliance with trans-boundary cooperation mechanisms in international flood risk management schemes.

c) Establishing active cooperation of the flood mitigation schemes amongst adjacent floodplains for pursuing flood risk reduction concerns.

The device possesses core philosophy by straightforwardly establishing and strengthening regional coordination and international cooperation to mitigate potential damage in trans-regional areas.

6.4.4.2 Plat regulation

The plat regulation tool concerns potential overuse by restricting methods and structures within the site scale, targeting primary and special uses in flood-prone areas. This instrument typically includes regulations or sets of instructions to implement adequate land resource uses in vulnerable sites.

Plat regulation indicates prohibitions within the site scale on responding to flood vulnerable uses and restrictions on structures. Laws target initial and unique permit development, addressing objects or actions affected to floodway operations or obstructing floodwater in the areas. On this scale, the flood-prone area restricting growth has been undertaken by significant designation development while a particular event implemented with strict revisions and considerations to adapt to high economic interest-attractiveness pressure within flood-prone areas.

Regulations, therefore, may be referred to as the drainage system and floodway operations. Towards drainage system operation mentions prohibitions of uses and structures increasing system loads as well as restrictions of hindering drainage actions at sites in both

domestic and industrial uses. Prohibiting floodway use and development assures the regular operation or retards obstructing floodwaters.

6.4.4.3 Structure control regulation

Concerning regulations on investors, the subdivision control theme covers improvements on the site and building scales. The measure addresses the obligation of new developments or investors' requirements in flooding-vulnerable zones. The majority of the tool is used to prohibiting further development on an area subjected to flooding or improved lands.

Structure control regulation develops methods of land change intention prohibition and building flood-protection control. Land change due to unintentional development must be managed well in both private and public sectors, in the manner of prohibiting further land development as well as public utility development plans. The latter theme of building site control, responds to building scale flood mitigation measures by addressing a self-protecting agenda.

Building site control regulation paves a way to legislative corridors by addressing sustainable development by keeping a balance between natural resource use and land development orientation. Setting regulations in this field may also bring investors and builders into compliance with building codes by a supplement to building requirements regarding minimum flood mitigation contributions. The regulation implementation on this community-scale is not only raising the stakeholders' awareness by embedding flood risk mitigation mandatory policy into practice but also serving as device measuring community feedback and awareness on flood risk in flood-prone areas.

6.4.5 Strengthening trans-boundary cooperation in the river basin scale

Trans-boundary flood-related issues are an international concern due to significant involvement amongst member states within the river basin. The disputed issues require stakeholder's involvement over a long period of time because these issues are a time-consuming process. The disputed problems they raise concern mostly economic interests as a priority instead of river resource or flood risk management. These problems involve a commitment of time and effort as a pre-condition for establishing a common language that addresses problematic issues. Therefore, stakeholder involvement plays a crucial role in disputed issue negotiation.

Setting long-term trust-building is the next difficulty that strengthening trans-boundary cooperation faces. As in many river basin cooperation regimes, the Mekong River Basin experienced a shortage of trust-building. Evidence of low trust in this international organization comprises the differences of the member states' views on political and economic interest resulting in the lack of an available and common language. In the European context, cooperation patterns in river basin scales were the result of progress in continuous phases, including raising voluntary awareness and establishing long-term goals.

Voluntary awareness amongst stakeholders converged by internationalization raises the stakes regarding disputed issues. The severe flood impact spectrum within the river basin forms the demand for the internationalization of flood risk issues. The process then puts the pressure of creating cooperation platforms on member states to minimize the adverse effects. In this respect, improving coordination amongst actors becomes more urgent, and to achieve sustainable commitment, it is crucial to forming the legislation platform in a universal language.

Voluntary decisions toward forced cooperation provide a feasible solution for disputed flood-related issues by establishing a legislation platform. Forced cooperation building is a process that has the possibility of shaping the construction of relations and mutual trust through connection amongst involving parties to address the common concern on an international scale. In the process of finding a possible and common language, stakeholders must fill the gap amongst national interest domination amid various parties. A well-prepared legislation platform will help involved parties identify and overcome challenges for trans-

boundary flood-related issues and facilitate other disputes and problems existing among stakeholders. Cooperation patterns achieve sustained improvement through a legislation platform where necessary concessions, cohesion, and willingness from involved parties on flood risk and other water-related management issues exist (Figure 34).

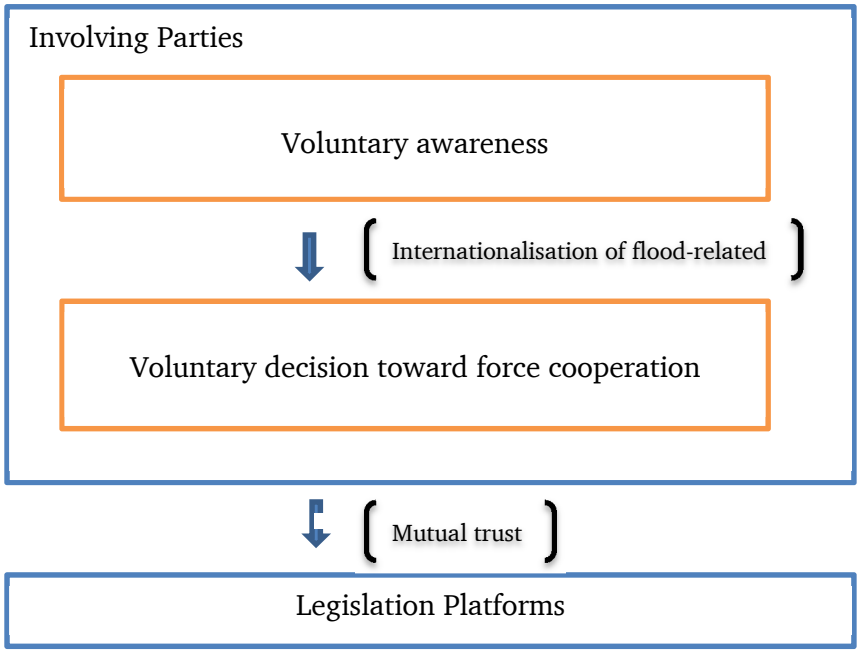


Figure 34 Cooperation pattern on the trans-boundary disputed flood-related issues

6.5 Outlook, limitations and directions for future research

6.5.1 Outlook

Adjusting routes of policy schemes regarding flood risk management and changing the regime of flood-prone areas is a small piece of a broad legislative fabric. The comprehensive solution requires a complete innovation of both terms of the national legal system and international cooperation that is otherwise inaccessible. In contrast, the improved progress on policy schemes may shape the choice of tomorrow. For example, flood management policy in the Vietnam context is moving towards integrating flood risk issues into a legal framework. There is also the added benefit of planning that includes ecological considerations in the decision-making process as well as long-term planning regarding flood-related international cooperation. A comprehensive solution demands careful evaluation. Meanwhile, an integrated flood risk management method is being utilized and frequently assessed within an existing European context.

An integrated approach to flood risk management demands a great effort from all involved parties. The policy scheme has evolved; nevertheless, the current method to measure the adoption of policies is not rising at the necessary rate to achieve set objectives in flood-prone areas. This critical investigation identifies and explores the direction for appropriate measures for flood risk reduction by reducing the trend of increasing flood risk within riparian flood-prone regions. These directions require more assessments and investigations.

Flood-prone areas are considered as economic zones due to their existing economic advantages and then triggered floodplain occupancy, regardless of flood risk. Economic development trends are not only attracting development but resulting in flood driving forces establishments. Flood risk management, thus, should be aimed to develop and implement measures to reduce flood risk with the perception of development control in flood-prone areas with interest and means, rather than protecting development.

In flood-prone areas, complex instruments of governments form and maintain urban development. Governance arrangements, treated as methods or the operation of overall measures for reducing flood risk consequences, include land use and development control policies. In guiding areas towards sustainable and managed development, integrated flood risk management is an essential development-control instrument and could be used as a device for balancing social, economic, and environmental factors in the areas damaged by the flood driving forces.

6.5.2 Limitations and directions for future research

This investigation contributes to knowledge development of flood risk management and flood-related policy patterns in riparian areas; however, the limitation of the study covers many aspects, and the issue requires further exploration.

The first limitation is the scope of the research. Can Tho City was selected as a study site, and the case study's range cannot be treated as a typical pattern due to local characteristics. Similarly, Ho Chi Minh City possesses a regional trend of rapid urbanization as well as urban flood risk. The development patterns within these two metropolitan areas are so quite different and cause different prevailed flood driving forces on both sites. The population growth rate in Ho Chi Minh City is higher in Can Tho City. This high population growth rate may exacerbate more civic flood vulnerability; or due to financial status, public and civil responses to risk of flooding are different in both places (e.g., abundant local budget for flood risk management may support city's infrastructural system improving and well maintained; however, vast areas of vacant land gives space for non-structural measures to take place).

The next research drawback is the combination of flood driving forces. The flood occurrence is the same phenomenon; however, flood impacts are different in distinct places due to local flood driving force characteristics. In the Can Tho City case study, two groups of flood driving forces have been pointed out separately, although the flood damage was due to many factors or groups of flood drivers. Flood regimes in other riparian regions may possess more flood drivers; hence, identifying precise flood risk factors contributes to the proper pattern of flooding and gives more options for flood risk response. This challenge requires further investigation.

The last limitation is the trans-boundary cooperation mechanism in the European river basin context, implying a significant gap in comparison with another river catchment. The collaboration scheme, as well as the cooperation regime among the European Member States, adopted a result of the long-term interest negotiation process; hence, the restrictive policy may work well based on fundamental cohesion. Nevertheless, the attempt towards community cohesion should be good practice and an excellent pattern, especially on trans-boundary flood-related issues.

Further progress on policy analysis research ought to continue, with empirical analyses and case studies. The assessment of flood risk management contexts through observations, review, and interview data extraction cannot, of course, be definitive. Indeed, outlining this debate with the result of semi-structured interviews can identify matters by building a holistic perspective rather than only an individual's perception. Also, the research conclusions contribute to the starting points for further policy analysis research on flood risk reduction on highly vulnerable land. These starting points, are essential not only to the policy analysis based on "motion of policy" observation but also affirming more potentials on flood risk reduction scheme as well as forming more insight into the relative contribution from spatial planning could potentially be gained from studies that attempt to project flood damage reduction in flood-prone areas.

This research, therefore, calls for broader generalizations about greater ranges of flood driving forces in flood-prone areas and planning responses that embed long-term development in regions as well as the whole catchment growth. In this research, two metropolitan areas (Can Tho and Ho Chi Minh Cities) reveal vulnerable flood characteristics and the nature of the EU policy scheme on flood risk management through case studies in detail (France, Germany, and the Rhine River Basin) were examined. The research's findings

depend on the study case selection, thus identifying that the appropriate flood risk management model requires more cases in different riparian regions and catchments. The further expectation goes to those more flood-prone areas selected as case studies through flooding mechanism investigations and responses towards sustainable development. Also, more discussion and conclusions could be drawn in the future in order to contribute to knowledge development and the transfer of flood risk management.

