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Title: The Influence of Institutions on Coordination among the actors involved in Flood Management: A Case of Chennai

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Summary

Flooding is considered one of the most extreme and significant natural disasters that threaten the world's cities. Especially, the urban flooding is threatening and a serious concern for both developed and developing countries. The impact of urban flooding has caused serious damage to properties, utilities, housing assets, interruptions in transportation, losses in industries, trade and whipping out employment. In November 2015, a sudden depression on the Bay of Bengal intensified into a cyclone and resulted in heavy and excessive rainfall in several parts of Tamil Nadu and instigated into the flood in Chennai. Although the main reason for the flooding was associated with excessive rainfall, the research undertaken by Arabindoo proved poor governance was the crucial element for flooding. The characteristics of flood management in Chennai are complex, highly fragmented with a large number of stakeholders. Thus, until there is a proper cooperation among the authorities, residents, city managers, and the public, it will be difficult to govern the worsening of flood problems. So, the research aims to understand the how the institutions assembled around flood management in Chennai influences coordination among the actors. In order to explain how aspects of coordination are influenced by the institutions in the context of Chennai flood management, the research has undergone a detailed theoretical analysis of institutions and coordination. From the theoretical analysis, essential concepts were drawn to conceptualize institutions and coordination. This research used the concepts of IAD principle to theoretically connect the concepts of Institutions and coordination. Through the theoretical concepts, the variables and indicators to analytically measure the institutions and coordination were developed. This research is a qualitative study carried out with a case study approach. Using the semi-structured interviews, the researcher gathered empirical data on the phenomenon of the study and the secondary data was utilized to triangulate the information collected through semi-structured interviews.

The findings from the analysis show that the institutions in the flood management are characterized by a diversity of actors with varying strength, size, and power, the formal and the informal rules. On the other hand, the coordination among the actor is characterized by the communications that occur parallelly with few points of intersection, independent planning, executing and controlling and centralized commanding. Further, the institutional factors such as the social capital strength, jurisdictional division, shared responsibility, monitoring framework, the unclear roles and responsibility, distinct mandates, lack of sharing resources, weakness in the regulatory framework, lack of information, rigid bureaucratic hierarchy, and political prioritization positively or negatively influence the coordination among the actors. The main conclusion from the research shows that the institutional factors can obstruct and enable coordination among the actors. Especially, the research has highlighted the importance of the regulatory framework and the elements that are essential in the regulatory framework to structure coordination. It has also stressed the need for political actors to be accountable to the public and committed to enable coordination.

Keywords

Flood Management, Coordination, Institutions, Governance & Management

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Abbreviations

ADB	Asian Development Bank
AE	Assistant Engineer
AEE	Assistant Executive Engineer
AIADMK	All India Anna Dravida Munnetra Kazhagam
ALTM	Airborne Laser Terrain Mapping
AWWARF	American Water Works Association
CAPML	The Conservation Authority of Pallikaranai Marshland
CE	Chief Engineer
CMA	Chennai Metropolitan Development Area
CMDA	Chennai Metropolitan Development Authority
CMWSSB	Chennai Metro Water Supply and Sewerage Board
CoC	Corporation of Chennai
CP	Chief Planner
CRRT	Chennai River Restoration Trust
CRZ	Coastal Regulation Zone
CWR	Center for Water Resources
DC	Deputy Commissioner
DCE	Deputy Chief Engineer
DCR	Development Control Regulations
DDMA	District Disaster Management Authority
DM	Disaster Management
DMK	Dravida Munnetra Kazhagam
DP	Deputy Planner
DPR	Detailed Project Report
DSE	Deputy Superintend Engineer
DST	Department of Science and Technology
DTCP	Directorate of Town and Country Planning
EE	Executive Engineer
FDI	Foreign Direct Investment
FPZ	Flood Plain Zoning
FRGA	Flood Risk Governance Arrangement
FRM	Flood Risk Management