Future explorations should be concentrated on how to transfer good practices and successful patterns into the specific flood-prone area. Similarities on facing flood challenges from the European context as well as other international cities may support good references on how sound flood governance can choose the appropriate approaches to complete the long-term objectives of flood risk management. Also, knowledge transfer helps not only flood risk reduction schemes but the larger scale of natural disaster management in the Vietnamese context, as Vietnam is one of the most vulnerable countries in the world to this kind of natural disaster.

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ANNEX 1. PARTICIPATING EXPERTS

No	Interviewee
Expert 1	Researcher working in the field of Water Management and Climate Change.
Expert 2	Spatial planner working for local planning authorities.
Expert 3	Researcher working in the field of Environment & Natural Resources.
Expert 4	Urban planner working for a local company. Freelance Journalist of urban planning.
Expert 5	Researcher working in the field of Water Management and Climate Change.
Expert 6	Researcher working in the field of Water Management. Founder of Climate Change Coordination Office of local authorities.
Expert 7	Researcher working in the field of Water Management. Officer of Vietnam Academy for Water Resources (VAWR) and Member of Vietnam Panel on Climate Change (VPCC).
Expert 8	Researcher working in the field of Water Management and Climate Change.
Expert 9	Researcher working in the field of Environment & Natural Resources.
Expert 10	Researcher working in the field of Water Management and Climate Change. An officer working for the Department of Science and Technology of local authorities.

ANNEX 2. INTERVIEW TRANSCRIPT CONTENTS

Question 1. What are the current approaches towards flood risk management in urban areas from the government policy theme?

1) Expert 1

Currently, prevention measures have applied in urban areas. This means the flood phenomenon had happened, then these measures have a task of reducing the event's damage, for instance, lowering the flood's peak or backfilling the ground floor, etc., However, flood risk damage is unclear definition term in Vietnam context, or many flood damage's factors have not been accepted or is in consideration. The flood damage depends on where inundation happened on, how inundation situation in the areas, and how sustaining the communities can be. For example, the flooding in the rice field is more acceptable than in central city areas. The current approach from the government policy is applying the measures in places in the inundation circumstance, and there is not considering the scale of flood damage (the damage caused by inundation in the city center is more significant than in suburban areas).

In my opinion, flood risk management means managing the flood risk, and it is not trying to control the inundation events. In general, the Vietnamese policy focusing on inundation events (more than the damage caused by inundation), hence this approach leads to the "unconnected situation" among the official departments or units. And these official departments tend to resolve the risk effects, instead of finding the inundation event causes.

2) Expert 2

The current approaches to flood risk management in Vietnam are first, via spatial development plans and other plans such as sector plans, etc. In Ho Chi Minh City, the spatial development has been verified in the government's decision and detailed in the official ruling (*Decision of 24/QĐ-TTg on approving of justified* Ho Chi Minh City *master plan vision to 2025*), with the latest justification focusing on identifying flood-prone, ecology protecting and rapid development areas, etc. These areas have been set as storage or open spaces to reduce the inundation situation within Ho Chi Minh City. Also, the government's decision affirmed the land use plan for specific areas and functional zoning plans to improve urban inundation.

The latter approaches are through action programs set by the local government or via the integration of flood control components into Ho Chi Minh City sector plans. In Ho Chi Minh City, the latest Ho Chi Minh City flood control action program counted as the strong point of the whole flood risk management strategy. There are some projects implemented by the DPA, with the bottom-up approach, such as the multi-functional parks in Ho Chi Minh City. That park project is a pilot project on the watershed in the Go Vap district and includes lakes functioning to the storage, bio-diversity protecting, enhancing community recreation and tourism purposes. The sector plans have contributed to Ho Chi Minh City flood risk management program, for instance, the park development strategy (integrated of storage function into city park development plan) or the plan of drainage system development (e.g. Ho Chi Minh City flood control project aiming to control tidal flooding and respond to climate change). Also, the solely projects sponsored by the World Bank, for instance, to improve the water drainage environment, named Ho Chi Minh City Environmental Sanitation Project, have reduced the flood risk damage.

3) Expert 3

In general, within the riparian areas in South Vietnam, the current approach in the flood risk matters is "resolving the arise problems"; and it means inactively resolving and situation-based solutions. In other words, the inappropriate ability in urban planning and management is the main problem. Urban management lacks policies, matter solutions, applied standards, and urban development is standstill spontaneous development, with

missing the appropriate urban development vision. In case of Ho Chi Minh City and other southern urban areas, although being riparian characteristics, Ho Chi Minh City and other riparian urban areas still miss the characteristic-based urban development plan, especially in the surrounding urban core (e.g. in the city North East region like Thu Duc, 9 and 2 districts located near the Dong Nai River). Although Ho Chi Minh City has published the regional master or spatial plan, the plan has a missing approach. Embedded the Ho Chi Minh City economic corridors (Ho Chi Minh City's four corridors), the master plan neither disconnected with environmental matters nor flood risk management. For example, Ho Chi Minh City development orientation (Vision to the year of 2020) expanding to the Southwest area is the "low -lying-land area," with vulnerable flood risk characteristics.

4) Expert 4

The current main approach is physical measure employment, either dam-building against flooding or drainage system upgrading. The government prefers focusing on large-scale investment in the urban infrastructure system.

5) Expert 5

The government has employed structural measures on urban flood risk management. The solutions are focusing on engineering measures. Lately, there is a slight rising of non-structural measure applications within the urban areas; the approach presented as an urban flood control policy. In the inundated areas, the drainage system improved or added because that is immediate intervention from the authority, possibly. However, the scarce of financial resources or limited state budgets is now increasing the demand for non-structural measures application. There is not sufficient budget for the engineering projects, for instance, the land clearance phase always takes a large part of the project's budget, or extended project duration makes the insufficient financial support (e.g., Ba Bo canal project in Ho Chi Minh City). Lately, the city authority finds out mass media utilization to increase community awareness (e.g., stop garbage throwing onto the open canal); or approaches the temporary water space detention by supplying the underground reservoirs and canal dredging, etc., Nevertheless, basically the structural measures still take the main tools.

The other approaches, possibly, are going on by the meaning of supporting incomplete and insufficient policies; but the government has considered this direction. For example, the stormwater reservoir has set in place that receiving community feedback of efficient engineering structure and then was being on the re-inundated situation after a short time. That is the disadvantage of structural measures and needs to be improved.

6) Expert 6

In the current, the flooding classification does not mention the flood cause and flood event. In the scientific approach, what is an inundation area? There are two elements, the amount of water comes in and comes out. The amount of water coming is more substantial than water comes out causes inundated events within a region. Nevertheless, in Vietnam, the approach towards flood events is finding the solution from the identified flood reasons. The more reason finding the move away from the real cause and people could get lost of sufficient reasons for flooding. Many government's sectors touch the flooding reasons. For instance, the transportation sector claims the flood caused by drainage system congestion and then implementing the dredging and other maintaining the urban drainage system, or the cause is from the low-lying ground, so the urban street needs to elevate. And Directorate of Water Resources has issued the same claim.

We must approach the matter from the water coming in and out viewpoint. We have to identify which water sources and the water amount; or factors affect to flooding situation should be found firstly; then we possibly resolve the flooding problem. Another scientific approach is a computer-based flooding simulation. In this direction, it is hard to create an appropriate model caused by scaring or insufficient data set.

7) Expert 7

The flood risk management measures applied to specific areas, like Ho Chi Minh City or district of the inner city. Can Tho City had such a same plan focusing on specific urban districts. The central government has the vision of flood risk management planning for the whole vast region; however, this concept is just in the beginning phase conducting involved researches. The central theme is still concentrating on some specific inundated areas in inner cities. In these plans, the flood reasons have been considered for preparing the appropriate solution (extreme rainfall, tidal water, or the combination of these reasons, etc.). In short words, the right solutions have been employed, with no consideration of the large-scale area flood risk prevention (e.g., the whole Mekong Delta or Dong Nai River Basin).

8) Expert 8

In my viewpoint on urban flood management, there are two official organizations have responsibilities on flood risk management, the Agriculture and Rural Development Department and Urban Drainage Companies.

The Agriculture and Rural Development Department is a permanent authority on flood control and natural disaster prevention etc. The main tasks include setting up the structural measure applications (e.g., build and operate border dike and tidal lock systems) on riparian flooding caused by tidal water or flooding from the upstream. In general, most of the concentration in riparian urban areas in Vietnam is on a border system or tidal lock to deal with flooding induced by tidal water. Then, the physical measures are prone to the urban drainage system.

The urban drainage companies are responsible for floods caused by extreme precipitation events and focusing on the municipal drainage system. In fact, the drainage capacity is limit and hard to extend. In addition to poor awareness from the community blocking the drainage pipe system could worsen the lousy condition of the urban drainage system.

9) Expert 9

In Ho Chi Minh City, urban inundation has acknowledged within four main causes. (i) The first is precipitation; (ii) the second has been claimed to tidal regime; (iii) the third is the combination of storm and tidal water; and (iv) the last is constituted by the upstream reservoir's water discharging (e.g., Dau Tieng and Tri An reservoirs must release exceeded stormwater when heavy precipitation takes place). The current solutions for structural and non-structural measures have applied.

The structural measures counted as an extending and improving urban drainage system; the other attempts used as deepening and widening the current open canal systems (e.g., Tau Hu-Ben Nghe and Nhieu Loc-Thi Nghe canal systems).

Then, the non-structural measure applying is a considered concept, forwarding to green and sustainable urban areas such as the regulations integrated into the planning process by request the stormwater storage or wastewater retention within civic buildings to prevent discharging into the main channel in the inundation period. Furthermore, increasing water infiltration surface on the pavement could be counted as a non-structural measure. Building reservoirs to store the water that integrated with the surrounding landscape is a combination of structural and non-structural concepts and implemented in the city center.

On the tidal cause, the combination of structural and non-structural has taken into account. Physical measures such as canal embankment, dikes system or check valve drain discharge while non-structural measures include groundwater exploitation ban in the subsidence areas (decreasing tidal head in specific areas causes subsidence in other places while Ho Chi Minh City's topography (approximately 60%) mostly is under 2m, thus with the max groundwater head almost 1,6m can cause 0,04m subsidence, even app. 0,07m. Tidal flood then could be claimed in low topography). Recently, the local government has

implemented groundwater exploitation zoning. That means some specific areas can exploit the groundwater while other places are ban, with the principle of banning on the sites where water supply is available or increasing the groundwater price to prevent overexploitation, especially in the industrial zones or parks and agricultural irrigation (setting groundwater limitation on agrarian activities). In Ho Chi Minh City, the annual groundwater head has decreased around 2 meters for over ten years; thus, there was over 20m declining on Ho Chi Minh City groundwater head.

Further, the first layer of groundwater polluted; and that leads to the deeper layers were being exploited. The consequence of this phenomenon is the lower areas of topography inundated. The combination of tidal water, land subsidence, and sea-level rise worsen the inundation situation in Ho Chi Minh City more serious.

With groundwater issues, the consideration of groundwater support suggested, however, the supported water needs to purify before spilling into the groundwater layers. This challenge suspended. The other consequence of lowering the groundwater head has identified as salinization. The salinity intrudes groundwater levels causing changes in natural soil properties and affecting soil quality.

The land subsidence now can be found in large cities in Vietnam (e.g., Ho Chi Minh City or Can Tho City). Can Tho City could be affected by land subsidence and tidal inundation. The rapid urbanization causing increasing hard surface makes insufficient groundwater support. In addition to developing a local economy without environmental protection, consideration leads to exhausted on groundwater resource. As a consequence, in combination with other climate factors, the lower areas within a city are exposed to flood risk. Also, the upstream hydropower dam activities block water downstream. Thus inundation in Can Tho City could be claimed to mainly land subsidence and tidal water causes.

On the last issue: reservoir water discharging, the cooperation policies have employed for the involved sides. In the principle of the weather forecast (e.g., identifying the precipitation and releasing exceeded water afterward), the cooperation is based on the prevention of discharging at the same time and follows the rule of the phase difference.

10) Expert 10

The main concentration now, for instance, in Ho Chi Minh City, is on physical measures. There are many corporations offered the inundation control measures to Ho Chi Minh City authority. Thereby, many approaches have been suggested, such as water retention in the underground system, etc.; however, there were not non-structural measures. The non-structural instruments should be applied, but the local authority has paid a little attention to these. The concepts could be lengthening the runoff or reasonable cost measures like increasing stormwater infiltration ratio (decreasing imperviousness) etc.

In my Center, many research projects have been conducted and then cannot apply in reality. In my viewpoint, the non-structural measure application requires support from the legal framework and execution system afterward (on the design phase and project implementation process, e.g.). The causes induced by the gap between the technical viewpoint and decision-makers. I was a researcher, and then I have worked as a local authority. Therefore I acknowledge that issues could be impossible for the implementation step.

Question 2. The combination of structural and non-structural measures is the standard choice in flood risk management themes to deal with increasing flood damage trends. In the case of Vietnam, should the next phase of flood risk management strategy be steered to non-structural measure applying? If yes, what have non-structural measures applied in Vietnam cities? Which ones have employed in large urban areas in detail?

1) Expert 1

In Vietnam, the feasible solution suggestions must follow three elements: the measured effectiveness, the solution feasibility, and institutional ability. The measured effectiveness implies all the solution suggestions must be planned well, considering project cost and benefits, even for the next many years with the project vision to decades, etc. The solution feasibility includes the technology level and financial ability. The institutional capacity mentions to the coordination and cooperation amongst the official departments or units of government.

The current Vietnamese legal system lacks appropriate policies to support non-structural measures. There are no quotas (the fixed amount of things) or the unit price for calculation the project's financial requirements. Thus, non-structural tools could be stopped in the scientific concepts, for instance, which commercial quota is reservoir based on to form the project total cost? Or which economic standard could be applied to create the price of water absorbed concrete (pavement utilizing to reduce the water run-off)?

The non-structural measures lack the supporting policies in reality in Vietnam. Thus the difficulty of action applying to the Vietnam situation is understandable. The institutional obstacles to fix these troubles could be last about five to ten years of policy adjustment and amendment. Hence, the solution feasibility is a real problem of applying non-structural measures.

Next example about the solution feasibility lack is when the local government building the Flap Valve system (Flood-control purpose) to adjust the flood water level within Ho Chi Minh City and part of Long An province, the Ho Chi Minh City local government cannot cooperate with the Long An province authority. Each local government has their interest. Hence, the project feasibility could not set in this project.

The next requirement for forming the project feasibility is community adoption. In community understanding, the concept of "flood risk management is a state duty" still exists as community awareness. The community thinking pattern described as "I can complain about the flood damage because that's the tax-payer responsibility; however, I will not agree in case of state's suggested option conflicting with my interest." The expert vision could be different from the community thinking (expert visioning to 100 years of development; however, community care focusing on the present interest). Hence the community adoption possibly would not be guaranteed because of not matching in project objectives within stakeholders. Thus, non-structural measures would not develop in Vietnam.

That project feasibility (characterized by social and institutional conflicts) could not be guaranteed. It is a common phenomenon, and this found in many cases of practice from developed countries such as the Netherland (with the powerful Water Board system) to the developing countries as Vietnam. In the case of Vietnam, the difficulty causing by the blocking at project feasibility is enormous, so that the solution-selecting process often can be prone to the easy-to-implementation suggestion. In this case, that is structural measure.

I shall give an example for this point; I joined a project in 2015 and 2016, the project implemented with the cooperation with GIZ (The German Development Cooperation) on the Vietnam seaside region support to establish the sustainable inundation control system within the region. The project included the planned drainage system, involving climate change factors. However, the system was in overload capacity caused by the combination of many climate change factor with the system. Thus, the project complementation suggested. The content of complementarity comprised the BMPs (Best Management Practices), with the concentration on the absorbed city models (water detention at the place instead of

transferring water to the other sites). For instance, the water-absorbed areas in combination with landscape design by employing the grass areas, reservoirs in an urban center, etc. The scale of the project is lying within five cities near the seashore, Quang Ngai – Phu Yen – Nha Trang – Binh Dinh – Soc Trang cities. The project is challenging in implementation because of the difference in the project's goals within stakeholders. The planner with the long-term vision met the disagreement from the community side, or "there is a gap between the expert vision and community viewpoint." Some community treats water as a foe instead of a friend, and they cannot accept "living with water" stance. Then, the project details must be adjusted to adapt to reality (less sustainable) to caption the project feasibility. In this case, applying the structural measures is more accessible than the non-structural ones, with the acceptance of less sustainability for the whole five cities. That explains why the structural measures still now the better choice than non-structural measures in the Vietnam situation.

2) Expert 2

In my opinion, the non-structural measures could be developed more in the next years, following the sustainable development theme. Incentive policies integrated into the social-economic development theme in the flood-prone areas. For example, the government must spare the concentration into the development of the flood-prone areas or focusing on the flood adaptation investment by issued the priority policies in these areas.

Assuming the incentive policy taken for granted, the multifunctional park (like I mentioned above) must be bound by the development boundary instead of literally park boundary — the intensive development policy integrated into the economic growth in the park by opening more functions such as tourism and services (not for sorely park function), etc. This approach can be described as an increasing coefficient of land territory utilization, for instance, to encourage the investors focusing on more infrastructures (including improving or applying new drainage system).

The non-structural measures are more suitable from the economic viewpoints of public investment by two points of investment efficiency, with the economic and environmental views. The first counted as the reduction of direct structural measures budget; hence, the public investment in engineering equipment would be reduced in the financial resources. The latter, in the later period, the structural measure investment harms the social-economic development (by affected people's awareness, etc.) and environment protection (by changing the river regime, etc.). In theory, the approach of learning on non-structural measures is a must, but in practice, the combination of two methods could be more efficient and implemented. The structural action, from the viewpoint of a flexible approach, could be smart and productive on the socio-economic efficiency.

3) Expert 3

Both structural and non-structural measures have advantages and disadvantages. Based on the current situation, the proposals would be selected to adapt to the context. In the long term, the structural measures are not the proper tools embedded with sustainable development objectives, and these applications could not fit with flood risk adaptation as well. Structural or engineering measures are an option of temporarily circumstance where impossibly applied the non-structural measures. The engineering measures, with the instant and recognizable functions, are easy to utilize; however, the environmental impact by action-applied always requires careful consideration. Engineering measures may fit for the urgent situation of flooding, but completely miss the urban ecosystem impact or "water sensitive urban design." Therefore, structural or non-structural options depend on the decision maker's ability and the recognition of flood risk. In the long term, the transfer into non-structural measures is a must, although arise controversial matters by applying non-structural measures between the planners and government agents. Lately, the government convinced by the advantages of non-structural applications. Nevertheless, the short-term efficiency from the structural measure dominated.

In many large cities (e.g., Ho Chi Minh City and Can Tho City), urban development approaches or good practices have studied. Lately, the water management concept (from the Netherland as "more rooms for water," which replacing engineering measures by non-structural ones) has been reported as a good example.

In my opinion, if the first matter is the different viewpoints amongst urban planners, environmental experts, and government officers, then the second is insufficient and inappropriate cooperation. There is the demand for urban development strategy for Vietnam urban areas, for example, Ho Chi Minh City or Can Tho City is missing the general approach. Every department has its development strategy (e.g., development plans of Ho Chi Minh City Department of agriculture and rural development, urban flood management programs from steering center of the municipal flood control program Ho Chi Minh City or Ho Chi Minh City general plan of drainage system visioning to 2020. However, the disconnected or out-of-integrated situations amongst these programs could be observed. In other words, there is missing a comprehensive spatial plan for urban development, taking into account climate change effects.

Lately, non-structural measures have concerned in some urban management programs such as a lake or channel restoration, detention ponds that have been built, or improving existing lakes (in the parks, e.g.). However, the non-structural measure application is discrete. Thus flood risk management means hydraulic or hydrological control instead of urban spatial management. In the current, the structural or non-structural measures operated by Ho Chi Minh City steering center of the municipal flood control program. In the long run, I think that Ho Chi Minh City officials must issue the non-structural measures to the community (It is hard to find appropriate information on the SCFC's website) and release the non-structural measure application policies to project's stakeholders.

4) Expert 4

The domination of measure using depends on the viewpoint. With the experts and researchers, the combination of two kinds of actions is a must. The non-structural measures are not the multifunctional parks or reservoirs, for instance, also the other tools. In the stage of the government's officers, in my opinion, there are two facts of governance. The first is planning ability (or institutional ability) is weak, it means it is easy to decide of drainage system upgrading project while in non-structure measures, the measure's effectiveness is not visual and immediate recognition (or expected objectives). Non-structure measure application is involved-firstly to law-makers. The non-structural projects (e.g., underground water tank or reservoirs; green top building) require the law support (public participation; project investor meetings), and the legal system identifies the project scale and level of investment amongst stakeholders. The latter is the political term pressure. The authority tends to adapt to flooding situations by employ the temporarily structural measures as the guarantee persuasion to the community. In the limited awareness of the community's members, the immediate action from authority quickly accepted and accredited. The latter issue is important to the point that decided the motivation of structural measure employment.

In my viewpoint, the water reservoir or stormwater detention tank is currently non-structural measures applied in Vietnam.

5) Expert 5

In my viewpoint, the urban area must possess the primary drainage system. Depended on the urban scale, the municipal drainage system designed with appropriate principles. The small size has its own natural or human-made drainage system, and the larger urban place possesses the proper drainage system to adapt to the urban demand — the urban structure based on this view.

Based on this viewpoint, the non-structural measures are the supplements to enhance the drainage capacity within a region, with the other advantages, e.g., resolving the matter of increasing drainage capacity and rising damage environmental issues.