FRMS	Flood Risk Management Strategies
GoI	Government of India
GoTN	Government of Tamil Nadu
H&UD	Housing and Urban Development Department
HTL	High Tide Line
IAD	Institutional Analysis and Development
ICSSR	Indian Council for Social Science Research
IFM	Integrated Flood Management
IHS	Institute for Housing and Urban Development
IRS	Institute of Remote Sensing
JE	Joint Engineer
JICA	Japan International Cooperation Agency
MIDS	Madras Institute of Development Science
MoDWS	Ministry of Drinking Water and Sanitation
MoHA	Ministry of Home Affairs
MoHUA	Ministry of Housing and Urban Affairs
MoWFCC	Ministry of Environment, Forest and Climate Change
MoWR	Ministry of Water Resources
MRTS	Metropolitan Rail Transport Service
MTC	Metropolitan Transport Corporation
PWD	Public Works Department
Reg	Regional
RWH	Rain Water Harvesting
SAP	School of Planning and Architecture
SE	Superintend Engineer
SEZ	Special Economic Zone
SFC	State Finance Commission
SP	Senior Planner
SWARAN	The Save Water and Recharge Aquifers Network
SWDD	Strom Water Drain Department
SWMD	Solid Waste Management Department
TC	Transparent Chennai
TCPO	The Town and Country Planning Organization
TNEB	Tamil Nadu Electric Board

TNHB	Tamil Nadu Housing Board
TNPCB	Tamil Nadu Pollution Control Board
TNSTC	Tamil Nadu State Transport Corporation
TNSUD	Tamil Nadu Sustainable Urban Development
TNUID	Tamil Nadu Urban Infrastructure Development
TNUIFSL	Tamil Nadu Urban Infrastructure Financial service limited
TWAD	Tamil Nadu Water supply and Drainage Board
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
WB	World bank
WRD	Water Resource Department
WRO	Water Resource Organisation

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Chapter 1: Introduction

1.1 Background

Flooding is considered one of the most extreme and significant natural disasters that threaten the world's cities (Jha, Bloch, et al., 2012). The consequences and severity of flooding have increased in recent decades affecting both the urban and rural settlement. Oxford dictionary (1989), defines flood as "An overflow or irruption of a great body of water over land in a built-up area not usually submerged." In general, floods are a combination of both hydrological and metrological events, which result in extreme precipitation and flows (Jha, Bloch, et al., 2012). However, adverse human activities (encroachment on the floodplains, unplanned growth etc.) can also encourage flooding. Globally, often people moving from rural to urban areas settle around areas that are highly exposed to the flooding. A lack of robust protection mechanism can severe the vulnerability against floods. In order to provide a robust defence mechanism, it is critical to understand the different types and causes of the flooding.

Floods are grouped into different categories based on the combination of its sources, causes and impacts. Depending on the combinations floods are categorized into pluvial floods, river floods, groundwater floods, coastal flood and failure of the artificial water system as shown in the Table 1-1 Categories of Flooding. In general, flash floods & urban floods are categorized based on the speed of flooding and its adverse effects on urban areas.

Table 1-1 Categories of Flooding

Types of Flooding	Causes	Human Influence
Urban Floods	Flash, Pluvial, Fluvial, coastal, & Ground water	Inadequate drainage and sewage capacity increase impermeability, poor management
Pluvial and overland flood	Extreme rainfall, Thunderstorms, melting of ice jam, glacial lake burst and landslides	Improper land management, encroachment, urbanization, surface runoff
Coastal (Tsunami, storm surge)	Subsidence, Coastal erosion, Earthquakes	Destruction of natural flora, Development of coastal zones (e.g., mangrove)
Groundwater	High water table level combined with heavy rainfall, Embedded effect	Interference with natural aquifers, Development around low-lying areas;
Flash flood	Caused by combination pluvial, river or coastal floods; thunderstorms	Catastrophic failure, Inadequate drainage capacity

Source: (Jha, Bloch, et al., 2012)

In recent decades, urban flooding is a serious concern for both the developed and developing countries. The impact of urban flooding has caused serious damage to properties, utilities, housing assets, interruptions in transportation, losses in industries, trade and whipping out employment. Urban floods are complex as it is typically a combination of all types of floods. Urban floods are intensified by deficient and improper land use planning (Lavanya, 2012). The existing laws and regulations mandated to prevent floods are frequently not enforced owing to political, economic or capacity or resource constraints. Additionally, with the probable impacts of climate change, there is a trend in growth of urban flooding (Kumar, Kumar harshawardhan, et al., 2017). Therefore, city-managers and decision makers need a holistic understanding of water, land and related resources to accommodate a decision-making process towards flood management.