The urban structure must base on the primary infrastructure system. In terms of a perfect point of view, the metropolitan area has to equip an appropriate drainage system. With the expanding metropolitan region, the public investment strategy follows the gradual principle. It means that the government invests 10 or 20 percent of the total annual income in developing the infrastructure system. That is the necessary investment, and then the non-structure measures are applied as the supplement to the primary system. For example, this urban drainage system was in good condition, given the assumption that rapid development results the real runoff water coefficient(c = 1) larger than the designed one (c = 0.7) — the option that extending the drainage capacity by enlarging the drainage pipe system could be an inappropriate solution. Thus the non-structural application would fill the gap and take the supplement role (e.g., rainwater collecting and store, green roof). Non-structural measures, in this case, play an additional measure role decreasing the runoff water coefficient. However, we tent to identify the actions in terms of extremeness; this means keeping in our mint simple structural or non-structural measures. For instance, the European countries applied the non-structural measures based on the long-term developed measure system. In the case of developing without the complete infrastructure system, I believe that non-structural measures implemented in these countries.

About the non-structural measure applied in Vietnam, there are not many have been used. The non-structural measures application does not meet the expectation because of lacking sufficient policy system or not mentioned in the law system — for instance, the drainage system designed by the decision of TCVN 7957 (National standard) or another guideline of construction standard. Therefore, the non-structural measure application conducted with legal guidance. For example, the ABC program (Active Beautiful Clean waters program) of Singapore formed and developed a green city. The legal framework has supported the city development towards to green standard for the whole city development. In case of Vietnam, the non-structural measure application is difficult to assess because of the delay situation or missing of the appropriate legal framework (e.g., stopping garbage thrown into the canal program does not work because losing of encouraging and punishment policy; or the delay situation of the stormwater reservoir). Thus, the non-structural measure is an excellent supplement concept, and it is necessary for more development. A good practice is a case of new urban Phu My Hung region in district 07, Ho Chi Minh City. In this new urban place, the design standard adapted with the ‘water retention and detention approaches’ (stormwater will be stored temporarily in the green grass areas and then conducted into the primary drainage system).

6) Expert 6

In my viewpoints, a region must find the proper flood causes; thus, there is no general principle for all cases. For instance, flooding caused by low topography, the efficient drainage system should be the right approach, or stagnant ditch could be applied a proper dredging process, etc. It is challenging to offer sorely structural or non-structural measures into flooding urban situations. Therefore, applying measures into a specific location depends on identified circumstances. I have ever questioned about the measure application in Holland’s cases with an expert on the transform from structural into non-structural measures, and I have received a reversed feedback. Within specific regions, some dike segments still maintain and even are consolidated with ten times (possibility one time happens out of ten thousand years, instead of one thousand years as usual design) because of high flood risk. And when I saw the Holland Delta strategy, there still exists the structural measure without any claim of action abandon. However, my view of the point is presented from my limited observation because I am not in Holland's authority role. So, this viewpoint should be more investigation.

It is hard to take the Holland example to prove this viewpoint; however, we can observe a non-structural application case in Vietnam. Along with Ca Mau seaside, the standing mangrove forest, known as wind-and-sand shielding with a maximum height of trees, could reach 20 or 30m, has been affected by large high waves; thus mangrove forest

could not consolidate the seaside area, especially on the climate change effect shortly. With the assumption that less wind or wave along this area in the past, mangrove forests took a protecting role, but in the current situation, a “Solf-wall dike” has been conducted in this risky area. The “Solf-wall dike” (River Bank stabilization) is a system of concrete columns arranged along the seashore, with the length of pile appropriate 7-meter height piled higher maximum waves around half a meter. The system includes two pile-sheets, has been organized with parallel shape, and measured distance of 30 cm for each pile; the gap between the two sheets is around two meters and filled with big stones; the connection of pile’s upper had finished at last to output a solid wall). The Solf-wall dike plays a protecting role against the massive high wave, and mangrove forest is kept going on growth in the inner land. The hidden land, which supported by the dike system, absorbs the alluvium from the seawater and forms alluvial soil. This wall can improve the situation in this case, with more resilience. I am implying the area with serious erosion damage. Therefore, depending on the specific case, we suggest the appropriate solution, and in this viewpoint, we can employ the structural or non-structural measures. The engineering measure or non-structural measure could be the solutions for each specific case rather than the potential of a matter. For more illustration, in Bac Lieu province, a concrete dike system has been employed along the seaside, with concrete hardening surface. As a result, the cracks have appeared on the cover after about one or two working years. This year, the breaks extended. Also, the land subsidence observed in the region during a long time caused by unintended groundwater exploited. Because of land subsidence is different in the system of dike segments; the cracks are formed and developed with affected by massive wave pushing forces. The dike system is on the verge of breaking. And so, hard measure literally in this case is not good.

Back to the urban inundation problem, the reasons investigated carefully. In lines with the ideas presented in the workshop, there is two types of inundation or flooding: the natural flooding and human-made inundation. The natural flooding is the seasoning inundation, and this is the primary type of flood in the Mekong Delta. This natural flood could be caused mainly by three sources: inland precipitation, water streams from Mekong’s upper regions, and tidewater. In my researches within Can Tho City, stormwater plays a minor effect; Mekong’s water streams play a side effect by increasing the water level, and the most critical role belongs to tidewater from estuaries. That explains why flood water level reaches a peak in August and September in Can Tho City because of the high tide at the summit in this period. In the case of combination with other sources, whether upper water streams or rapid precipitation, the water level is at the top. Anthropogenic inundation or urban flood is a result of inappropriate urban development or inadequate drainage system. This phenomenon caught in large cities as Ho Chi Minh or Can Tho cities. These developed without proper drainage causes inner-urban inundation. The drainage system then is expanded however eventually the flooding is still.

I have conducted three specific observations. The first place is natural inundation. In this place, the rapid development invaded the native soils and replaced by human-made land surface by filling the natural ponds and canal, etc. The stormwater cannot be drained and in combination with high tide (with the high pressure keeping the drainage water remaining in the area), thus making the inundation situation at a particular time. In conclusion, the urban development strategy must consider appropriate drainage system and employ large-scale pump system is necessary. The second place is a planned metropolitan area; there includes two-phase development. WB was sponsoring the first phase to upgrade an area inside Can Tho City. Site clearance applied and then building new houses. The new drainage system planning, but the system is too small (pipeline diameter is about 400mm), with the combination of sewer and stormwater drainage. Also, the street vendors wrap the manhole-covers because of conduit odor.

As a consequence, the inundation when a rainfall strike is a must. A last-place equipped with a larger drainage pipe system, with a 1-meter diameter and separated storm and sewage water. This system guarantees the appropriate drainage system, whether in the

rainy season. These observations answer the inquiry of urban inundation phenomenon. The faulty design or inappropriate operation (breaking, poor maintaining, etc.) in the drainage system could cause urban flooding.

In the urban development policy, the existing with the limited infrastructure and insufficient pipeline systems developed condense high-rise buildings in Ho Chi Minh City CBD, for instance. The development trend steered to another area or new planned place. Eventually, a drainage system and transportation, etc. in current were being in the problem. In Tokyo (Japan), the G-Cans system (The Metropolitan Area Outer Underground Discharge Channel) is a large water tank system and can face any scale of rain events. However, this approach is suitable for an abundant budget. Therefore, the method depends on the context, and there is no universal rule and the typical answer for the flood risk management application.

Tidal water is a particular case for measure application consideration, but this issue often is neglected. Tidal problem is pretty unlimited, and it is, of course, hard to employ retention measures like a reservoir, etc. So, there is no suitable action on the tidal water issue, and the feasible method maybe a dikes system or causeway. The reservoir, possibly, fits with stormwater relief measure (maximum stands on 200mm), but there is scaring on vacant land to build the lake. There is not enough space in Ho Chi Minh City, for instance, to apply the retention measure for the whole city with maximum precipitation of 200mm. The feasible way is cleaning up the catchment basin and then at the end of the catchment, pumping up the stormwater into the river. The natural river continuously is extended, because the river bed is the lowest point of the region. Investment in the underground discharge channel (e.g., Japanese G-Cans project) is an excellent option.

About the implemented non-structural measures in the rapid development area such as Ninh Kieu Urban District, I have suggested some ideas to local government, and partly my points have been considered. Causeway counted as a government's effort because the urban flooding reason in Can Tho City mainly caused by tidal water. Therefore the intruded water could be blocked rather than contained in a specific space. The causeway is the combination of dike, embankment and road measures and you can easily observe such as Xang Thoi Lake (Hồ Xáng Thổi) or along Tham Tuong Canal(Rạch Tham Tướng) lying in the inner city. These areas, in the former period, were crowded areas; and these encroached areas have been clearance then (stilt houses or temporarily blockage objects, etc.). The next step was raising the road level, embanking the outside bank, and upgrading the drainage system. Eventually, a new road built and improved the surrounding landscape. The measure impressed the stakeholders more than merely dike because of the measure utilization. Also, the causeway frequently maintained that guarantees in good condition. In this case, the flood risk reduction integrated with urban development activity. I count this viewpoint as an appropriate measure within the flood risk management strategy.

Back to the retention measure, there is hard to implement in Can Tho City because the city possesses the complex of canal network; the fast intruding of the tidal water stream makes insufficiency from the retention ponds. The late retention pond implemented in Can Tho City is Bun Xang Pond, with the same type of causeway upgrading method. Lakes transformed into space to store the stormwater temporarily. I think this measure could not be efficient; however, the lake connected with everyday activities so quickly to take the consensus from stakeholders.

7) Expert 7

The structural and non-structural measures are long-time applications; and actually, the domination of physical measure employment cases reported around the world. Risk control is a common term with most recognition, and when the risk frequency is over the threshold, the risk management has been used (more frequent extreme events).

In general, structural measures have been employed in many large cities within Vietnam, especially in Megacity, like Ho Chi Minh City, where an urban flood observed in the

inner districts with more frequent inundation taking place. The structural measures dominated the government's policies, for any inundation's reasons (e.g., tidal or precipitation). However, there are still cases of non-structural measures such as weather forecasts, etc. The other step is urban management, for drainage system clearance, e.g., and lately, spatial planning has been revised by the government to integrate flood risk prevention into the plan.

In my viewpoint, that structural measure employed in the high-risk places (which left severe financial impacts when risk takes place) is an appropriate approach, however, in fact, the urban planning is not proper, and the planning implementation is even worse. That results in inefficiency in the flood risk management process. The high-risk areas should be pointed to set options properly. For instance, Ha Noi and HCM Cities approached with a better implementation, but that's still the "separated-area applying" approach.

The efficient non-structural application counted weather forecast; even the "high flood risk maps" have been drawn to support the flood prevention plan. The other group of non-physical measures is supporting retention spaces; this approach integrates flood prevention into surrounding areas. On the urban governance, the water space management has considered and planned, but there is no result report or outcome assessment issued; also, the drainage or infrastructure system has maintained in high-risk regions, with the direction of reducing the runoff or enlarging the water space in the inner city. On the community scale, the raising community awareness or rain harvesting implemented; however, this method has an inefficient assessment. In the current, the main direction is still fast stormwater discharging into the canal or river; however, this faces the urban space scarce.

The current philosophy pressed the importance of structural measure and then, applying the non-structural measures is for the strengthening. The principle is more appropriate to offer a set of activities combining physical and non-structural tools from the beginning, with the concept of, at the same time, two kinds of approaches mutually promoted. In the planning system, the structural measure should be implemented regarding cooperation with the non-structural measure. In my viewpoint, the manner of collaboration between the two approaches would promote efficiency.

8) Expert 8

There are the advantages of structural measure applications (e.g., visible outcomes and easy in implementation stage from stakeholders, especially from the local authority), and that induces the nominated role of the measures in compared with non-structural measures. Also, the non-structural measures are more difficult to implement, although the involved parties have considered these measures concepts. Non-structural measures (e.g., raising community awareness) required the involvement of many stakeholders or consensus from communities. Thus it is clear that implementing non-structural measures is more difficult than the other means, or these measures ask for more efforts and determinations from the government. Also, non-structural measure effectiveness observed with many projects implemented at the same time; therefore, that is not easy to convince people with the non-structural measure in a short time.

In the other countries, with the high specification on physical measures (e.g., high frequency of extreme events in design inputs), the non-structural measures have been applied as the supplement in case of flood frequency exceeded (for instance the water space management program or increasing water absorption surface, etc.). Thus, the adverse impacts worsened if the non-structural measures would not be employed from now. For example, the small-scale of non-structural measures should be applied now to prepare for the mass applying in the next ten years. Not very far from Vietnam, the Malay government has approved the standard of the sustainable drainage system, and they have prepared for the standardized stage for the technical specification from over ten years ago. If we want to obtain those outcomes, we must effort the preparation from now, with the expectation of the functional consequences of non-structural applications. Besides the physical measure

concentration, the community awareness should be more rising as well as the socio-economic factors integrated into natural risk management policy or long-term strategy.

In Ho Chi Minh City, recently, the reservoirs have been considered as a non-structural application. There was an approved reservoir project in Hoang Van Thu Park in the city center, with the expectation of stormwater retention function. However, there is no information about the other non-structural measure will be implemented in HCM for further application regarding flood risk management. In my viewpoint, the non-structural measure application in Can Tho City is still limited; the central investment focuses on urban infrastructural improvement. The reservoir measure, outside the rainwater detention function, the afterward environmental impacts now are the crucial issues. In similar to an open channel in the storm discharge concept, the urban canal system has the same problem with the ecological effects. The other non-structural measure, such as land use, landscape, or open space planning has been considering as a potential investment, but there is tiny efficient reported.

The causes for retardation of non-structural measure implementation claimed to the poor cooperation amongst involved parties. Non-structural measures are not only requiring the trans-sectoral organization cooperation but also the high consensus and support from the community side. For instance, the Ho Chi Minh City flood control center should take more connectivity with other organizations to handle the flood situation outside the central role of flood control measure implementation. However, the center has no management role, and that makes the difficulty while measuring implementation. That is the institutional organization gap in the non-structural measure implementation phase.

9) Expert 9

On the potential to measure employment, the non-structural measure concept dominated as the common acknowledges in many places. Non-structural measures considered sustainable instruments because of cheap cost and long-term efficiency. But, these applications are suitable for the new urban areas (which planned in the first phase) or extended urban places.

The physical measures, on the practices, required a massive budget; however, the efficiency of the instruments is not meet the expectation (e.g., on the maintaining and expanding of measures afterward). Nevertheless, the old urban areas must implement structural measures to improve the degraded infrastructure, under the guidance of adapted development on the thread of climate change, for instance. The previous urban plans had no consideration of climate factors such as increased precipitation, sea-level rise, land subsidence causing by exhausted exploitation groundwater, and the polluted environment as well as the scare of other natural resources, etc. Thus, the low topography is on the risk of inundation and permanent flooding.

The non-structural instrument application is in the first phase of the planning process and has not yet supported by law system. The term of sustainable urban development has been recognized recently in Vietnam, and this concept must be supported by transforming into executed policies and then integrated into planning law, construction guidance, and possibly guidelines on the local authority level. It is difficult to employ the sustainable urban development concept in the current urban areas, and appropriate strategy in this issue may be step-by-step integration.

Vietnam government has implemented this concept on the step by step principle by applying increasing infiltration surface and reservoirs (or rainwater harvesting) as well as standardized construction levels on a large scale. For instance, the regulation of national building construction ground level must higher 2m has been implemented in Ho Chi Minh City and dwellers base on this level for reference (because inundation will take place within next 30 years in case of building level is lower than 2 meters). Thus, a required construction license issued based on this regulation. Another instance could be improving pavement material to widen the infiltration surface in the city. On the raising people's awareness issue,

there is rainwater harvesting policy to prevent the run-off (encouraging city dwellers to store stormwater for everyday usage) and keeping the utility hole system tidy to prevent garbage blocking in the sewer pipeline.

10) Expert 10

The combination employed in many countries, and there is no place applied just physical measures on flood issues. The Netherlands, in the past, has implemented large physical measures and then inducing the apparent consequences. The non-structural measures could be applied in Vietnam; however, the researchers should present more proof of effectiveness. For instance, the exceeded water quantity for every rainfall within Ho Chi Minh City (based on the current drainage system capacity) must be shown and then suggesting the appropriate non-physical measures to retain or store the exceeded stormwater.

Question 3. The riparian urban areas affected by the urbanization process, land used planning has employed as a sustainable development tool in the context of flood risk management forwarding to reducing potential flood damage in the next recent years? If so, what are the real reasons for the land use planning role in the Vietnam planning theme?

1) Expert 1

Inundation is a phenomenon of water staying in human-made areas instead of water places. Water can come from many sources such as precipitation, river, sea, etc., and then, water occupied in residential locations. Hence, flood control traditionally includes two types of strategy: the first is steering the stream, and the latter is staying away from the natural waterways. The land-use planning belongs to the latter approach, and it means people should not settle down in the water areas or must reserve space for water. In low-lying areas, the water stays and runs following the hydrological regime in the water basin and then, people come and invade the river places by putting the robust infrastructure to the land or people take place the natural topographic to human-made one. The hydrological water regime then was changed to adapt to the new topographical condition and forms the inundation in people dwelling. The technician could easily point out the inundation places, but the technical perception about inundation phenomenon is different from the urban planner viewpoints. The urban planners set possibly the inundation as the social, economic development effects, and concentrate on the financial aspect of land more than other elements.

In the case of the current Vietnam situation, they are planning described as the process of implementing setting goals, with the visions for the next some years. The planning goals could be the best objectives in the view of planners, and the unknown units would resolve possibly unpredictable damage. It described as the process of the master plan coming first, then the sector planning, and in this situation, flood risk management must be implemented after the master plan. The urban inundation firstly took place in regions such as Ho Chi Minh City, and then the phenomenon happened in Ha Noi, Hai Phong cities, and even Sa Pa city (known as the highland areas).

The inundation observed in the rapid urbanization, and urban flooding claimed for the urban planning regime in Vietnam. However, that is difficult to resist the urbanization, especially in the developing country like Vietnam. The migration influx is a seeable phenomenon in large urban areas; the flow is from the poor rural areas to the more attractive regions like metropolitan regions where people could find a job and hope for a better place, with better facilities and infrastructure. Hence, the influx forms the wave of migration within a country. The vacant land is not available in urban areas; therefore, the migrant must seize the “less appropriate land,” the property with risk or high risk of inundation, for instance. The risk is acceptable in this case. Some social circumstance makes the technical solution inappropriate.

Back to the question, land use planning could be the appropriate measure or not for sustainable development is a good question, and the answer is yes literally. In the concept, land use planning is an excellent choice; however, that cannot be the best option in reality.

2) Expert 2

There are two land-use planning regimes in Vietnam. The first system belongs to urban planners, and urban land use plans are products issued by planners. In this system, the land use plan is an urban master plan’s component, and the plan detailed the land functions properly (such as land for transportation, specialized and resident areas, etc.). The second system, land use planning regime, was operated by the Ministry of Natural Resources and Environment. In this land-use plan, the land divided into natural parcels and land parcels functions, and utilization set annually (agricultural, forestry, land for residential areas, specialized and unused lands). However, the following land use plan does not match with the urban land use planning.

As far as I am known, land use planning is an essential tool, especially affected by socio-economic development and environmental protection. However, within two land-use planning regime, the lack of sustainable development aspect, which integrated into the planning process, could be seen as the salient characteristic. The priority in the urban planning process tends to socio-economic development instead of land use assessment. The urban planners employed the "top-down methodology" and produced the urban development master plans showing the planner's willingness. However, in the urban planning process, the other countries' approach is basing on the land use assessment (in socio-economic, environmental benefits, etc.) instead of transferring the authority's desire. Within the urban planning outputs, the Vietnamese planning style addresses the topographic or geological characteristics, etc., on the general plans; in the meanwhile, the other final productions conducted via the consideration to sustainable development, environmental development, and socio-economic benefit or resource-utilization stances. The latter planning method is scientific-based and more efficiency.

Not yet. Like I mentioned in the above planning process, including two styles of planning, that makes the different approaches to river management.

In the southern urban regions, the waterway use (e.g., traveling by boat) is a community custom within a long time of history, and Southern cities have derived from riparian areas. People come and form the urban style, and the metropolitan regions expand out to the river basin. Thus, flooding is an uncontrollable phenomenon. The flood damage can reduce and unavoidable.

The form of settlement in the riparian area has constituted the urban form and then spreading out to the surrounding. Hence, the Southern metropolitan regions exist itself the flooding risk or belong to flood-prone areas. The master plan justifications have a role of damage reduction, rather than flood damage control.

Because of the riparian-form of the settlement, many cultural characteristics have been formed and developed. So, the community admitted the riparian features like a unique cultural heritage and demanded to the reservation. The urban planning role in these areas, therefore, addressed the justification rather than form new urban places. The region development ought to be reassessed to answer the questions of how to develop these cities in light of sustainable development and other environmental inquiry. Then, building the range of flood risk management policy to cope with existing flood damage is a must and applies appropriate measures into the developing areas to slow down the flooding consequences (e.g., multifunctional park, storage reservoir, controlling flood stream system).

The urban plan then answers the question of how to improve a specific area to adapt to the flooding situation (justifying the rapid development zone by another form of development and restoring the water space, for instance). The development strategy is so flexible to change the existing flood-prone area into an adaptation strategy to deal with the flooding situation within regions in the manner of a more sustainable way.

3) Expert 3

Land use planning plays a vital role in the urban planning theme. The riparian metropolitan regions have their characteristics. Thus land use planning narrows down the scale of work by pointing out the functional areas compared with other urban areas. The land-use planning defines the civic functions and applies appropriate designs (e.g., non-structure measures utilization or urban sensitive design school – urban design adapted to flood risk management). These steps are necessary, especially under the negative impact of climate change. Therefore, land-use planning could identify the public risk and possibly assess the non-structural measure applications into urban areas or integrate the non-structural tools into engineering measures. This approach is not the new concept in the European metropolitan areas and proved within development periods.

4) Expert 4

The land-use planning entirely is a substantially important measure with many potential applications; however, the current approach of Vietnam land use planning has many controversial issues. The planned use plan had been expected and applied regardless of essential factors. The land-use plan has been processed and designed with a geographical viewpoint. The method is not merely getting involved in technical matters; also regarding political will as well. In some cases, the political expectation dominated. In other countries, the land-use concept has been suggested by experts or by commission via transparently formal procedure; and the legal framework supports this process. Therefore, the planning process set and respected by the involved stakeholders.