1.2 Problem Statement

Chennai experiences a large fluvial flood every five to ten years (Jameson and Baud, 2016). In November 2015, a sudden depression on the Bay of Bengal intensified into a cyclone and resulted in heavy and excessive rainfall in several parts of Tamil Nadu and instigated into floods (Narasimhan, Bhallamudi, et al., 2016, Assessment, 2016). Based on the assessment report (2016), Chennai received 1522.7 mm of rain against a normal of 662.6 mm. Damages have been estimated at over US$737 million, with more than 450 deaths in Tamil Nadu. The whole city stumbled with airport shut down, electricity and mobile network cut off and most importantly no food and drinking water to survive.

Although the main reason for the flooding was associated with excessive rainfall, the research undertaken by Arabindoo (2016) proved poor governance was the crucial element for flooding. The controversial decision of the State government to release water from the upper catchment region (Chembarambakkam lake) of Chennai brought a huge influx of water into the city. Secondly, it was observed that urbanization and encroachments on the riverbanks, low-lying areas especially along the Adyar river has worsened the flooding problems (Narasimhan, Bhallamudi, et al., 2016).

A study by Chandan et al. (2014) acknowledged that the total amount of impervious surface has increased by approximately more than 20 times mainly by converting grazing, agricultural and open areas. This reflected in the loss of vegetation cover which drastically decreased from 70.47 % in 1991 to 35.53% in 2013 (Seenirajan, Natarajan, et al., 2017). Additionally, the flat topography of Chennai makes difficult for the flood water to drain quickly.

Apart from flooding, Chennai also faces severe drinking water scarcity problems. It has the lowest per capita availability of drinking water among the large cities in India (Roumeau, Seifelislam, et al., 2015). The primary water authority extracts an extreme amount of water from the non-renewable aquifer to augment the excessive demand for drinking water (Jameson and Baud, 2016). It has led to 80% of groundwater depletion and saltwater intrusion into the water table. Furthermore, the proximity to the Bay of Bengal has made Chennai additionally vulnerable to the rising sea level and tsunami (Kennedy, Varrel, et al., 2014). Therefore, Chennai's relationship with water is peculiar, with swigging cycles of floods, droughts and tsunami making water management more complicated.

In Chennai, flood management is a concern of the state and local government, apart from the coastal zone regulations provided by the National government. The flooding problems are primarily addressed through stormwater drains and not Integrated Flood Management (IFM) (Jameson and Baud, 2016). Since, there is no practice of IFM adopted, mostly each department concerned with flood management work independently without collaboration. The lack of collaboration among different department concerned with flood management have aggravated the problems of flooding tremendously. For instance, the metro rail flyover constructed over the Buckingham canal undermines the flooding regulations mandated by the water authority. Similarly, the stormwater plan prepared does not follow the topographical map prepared by one authority nor connected with the macro-level drainage network maintained by another authority. The above-mentioned problems collectively indicate that the characteristics of water management are complex, highly fragmented with a large number of stakeholders (metro rail, macro drainage, micro drainage, planning authority etc). Unless, there is a proper cooperation among the authorities, residents, city managers, and the public, it will be difficult to govern the worsening of flood problems (Jha, Bloch, et al., 2012).

1.3 Research Objective

The research aims to understand the relationship between the institutions and coordination among the actors and explain how the aspects of coordination are influenced by the institutions in the context of Chennai flood management. Understanding coordination in the water management arena from the institutional perspective enables the researcher to gain insights on the institutional blockages that impede the actor's interactions and stresses the importance of coordination in the flood management.

1.3.1 Main Question

To what extent do the ***institutions*** influence ***co-ordination*** among different actors involved in the course of flood management in Chennai?

1.3.2 Sub-Questions

i. What is meant by institutions (formal and informal rules) in flood management in Chennai?
ii. How does coordination take place among the actors involved in flood management?
iii. Which are the factors that enable or constrain coordination among actors involved in the flood management in Chennai?