I have worked as a representative for the private investor, and then, I realized many inappropriate policies from the local authority (too nonsense policy). As a result, the output of management, in this case, is the combination of professional competence and transparent process.

5) Expert 5

(...)

6) Expert 6

Land use planning, in my viewpoint, the contemporary land-use planning had many matters when I had opportunities of observation in many presentations. In the current, the suggestion issued in the urban areas (e.g., high-rise buildings in plot A and terrace houses in plot B) and planners try to draw a beautiful picture, then that is all the plans. Urban planning must consider the involving factors within the planning process (e.g., natural resources), and this means what resources are based on serving the economic development. Resources include natural and human being forces, and then the other development directions (e.g., transportation system, the scale of commercial districts, industrial factories) would be planned from these resources. The current plans have been followed by personal desire and submit to Prime Minister's approval. If planning processed embedded in this viewpoint, the outcome would not be formed such high density in the urban center, in reality.

On the low or high topography, in my opinion, that we should not distinguish two types of urban terrain. Even the definitions of lowland, inundation, high-level areas are the unclear terms because, for instance, the Netherlands with low topography (approximately 6 meters under sea level) still controlled the civil inundation matters. Thus, the point is how robust infrastructure system in the metropolitan area; or capacity of drainage in inner-city and catchment basin within the region. As usual, the concreted surface is planned, without consideration of the underground water interaction.

The most wrongly measure in current is floor raising activity within the inner city., House sorely decides floor elevated to prevent the inundation; then the next-to house must follow in dealing with urban flooding. As a result, the house floor is a higher road level, and this makes blocking transportation. The road level shall be raised afterward (by local government, possibly), and the loop is going on. The inundation moved from one to another place.

Another point considered in the planning process is urban land-subsidence. In Ho Chi Minh City, land subsidence is about 4cm each year. However, the situation depends on locations; some places have been observed over 7 cm annually. Within the city, in Ninh Kieu urban district is about 4.5 cm/yr-1 instead the surrounding areas reported from 1 to 2 cm annually. However, how many centimeters for ten years of land-subsidence? And that is 40 cm. That the inundation planning, as usual, would be implemented within ten years with missing the land subsidence factor is obsolete, and as a result, the situation is remaining.

On the viewpoint of ground floor elevated matter, when the reasons for inundation identified, then the solutions were found out. In the case of inundation sources are from tidal and stormwater, the dike system would be more consolidated. The necessary is the catchment

must be cleaned up and pumped afterward. The watershed should be prepared well for the whole time readiness. If so, this strategy will be efficient, and when the land-subsidence happens, this problem resolved. Nevertheless, only the drainage system is invested and maintained. Therefore, the more land subsidence, the more inundation situation within the inner city.

7) Expert 7

Although I have less opportunity for deeply investigating land-use planning, however, in many cases, I acknowledge that land use is a fundamental issue. On the vulnerable or sensitive areas with natural disasters (e.g., flooding), the land use planning plays a more critical role. Because following the land use planning is including preventive and protection measures; thus, land use planning is a more substantial issue.

On land-use planning, we acknowledge the vulnerable areas or the flooding regions, with the perception of temporary inundation or permanent flooding and developing area as well. The central theme of the plan concept must transfer the relationship between the expanded region and the temporary flood or stable regions and identified the role of specific areas in the central idea of common spatial distribution. This theme is critical, especially in the city with low topography. The planning in years ago had no consideration with a natural disaster because of poor expectation; therefore, if a natural disaster embedded in the spatial plan, there was no one or organization issued such current land use planning.

The transformation from disaster control to adaptation is a central theme of planning, and this perception coming from disaster impact recognition. Although the role of land use planning within every specific planning issue had to be more investigated, the purpose of land use planning in spatial distribution is transparent and essential.

8) Expert 8

Land Use Planning indeed is an important measure. For instance, we need to point out green space ratio, space for water discharge, etc. There are two viewpoints for this issue: the general land use planning issued by the Ministry of Natural Resources and Environment (MoNRE), and the Ministry of construction runs the construction plans. In shorts, we could classify the planning system by socio-economic development plans (by Ministry of Planning and Investment) on top, then coming land use planning (by MoNRE) in the middle and Construction plans (by Ministry of Construction) are the detailed plans for local implementation. The land use and the construction plans connected and how to track the construction plan implementation regarding following the land use planning is one of the substantial issues.

And the current weakness of the planning process is the lack of assessment phase — the general land use planning based on the detailed assessment such as environmental assessment. You cannot suggest a plan and then conclude that the plan is a good choice, without any evaluations or reliable references. The plans' outcomes must be assessed on the environmental or flood risk factors; however, the assessment often ignored. Even if the assessment initiative would be approved, no agency that has the legal competence to implement in the evaluation. Or, the approved plans performed on the wrong methods, thus the expected objectives might be steered to the other sides.

9) Expert 9

Distinguishing land use planning and urban planning is essential. Land use planning is the first step to identify urban land, and urban planners then organize the civic activities and necessary infrastructure (residential dwellings, commercial places, transportation, etc.) in such urban land. Then, land use planning points out the urban areas where are suitable for housing and other activity infrastructure without consideration of land fertility. Urban land, in this case, serves for residential dwelling and industrial purposes — the area with rich fertility

reserves for agricultural activities. Therefore, land use planning, like the above question's mention, is the open space ratio within the urban area.

In Vietnam now, the investors cannot use the whole land for building activity; and the government regulates the allowed building area occupied from 40% to 60% of the land. The open space ratio, in this case, is from 60% to 40% square of land — these public areas preserved for urban landscape and infiltration surface. Urban land-use planning, thus, is an important task, with the role of urban drainage. For instance, Ho Chi Minh City was planned for one million inhabitants and located on the high topography; then, the city has been expanded out to the Southern area where taken the drainage role for the city. The Southern place is a low terrain area, with an intricate canal system and silt deposition. Therefore, city expansion makes the downstream blocking. In the new urban area in Southern, the inundation caused by tidal water and land subsidence is forming. The apparent consequence for the old part of the city is flooding (flood caused by insufficient drainage system blocking). These problems claimed to inappropriate urban land use planning.

Land use planning, in my viewpoint, is hard to be the primary tool for reducing flood damages in Vietnam. Land use planning is just a fundamental base, which identifies the urban area, and the urban land use planning keeps the leading role on flood damage prevention, with the long-term visions considering the inherent risk for the next many years. Phu My Hung new urban area approximately 750 ha, for example, is the new metropolitan area has been developed in the Ho Chi Minh City Southern areas (the expanding part of Ho Chi Minh City). Phu My Hung new metropolitan area, with the vision of preventing natural hazards, has been setting the standard level of building activity is 2.45 meters while the ground level for the whole area is about 1.00 meter. Soil would be excavated on designated areas to fill residential land aiming to elevate the ground up to 2.45 meters. In this case, urban land use planning claimed as efficiency measures that integrated flood risk management into the planning process.

10) Expert 10

In developed countries, the long-term vision plans have been applied, with a hundred years of vision on setting objectives. In Vietnam, the land use planning and urban spatial planning possess dynamic characteristics and then legalized on the legal framework. The plans, which conforming regulation, must be revised for five years, and thereby, the adjustment approved then. Therefore, the planning process depended on the political terms and rapid development within large urban areas (e.g., Ho Chi Minh City and other megacities). For instance, Ho Chi Minh City is on the quick development period and fast speed of urbanization, thus the urban physical changes and public investment budget demand for development are observable. The situation requires the trade-off on public investment goals and investors' objectives. For example, the public infrastructure exchanges to commercial land to the public investors, thus the land use plan, in this case, is changed.

The plans and following policies are always ready to implement, but there are many matters required to revise and amendment. The Ho Chi Minh City Southern area, the place with natural drainage function, has been filled with residential areas and still going on urbanization.

The development potential now is going on in the Southern (e.g., Phu My Hung new urban area and Nha Be district) and Eastern directions (e.g., Thu Duc district). Therefore, the suggestion of land-use planning that employed as main instruments to the flood risk management issue should reconsider. It is hard to compare the Vietnam planning system with the other planning systems that have long-term vision objectives and good implementation staff. The planning objectives must be maintained for decades, while Vietnam's rapid development situation induces the plan to revise for every five years to keep track of urbanization pace. Ho Chi Minh City government is hard to plan very long-term development while the current efforts are focusing on fixing the fast urbanization consequences such as flooding or traffic jam, for instance. On the urban flooding issues, the design, build, and

system maintaining works implemented in the district levels without cross-reference in the project execution phase. Thus, urban flooding is difficult to improve with such cooperation.

There is pilot research of climate change adaptation conducted by Ho Chi Minh City Department of Natural Resources and Environment. The study site is District 4, known as the riparian area. The climate change analyzed, and the buffer zones concluded as the inappropriate areas, with recommendations of advanced control and banned areas as well as non-structural measures (e.g., water reservoirs, parks, green space, etc.). The research recommended adequate non-structural measures; however, the suggested rules may not be applied and impossible implementation in current situations.

In my viewpoint, the local authority vision on contemporary climate issues dominated by short-term objectives (5 or 10 years of view) rather than the long-term consequences causing by climate issues (e.g., clean water scare, adaptation with sea-level rise, etc.). Sum up, the expert or technical views cannot be received instant responses from the authority because of the view gap amongst these sides; thus, the decision-makers' actions often based on the current situations without consideration of expert's recommendations.

On the land-use planning as the non-structural measures, the land use plans should maintain with the firm stance of long-term vision objectives. The adjustment afterward would be applied to the small scale to prevent effectiveness to national premier goals.

Question 4. In the riparian urban areas, what are the roles of river basin management in the flood risk management theme? What are the central policies or execution steps in this field?

1) Expert 1

The flood risk management, which based on the river basin management, has been considered and investigated by the official departments in the Vietnam context. In a small river basin, for instance, Dong Nai river basin, there are two tributaries (La Nga River and Dong Nai River) surrounded by many provinces (Binh Duong, Long An, Ho Chi Minh City, Lam Dong, and Dak Nong Provinces, etc.,) and the Dong Nai river basin commission has been set, with the "changing role annually" regime. However, from the formal setting up, the achievement of the commission is less, and there were no signed agreements because of the "conflict of interest" amongst parties for more ten years. That is the small example of the institutional ability affecting flood risk management in the river basin scale in Vietnam in general.

2) Expert 2

(...)

3) Expert 3

Water resource management is an existing concept in Vietnam for over a recent decade; however, this theme concentrating on specific urban use (e.g., urban agriculture, water supply). For example, the Dong Nai river basin includes around 12 provincial territories and the basin management developed with a sufficient legal framework. Dong Nai river basin is one within three river basins that formed with river basin management boards and supported by the legal framework. However, output efficiency needs more assessment. Once, I attended the manual Dong Nai river basin meeting; then I realized that the authority approaches the water resource management instead of developing towards reducing flood risk for the along-river-urban areas. In the case of Mekong River, which spreading over thirteen cities and provinces of the Mekong Delta, the integrated management policy is almost not taken into account. In other words, there is no or insufficient approached (e.g., programs, an appropriate system for urban development, or a long-term strategy for flood risk management) for the river basin management towards flood risk management within the Mekong River basin.