1.4 Significance of the Study

Since decades natural science and technical knowledge have contributed and dominated the practice of flood management (Driessen, Hegger, et al., 2016). However, it is essential to recognize that flood management is not only about building a warning system and developing a defence mechanism. It is a process of societal transformation and successful governance of adaptive capacity. According to Hegger et al. (2016), governance and legal framework studies on flood management are scares and limited, especially about the urban flood management. These scares and the limited amount of studies conducted are in different regions of the world and are unique to the context. Shedding lights on the institutions and coordination aspects of flood management will help us understand the where improvements in policies are needed as well as paves the pathway for the decision-makers to realize the importance of participation all the stakeholders in the decision-making process. Progress in the arena would not solve the flooding problems but, it would improve the institutional aspects to enable participation and cooperation from all the stakeholders.

1.5 Scope and Limitation of the Study

The research was limited to a single case. The research was intended to understand flood management in Chennai from a larger perspective. Therefore, different initiatives implemented to address flood management were studied. Though there were several initiatives, the study was concerned only to initiatives such as the provision of micro and macro drainage facility, preparation of Masterplan and RWH (Rain Water Harvesting) due to the limitation of the time. Other initiatives were considered beyond the scope of the research. The study concentrated on analyzing the relationship between institutions and coordination based on the initiatives for flood management. For analyzing the institutional aspect, the research adopted the Institutional Analysis and Development (IAD) framework of Ostrom. However, the researcher excluded the biophysical condition (physical and human resources such as capital, labour, technology, finance, distribution channels) of the IAD framework due to the limited time available. The study considered the only the socio-cultural and institutional aspects of the IAD framework. Further, this study does not deny other factors that will possibly influence the dependent variable in other cases.

Chapter 2: Literature Review / Theory

2.1 Nature of Floods

Flooding is one of the parts of the natural hydrological cycle (Sparks, 1995). It has existed and will continue to exist. This process maintains the balance of water in the air, on the surface and in the ground. Sometimes the cycle gets out of balance, sending an influx of water on the surface more than its capacity. This results in huge socio-economic and ecological losses. Oxford dictionary (1989), defines flooding as "An overflowing or irruption of a great body of water over the land in a built-up area not usually submerged". Flooding occurs most commonly as a result of excessive rainfall, melting ice, or a combination of both that exceeds the carrying capacity of the rivers, lakes, seas, and ocean (APFM, 2009). In some cases, flooding is consequences of both natural and human-made factors. Flooding can be categorized into different categories depending on the combination of sources, causes and impacts (Jha, Bloch, et al., 2012) – Refer to Table 1-1 Categories of Flooding. In general, flash floods & urban floods are characterized based on the speed of flooding and its adverse effect on urban areas.

2.1.1 Flood Risk Management

Flood Risk Management (FRM) is a process of reducing the impacts of flooding (Pettersson, Van Rijswick, et al., 2017). Traditional flood management approaches mainly focused on structural measures to reduce the vulnerability of flooding damages. Modern FRM is contradictory to the traditional flood management approaches. It is considered as a "continuous process that attempts to utilize limited resources of time, social effort, environmental capital and money to deliver multiple benefits" (Sayers, Yuanyuan, et al., 2013). Modern FRM emphasis the paradigm shift from the technical perspective to a risk management approach. To tackle the growing consequences of climate change, modern FRM recognizes the use of a wide range of FRM measures and instruments. These can be drawn upon 'hard' measures such as technical solutions and 'soft' measures such as policy instruments. The fundamental decision in FRM is to choose when to intervene, either before the flood to reduce risk or during the flood to reduce consequences or after the flood to enable recovery quickly.

The FRM is composed of Flood Risk Management Strategies (FRMS) to resolve the problems of flooding. According to Hegger et al., (2014), FRMS can be defined as "the approaches for dealing with flood risks which can be distinguished from one another by their focus on the probability of flooding, its consequences or on recovery after a flood has struck". The FRMS are classified as prevention, defence, mitigation, preparedness, and recovery. Successful implementation of FRM requires systematic governance mechanism that is crucial for alignment of FRMS. Coordination and cooperation among actors, communication, partnership, adaptive management, clear institutional and legal framework are identified as driving factors for FRM (Sayers, Yuanyuan, et al., 2013). Barriers that obstruct FRM includes changes in leadership, changes in priorities, lack of clarity and resources, inadequate capacity for adopting plans.

2.2 Flood Risk Governance Arrangement

The most common definition of governance is defined by the UNDP (1997) "It comprises the mechanisms, processes and the institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences". The term governance is focused on the field of public management and legal fields. Lange et al. (2013), defines governance as "a process of more or less institutionalized interaction between public and private entities ultimately aiming at the realization of collective goals". There are various modes of governance such as "decentralized governance", "public-private governance"

and "interactive governance" (Lange, Driessen, et al., 2013). These modes of governance may range from a 'hierarchical governance' which is mainly under the actions of governmental actor to a 'self-governance' that is carried by the non-governmental actors (Hegger, Green, et al., 2013).

Flood Risk Governance Arrangement (FRGA) is defined as "the constellation resulting from a dynamic interplay between actors and actor coalitions involved in all policy domains relevant for FRM – including water management, spatial planning, and disaster management; their dominant discourses; formal and informal rules of the game; and the power and resource base of the actors involved" (Hegger, Driessen, et al., 2016). This definition for FRGA considers two aspects, firstly, it is concerned with the interdependency in the sectors (Disaster management, spatial planning, and risk management etc.) relevant for FRM. Secondly, it is concerned with the four dimensions (actors, resource, rules, and discourse) of policy-making (Hegger, Green, et al., 2013). FRGA is embedded in actor networks, rules, discourse, resources and multilevel coordination mechanism through which FRM is practiced (Pettersson, Van Rijswick, et al., 2017). Especially, the governance arrangement in metropolitan areas are more complex with a large number of actors, various rules and hence requires better coordination for FRM. Grigg (1998) identifies coordination as a tool for integration of various actors involved in the FRM. Similarly, Lockwood et al. (2010), identified integration as one of the essential principles for natural resource management and represent it as "(a) coordination across different governance levels; (b) coordination across, organizations at the same level of governance; and (c) the alignment of priorities, plans, and activities across governance organizations".

2.3 Coordination

The term 'coordination' is too diverse, and it is a subject of several academic disciplines. Recently, coordination has gained its importance from the contemporary advancement in businesses management. The dictionary meaning for 'coordination' is (1989) "the act of coordinating, making different people or things work together for a goal or effect". The simplest definition of coordination is outlined by Malone and Crowston (1994); "act of managing interdependencies between activities". This definition indicates coordination as a notion of interdependencies among the entities engaged in managing the activities. Therefore, coordination depends upon the entities involved, circumstances and the dynamic environment in which the entities operate. Often good coordination is impossible to perceive, but it is noticed only when there is a problem.

Two-main disciplines that influences coordination are; firstly, organization studies and the computer science (KRÁL). In the organizational studies, coordination is identified at two levels: intra and inter-organizational coordination (Kożuch and Sienkiewicz-Małyjurek, 2016). The former refers to coordination within an organization while the latter refers to coordination between different organizations. Inter-organizational coordination is connected with harmonizing actions of each and every actor to support and render the specific type of service (Kożuch and Sienkiewicz-Małyjurek, 2016). It mainly depends upon organizational and relational conditions that occur among the coordinating entities. According to Gulati et Ranjay (2012), inter-organizational coordination is defined as "the deliberate and orderly alignment or adjustment of partners actions to achieve jointly determined goals". Inter-organizational coordination is stemmed based on legal, organizational, social and situational conditions. The inter-organizational coordinating mechanisms include rules, procedures, routines, liaison, integration roles, partner-specific communication and interim authorities, etc. Because coordination is evolved through a functional and formal bureaucratic organizational setup (Weber, 2006). The strong sense of spokesman/leader also evolves coordination in the

organisation (Mintzberg, 1981). In some cases, coordination evolves as a "result of institutionalized norms, rules and logic of appropriateness" (Sehested and Groth, 2012). The coordinating mechanisms can be divided into formal and informal mechanisms. However, informal mechanisms strengthen the relationship between the collaborating units than the formal mechanisms (Kożuch and Sienkiewicz-Małyjurek, 2016) as it drives based on goodwill, trust, and commitment.