4) Expert 4

As far as I concerned, the basin management in Vietnam operated and reported as quite good management. There were the appropriate management policies issued and executed; however, the regulation should be more specific.

5) Expert 5

The current approach to flood risk management is trans-boundary river basin management. For instance, The Dong Nai River Commission is responsible for the Ho Chi Minh City area, and the Mekong River Commission is the primary organization addressing the flood risk theme for the whole Mekong river basin in general and Can Tho City in particular. I have little information about these organization activities; however, the current approach is a river basin management.

6) Expert 6

The river basin management for the Mekong river delta took into account a long time ago. However, the implementation of this issue requires institutional and financial support. For instance, the trans-regional management must be charged by the regional administration

within the whole delta region. However, this administration unit does not exist in the Mekong Delta. Also, the scare of financial resources makes this river basin approach impossible.

In the same matter, the lessons could be good advice from the Netherlands' practices. The grand project includes sub-projects, and financial sources support to every single project. The government assigns the general responsive authority to implement this grand project independently and has a responsibility to the Parliament. This action could be a good effect of approaching the trans-regional river basin management. However, we must wait for the trans-regional administration initial, with the following lacking of financial support. The approach of the grand project, with the detailed content and sanctioned by the Parliament, can assure the project's outcomes. The trans-regional matters recognized, but the government has hesitated for the next stronger actions. The issue is related to institutional conflict, or there is a requirement of the regional institution within the river basin, supported by the state budget. If so, the Vietnam administration changed, and that explained for the pure reason of missing the trans-river basin management within Vietnam.

7) Expert 7

There is an information exchange mechanism within river basins. For instance, Dau Tieng and Tri An reservoirs exchange the operation activity information each other or the operation activities referenced while two reservoirs' operation activated.

In the city's development plans within the river basin, I have read these plans; however, the connection amongst these cities did not mention.

8) Expert 8

The management on the River basin is defined quite evident; however, on the lower river basin, the boundary issues are always complicated. The reasons claimed to the flat topography in combination with the complex tidal regime. I am quite sure to say that is difficult to identify the basin boundary, although there are efforts, for instance in Ho Chi Minh City the Nhieu Loc, Thi Nghe canal systems pointed as a drainage basin (and Tan Hoa Lo Gom or Tham Luong Ben Cat basins, etc.).

In theory, the river basin boundary identified, but this issue considered natural and human-made (regarding house level elevating activity in the urban area, etc.) limits. Also, the unclear situation between river basin and administration management boundaries makes the river basin challenging to approach, extraordinarily involved with areas or regions shared common border). For instance, the situation of Ba Bo stream basin could illustrate the complexity of the trans-boundary issue. The stream starts from Binh Duong province and flows into Ho Chi Minh City, as the downstream area. The impacts of stream activities considered within many meetings and negotiations between administration authorities. Some conclusions declared with the responsibility of two parties. However, some issues were being still (flooding, pollution issues, etc.)

9) Expert 9

In the current, urban land use planning authority has no attention to the river basin approach because mainly, the river basin or drainage catchment is challenging to identify in real while river catchment is observable on the mountainous regions. The primary goal is now no inundation on the urban street system. The catchment management is on the consideration of water quality management rather than flood impact deduction.

On the authority's attention recently is not river basin management on flood risk issues; however, that is the river bank landslide. Local dwellers encroached on river fringe space and erected houses along the river fringe. Therefore, the main concentration now is the river bank and pollution issues instead of the flood impacts in the river catchment effect dwellers shortly.

10) Expert 10

(…)

Question 5. In riparian areas, what are the contributions of trans-regional or trans-boundary flood risk management policies? What is the legal framework in current Vietnam circumstances in the trans-regional or trans-boundary areas to manage water resources in general and to reduce flood risk damage in detail?

1) Expert 1

For the larger scale of river basin such as the Mekong river basin, the flood or drought happened in the Mekong delta causing by the unpredictable damage from the upstream countries (including China). The role of the Mekong River Commission is limited and mainly focused on consulting. The Mekong River Commission's activities have been evaluated as a less and limited role in reconciling the arising conflicts amongst involving parties. The countries within the basin keep going on "the best developing strategy." Therefore, the matter of River basin management is, in my opinion, a rare successful case within a couple of groups. The Rhine river commission, for instance, could be observed as a successful practice because of some actual reasons. The concession has been made among parties because of the conflict of interest negotiated. The water quantity matter decided by the official German and the Netherland authorities; however, the issue could be difficult within the Mekong river basin between Vietnam and Laos's government. The reason for that problem claimed into the concept of water's value, and water just can be traded between the two countries. Or, the negotiation made with the economic interest. The river basin management is possibly successful as if the agreements based on the economic stance.

2) Expert 2

In my opinion, that is necessary to manage flood damage in the manner of trans-boundary or trans-regional flood risk management, because this approach of management addressed the water resource management within an area of many regions or nations. About the Mekong river basin scale, there was a policy framework of resource exploitation consensus within member nations. This policy framework is the endeavor of the expectation of reducing downstream damage. However, the water resource management addressed many economic and political themes within the member states; and thus, it is hard to harmonize the multilateral interest. In the case of Vietnam, the last country of the Mekong River Basin created a dangerous threat whenever action from upstream countries is taking place (e.g., discharging from floodgates, hydropower activities).

3) Expert 3

Within four countries in the Lower Mekong region (Vietnam, Thailand, Cambodia, and Laos PDR), there has the Mekong River Commission, with many active activities. However, the Mekong River Commission approached the water resource sharing and management within the member states. It is said that the Mekong River Commission roles are so limited. For instance, the recent workshop conducted in Can Tho City, the risk of the Mekong Delta water scarcity, or the climate change effects in the Mekong River, also with the development of cascade of dams within the Chinese upper Mekong region presented. Therefore, the Mekong River Commission's main missions only get involved in academic research and assessment and the Mekong River Commission's (e.g., biodiversity assessment within Mekong delta and along the river communities), and as a matter of fact, the Mekong River Commission's achievements have not integrated into Member States' legal framework. The call for the prevailing legal framework is always on the authority meeting, but the most strong appeal for the context is still from the lower Mekong countries (e.g., Vietnam); the other Member states (Laos PCR or Cambodia, etc.) feedback the adverse effect ignorantly. So, the contribution of the Mekong River Commission on the trans-boundary issues is not clear, and the adverse effect of climate change is the most popular reason which claimed to the catastrophic flood events.

In the stance of Mekong river Member states, although China and Myanmar are not the Member states, they still take roles in the Mekong River Commission as the observers. The main conflicts within the member states could not be resources sharing or utilization, and these issues get involved in Geo-political matters, with the purpose of dominant resource use to get the advance of political negotiation. Or within the commission's members, the issues look getting involved in socio-economic issues, but these issues are related to political issues.

It is necessary to follow up on the Mekong River Commission issue and activities; however, Vietnam should have its strategy to adapt to the political problems of the Mekong River Commission. Because Vietnam cannot request the legal changes from the other Member states and that's not easy to reach the familiar voice within members' interests as well as resource sharing, therefore it is urgent for the Vietnamese adaptation corridor on the Mekong river issues instead of waiting for the Mekong River Commission official declarations. It is difficult to achieve the multilateral consensus; Vietnam strategy ought to set the adaptation strategy for every issue (water scarcity, water use, agricultural problems, etc.), and within the adaptation reply, there is an opportunity to non-structural measure applications. Like the Netherland, the lower Member state of the Rhine and Meuse rivers, the country has its development strategy to adapt to hard situations of the lower river basin.

On the European scale, there was the institutionally legal framework on the water issue and the culture of interest respect within the Member states. The Mekong River Commission could follow the European approach for Mekong river issues and issue the flood risk management in particular as well as the water resource management in general. In the case of the Mekong River issues were being a restrictive policy within the Member states, the situation indeed will be gradually improved in this river basin region.

4) Expert 4

It considered a trans-region cooperation mechanism in Vietnam, and the legal framework had supported this activity. The cooperation based on the awareness of interest sharing and common objections. On the legal framework, it seems sufficient and supports construction investment more than being towards collaboration. On the transnational cooperation in the Mekong river basin, there was the signed agreement on the dam building and operation, and the Vietnam government approved and officially affected by this agreement. That could be the mistake, especially with the last country in the basin-like Vietnam. On the basic, trans-national cooperation is a difficult theme because of the unavailable effectiveness and punishment on violation commitment within the member states. Thus, every country has followed her policy, although the other state's objection. I think that could be a tough scenario in this basin region.

5) Expert 5

About the legal framework of the Mekong River Commission, on a theory, I think it could work, possibly. On the Mekong River Commission activity, there is the Mekong agreement (the agreement on Cooperation for Sustainable Development of the Mekong River Basin on 5th April 1995) amongst member nations (Cambodia, Laos PDR, Thailand, and Vietnam) however I think this river basin approach of Mekong areas is difficult to be a success.

Member states within the area have been pursuing their main interest rather than River Basin common interest, with the dominance of core national interest in this river basin. It is hard to implement the policy that decreases Laos' profit in the basin, for instance, because of Vietnam's interest. Laos' government could not accept to sacrifice the national advantage for many reasons because of a national decision based on the political advocate. The most restrictive policies within the legal framework addressed environmental protection, and it means that the environmental issues make the international legal framework. Every country along the river have resource demand. Thus the argument amongst parties is always dominated by resource utilization within a member state's boundary. Therefore, the

expectation of the outcomes of the Rhine river practice case is not convinced, with the current situation of the Mekong River Commission. I press that every nation has its strategy to pursue the core interest in the river basin; as a matter of fact, the Laos PDR government set up a group of Hydropower, and no other downstream countries can intervene and require the discussion as well. There is no biding policy for this conflict in the real River Basin circumstance.

Therefore, that pursuing the autonomous capacity should the best national policy within every member state now. This capacity implies the properly necessary actions to answer the hard situation (e.g., actively water resources, adaptation in flooding and drought events); that is the sustainable reaction on the national scale. The downstream countries have a protesting issue on the upstream country's actions, and that is the proper right that the country affects another and possibly delays the damage from the harmful activities. In the case of the Rhine River, the downstream countries include many countries shared the same national situation, geopolitical characteristics, etc.; therefore, this is difficult to speak the correlation between two river basins.

6) Expert 6

In the Mekong River Basin (or trans-national level) and on the official representative by the Mekong River Commission, there were two agreements have been signed. The first is in 1957, and this is a formal agreement, with the consensus within the Member States for the Mekong river involved actions (e.g., the Can Tho Bridge project required the approval of the Mekong River Basin member states). The latter is the substitute of the first agreement and approved in 1995. This recent agreement was signed by four Member states instead of six members for the whole basin (China had not recognized the Mekong River Basin at that time, and Myanmar was in the political crisis), and this agreement issued with no international legal binding. Lately, there are many protests from the Thailand Member state because of the inefficient role of the Mekong River Commission. For more instances, Laos PDR implemented a cascade of Dams, and this action directly affected on the Vietnam Mekong Delta. The problem raised the protest from Vietnam government; however, on the 1995 agreement, the Laos government has a responsibility to inform the Dam project to Vietnam. The latter deal is worse than the first one on the international legal binding aspect.