The concept of pluricentric coordination is identified to provide potential insights on networking, harmonizing activities of different actors in a fragmented situation (Sehested and Groth, 2012). Pluricentric coordination is derived from three theoretical contributions. Firstly, the public governance theory contributes to the notion of interdependencies between actors engaged in the process of management. Secondly, the narrative organization theory highlights the concept of storytelling and sense-making to strengthen coordination by gluing the fragmented organizational structures. It considers coordination arising through formalized rules, procedures, plans, schedules and standardized information. Thirdly, the relational planning theory provides temporary fixation through selective inter-connectivity and introducing the relationship of power that affects the coordination. It is developed in opposition to the ideas of planning as governance mean and considers power/resources as an important element for coordination. Pluricentric coordination is formed by combining all the ideologies from the three theories. Policy networks are considered as a forceful instrument for coordination in pluricentric political systems (Sehested and Groth, 2012). The Danish case identifies collaboration among regional actors, common understanding, organizational changes, sectoral cooperation as the driving forces for pluricentric coordination while former hierarchical system, organizational obstacles, inadequate planning competencies and major power struggles as a barrier to pluricentric coordination (Sehested and Groth, 2012).

2.3.1 Motivation for Coordination

From the sociological perspective, it is recognized that human relationships exist due to the advantages associated with the relationship (Corsame and van Ast, 2016). Similarly, it is important to identify the advantages of coordination to ignite the relationship between coordinating agencies. The exchange theory argues relationship among actors occurs when one actor is dependent on the resources of another actor (Hoffmann, Schiele, et al., , 2012). The sharing of resources among the actors involved in the management incentives in minimizing the external and internal transactions costs associated with achieving the goal. According to social capital theory coordination is perceived as aligning social relations among actors for achieving collective benefits (Brosius, Haki, et al., 2016). Therefore, social capital theory interprets coordination as a relational instrument that can foster lateral relationship and socialization among the actors through which exchange of information among the actors occur. The lateral relationship acts as a bridging mechanism to link the dissimilarities among the actors to achieve the collective benefits. Besides everything mentioned above, coordination can be an instrument for mitigating the expected negative effects and for providing legitimacy (Brosius, Haki, et al., 2016). For instance, agency theory perceives coordination as an instrument for conflict resolution that may arise due to the conflicting behavior of an individual during the sharing of common resources. Hence, coordination is used as a control instrument at both the intra and inter-organizational levels.

2.3.2 Coordination in Management

Management is an arena that is essential for any type of business, organization or department etc to succeed. The principles of the management deal with human behavior and broadly act as a blueprint for decision-making in an organization (Godwin, Handsome, et al., 2017). All organizations require management in order to accomplish the goals and objectives effectively

and efficiently through people. Fayol (1916) viewed management as "to forecast, to plan, to organize, to command, to coordinate and to control". Fayol labelled these elements as the process of management or the functions of a manager's job.

i. **Forecast:** The forecasting is recognized as the information transfer or communication process among the organisations required to make the necessary plans and decisions. It is the process through which the exchange of information among actor takes place in order to forecast the unexpected occurrence.
ii. **Plan:** Planning sets the stage for other elements of the manager's job. It is recognized as the firm's plan of actions prepared for envisioning or anticipating the unexpected occurrence that may arise. Though all unexpected occurrence cannot be anticipated, the plan could provide some space for it. Therefore, Fayol stresses on long-term planning with the engagement of all the stakeholders as a unique contribution to management (Godwin, Handsome, et al., 2017).
iii. **Organize:** Organising is identified as a process of providing the actor with all the resources (land, labour, and materials) necessary to function. For instance, it can even refer to human resources management.
iv. **Command:** The commanding is the fourth element and it is known as the process of supervising the management. The process of commanding enables unite and negotiate among multiple actors involved to achieve a common goal.
v. **Coordinate:** Coordination refers to harmonizing all the actions of the actors. Though Fayol (1916) mentions 'coordination' as a separate element of management, he stressed the necessity of coordination in all the elements of management.
vi. **Control:** Controlling is the final element and it refers to verifying whether everything occurs in conformity to the plan adopted. Controlling have an integrative effect on other elements as it aids in stimulating better planning, strengthening the organisation and facilitating coordination.