It is concerned with the Vietnam staff in the Mekong River Commission, many matters that should be revised on the organization's activities. Due to Organizational structure, there are few Mekong delta experts in the Mekong River Commission's Vietnam staff, although the primary role of the Mekong River Commission Vietnam office is serving Mekong Delta communities. I have advised moving the office back to Ho Chi Minh City because, in current, the Mekong River Commission office located in Hanoi. In the official meeting, the province's presidents have invited in spite of the Mekong delta experts or community representatives, etc. As a result, all the office's goals and objectives would be approved without the rejections from the Mekong Delta stakeholders. Moreover, that is the Mekong delta future rather than the Mekong River Commission's activities, that's why the inefficient management raised.

7) Expert 7

In the larger scale of the river basin, for instance, the Mekong River Basin, the Mekong River Basin agreement, which approved in 1995 the trans-boundary issues have been mentioned the consideration, however, to the trans-boundary cooperation is weak. All the involved nations agreed on some river mainstream management principles; however, the attention to river basin management is rare. As a result, it is difficult to solve the problems in case of rule violation (e.g., the common term violation is on the Member States) because no punishment applied with every Member state for the rule violation committed in her private land.

8) Expert 8

In the Mekong River Basin, there is The Mekong River Commission includes four Member States. The organization does not include all countries within the Mekong River Basin that participated in the Mekong River Commission. Some other upper countries kept the observation stance and refused to join the Commission. However, the role of the Mekong River Commission is still on sharing information because the Mekong River Commission can access trans-boundary gauge station data within the basin. In my viewpoint, data sharing is the standard issue, and this is not significantly more than the hydropower reservoir discharging problem.

Within the Mekong River basin, there is no legal regulation or guidance on the Hydropower reservoir operations on the flood prevention theme. In Vietnam, the framework on this issue revised and approved (e.g., the legal framework on reservoir operation is available on the Dong Nai river catchment or on the Vietnam Central catchments to prevent flood risk). Indeed, it is a gap in legal regulation in the hydropower plant operation on the flood prevention theme. For instance, Vietnam has no information about the Chinese hydropower dams, and there is no communication channel on this issue because China is not the Mekong River Commission Member State. Vietnamese authority based on the gauge station system to produce the early alarm date to manage the trans-boundary flooding situation in the current. This way serves the active reaction and proper preparation for the trans-national flood risk.

9) Expert 9

That is a big challenge for The Mekong River Commission. On the legal framework or institutional corridor of the lower river basin protection, there is no sufficient agreement from the State members. The trans-national flooding issue has not ever been resolved thoroughly in the Mekong river basin regions, and now, on the facing of drought caused by the upstream hydropower dams the lower Mekong region is on, the more difficult situation. In the Mekong Delta, for instance, the ecosystem has changed dramatically. In the flooding season, the Mekong Delta has been received silt and sand deposition annually, but the decreasing of floodwater quantity in recent years worsens the salinization for the whole Mekong delta regions. The saltwater intrusion would change the Mekong Delta ecosystem seriously.

The legal framework based on the multilateral negotiation amongst the Mekong river basin member states to keep the balance of the national interest; however, the consultation is still going on. There was a Catch Mekong run by DLR (The German Aerospace Centre) with the effort to assess the changes to Mekong Delta caused by the alternation of upstream development regime (on land use, hydropower dams, sand mine activities, etc.).

10) Expert 10

(…)

Question 6. What are the roles of land use planning in the flood risk management theme focusing on riparian urban areas?

1) Expert 1

(…)

2) Expert 2

The trend of land use planning employing as a non-structural measure is, in my opinion, is the right approach in developed countries; and this does not mean that approach could not be applied in developing countries like Vietnam. However, in the case of Vietnam, financial resources always are the biggest challenge for every project that getting involved in flooding risk management, especially the project applying the long-term vision like non-structural measures. The other countries, with the massive budget for sustainable development and public investment, can run the non-structural projects easier than Vietnam, where the financial resource is always scared.

The priority projects are economic-interest-based programs. These economic-based projects considered with environmental protection factors; however, the priority decisions still favor the economic aspects. Or, the priority of development is on the financial element more than other considerations (sustainable development, environmental-interest objections). For example, in Ho Chi Minh City, industrial and service sectors contribute from 90 to 99 percent of annual city income (GDP) and takes approximately 10 to 11 percent (even 4%) urban land using, while agricultural sector taking over 65% of land use is just provide 1% of the city's GDP. So, the Vietnam land use planning situation basing on the inappropriate land use of industrial, service, and agricultural sectors revised. The agricultural land includes lake, stream, storage areas, etc., and cultivation land takes 65% agriculture land, and the economic factor of cultivation land should be considered, with the tourism and service factors increasing financial interest. For example, the cultivation land could be exploited in combination with tourism or eco-tourism; however, the land use plan claims single using purpose cultivation. Therefore, economic benefit as a traditional definition (cultivated land use and the farming product brings economic benefits) from land-use planning (earning 1% GDP annually) keeps the situation standstill: bright, the cultivation land considered with another approach by combining the other land functions (tourism, for instance) to decrease the economic benefit and sustainable development.

3) Expert 3

(…)

4) Expert 4

(…)

5) Expert 5

On the land-use planning issue addressing flood risk management, as far as my concern, there are many projects have been implemented, such as the Mekong delta irrigation system planning or planning on the riparian area near Saigon River (on Binh Duong of the province). In general, most of the urban planning addressed the flood risk management factors in the detailed plans.

6) Expert 6

There is a natural disaster risk management strategy applied for the whole country, and a part of the plan concerned to Mekong Delta. In other words, many single projects that have been implemented within the Mekong Delta focusing on natural disaster risk management; however, these scattered and missing inter-connected. Compared with the Netherlands' whole project-implementation model, these single projects could not protect the

Mekong Delta away from flood risk. In my opinion, that is the model that suitable applied to Can Tho City.

For instance, the projects implemented in An Giang Province could harm or increase the flood risk in Can Tho City. That is a real phenomenon, and that is why the trans-regional cooperation raised recently. The single plan applied in a specific place without considering the other areas' impacts now is a potential trend within the Mekong Delta. However, the urgent demand is the whole region scale approach, with the appropriate assessment and evaluation.

The environment impacts should be careful consideration of the outcome, whether good or reverse impacts. The plan's expectations are useful in this place but may harm the other regions. For instance, a group of dikes of Ba Lai - Lang Then - Tra Su implemented to protect communities; the Lang Then dike utilized to prevent the soil salinity, but this action blocked the river water running into the East Sea. In summary, the trans-regional cooperation concept and policy considered by the government, but the effects of this policy limited because of the weakness in implementation and management, as well as the disconnected project situation.

In the rapid development area like Ninh Kieu Urban district, there is an irrigation project O Mon-Xa No (spreading approximately 45000 Ha), with many sub-projects including dikes, dams, causeways, and roads, etc. These measures have not yet operated. However, the first benefit observed is the excellent transport of agricultural products meets the community expectation. The flood prevention effect has not yet evaluated. I mean that achieving to main objectives is not clear, but the side-effects can be observable. Also, the amount of water from upstream has been decreased lately (because of the Cascade of dams from China, e.g.); therefore, the efficiency of the project revised. There is another project sponsored by WB for the city dike system to prevent the tidal water, including Ninh Kieu, Binh Thuy, Cai Rang Districts. Because of the urban flood in Can Tho City caused by the tidal reason, the dike system applies like an appropriate measure.

7) Expert 7

Most of the large cities in Vietnam planned for urban flood prevention, Embedded with land use plans. In this part, the land functions have been assigned, within details the drainage system, dam or dike or pump stations, etc. We can count on Can Tho, Vinh Long, or My Tho cities (My Tho city could be on the preparation process) and regularly adjusting to adapt to the real situation. Most cities implemented these plans. With the developed long-time town, there was a surrounding dike system for flooding prevention, and then pump stations have a task discharging stormwater into River mainstream, to guarantee the central area dry. The non-structural measures were difficult for applying in the Megacity, such as Ho Chi Minh City; as a matter of fact, the city is now densely compacted with engineering structures and have no space for the other applications. Ho Chi Minh City plays a crucial role in economic development, and that causes the domination of physical structures in Ho Chi Minh City as the protection. The other solutions were considered however in my observation, non-structural application in Ho Chi Minh City is very few. If the other factors counted in the urban planning process at the beginning of urban planning, the city would be so different now. In this case, non-structural measures implemented in the new urban places where physical structures had less existing. In an area with dense development as well as rapid structural measures, the non-structural tool is just in flood early warning, etc.

8) Expert 8

The land-use plan, as I mentioned in the above viewpoint, is not an appropriate approach to flood risk management. Precisely, In Vietnam, the Urban Construction General plans to take a role in flooding issues. However, the main problems are coming from the plan implementation. In other words, the implementing capacity of plans should be the critical consideration within the planning process (e.g., the new policy demands 30% vacant land for

green space is difficult to attract new investors. Thus, the idea could be failed in the implementation because of scare financial support).

Therefore, the plan without considerations from many viewpoints limits the possible implementation ability. Also, without assessments could add the plan more troublesome. The project without the evaluation (or inappropriate assessment procedure or producing low reliability) concluded as a fail plan. For instance, the project developed new infrastructure in the floodplain area may pay more for the protective measures to ensure the safety of that developed infrastructure.

As I said, the plan without appropriate assessments gave us wrong information and fundamental understanding to set the land use plan outcomes. For example, the development's direction heading to the sea may take risks, with the high awareness of sea-level rise. However, the investors were attracted to these areas because of the upper housing demand. The local government keeps the top recommendation of these risk regions, but the investors, as well as the customers all, accepted the flood risk. Therefore, in this situation, the local authority has no actions because of missing a precise assessment. There are no wrong or right sides to this situation because the land has potential development, and there is a risk acceptance from the stakeholders. On the other side of thought, if every building assessed the flood risk resistance, the circumstance is simpler to understand. Planning is not proper because of missing the appropriate assessment.

9) Expert 9

Land use planning plays an essential role in many urban management issues, including flood risk management. However, there is a gap between the long-term vision objectives and the plan implementation to keep up these set goals. Via adjustments on detailed planning for every five years caused by the previous plans had no considerations to climate factors or concentration on socio-economy changes; the general ideas could be torn down by changing the long-term setting goals.

This plan adjustment leads to more impacts than flexible adaptation to real circumstances. Thereby, the detailed plan demands the changes and modifications from the general plan while a comprehensive plan is then implemented phase and based on the general plan. Therefore, land use planning as a general plan is hard to keep the leading role within the urban development in the situation of Vietnam.

For example, in the general plan, there is 100 ha assigned as a private function in a particular area within Ho Chi Minh City's districts. However, the decision-maker (in the five years of the political term) expects more development in the pointed area to increase economic growth and local budget. Thereby, the local leader urged on demand to the higher responsible authority for changing land use. Therefore, in people's expectations, the land use planning could take a prominent role; but in reality, the plan implementation often breaks the approved general plan and then, changing the previous plan's set objectives.

10) Expert 10

(…)