2.3.3 Contextualizing Coordination in Water Management

Water management inherently requires a high level of interdependencies not only among the water management organization but also among the land, environment, and ecology (Grigg, 1998). The Interdependency is the central issues in achieving the success in the water management. Coordination is all about managing dependencies between activities. The American Water Works Association (AWWARF) uncovers different types of coordination under the concept of Total Water Management as shown in Table 2-1 Effectiveness Ranking of Coordination. Grigg (1998) provides a brief discussion and effectiveness scoring for each type of coordination that represents his judgment on how well the type of coordination would work in the contemporary policy environment. Though there are several types of coordination, Grigg (1998) believes that watersheds and natural water systems, means of water Management, Intergovernmental, Water quality and quantity and Local and Regional concerns coordination requires policy attention and could offer promising improvement in the water management arena. While other types of coordination have more educational value and not really dealing with practical problems of water management. The significance of Grigg (1998) study highlights the local and regional coordination as the most challenging and least developed coordination. It is difficult to make the local water authority to work at the regional level. Often local politics interfere with the regional cooperation and thus the scenario is more complex. However, the study of Grigg (1998) mentions that improvement in the local and regional

coordination requires effective policy. But further research is required to understand where the improvements in the policy are needed

Table 2-1 Effectiveness Ranking of Coordination

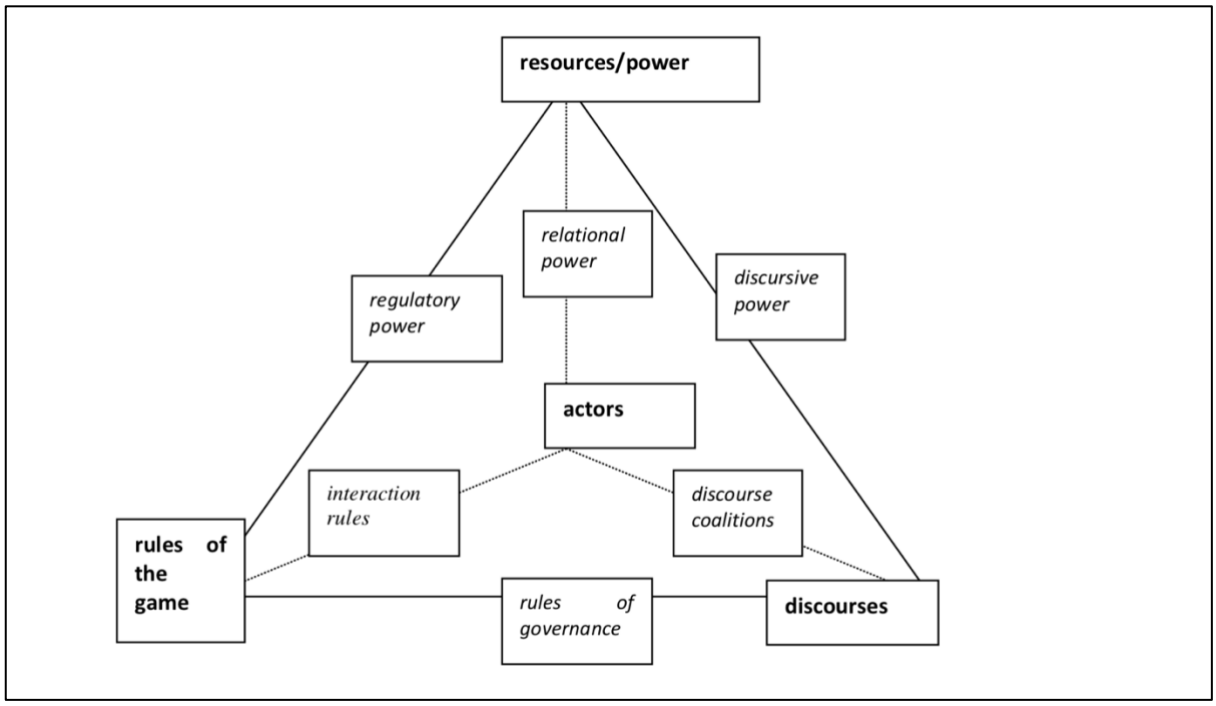
Type of Coordination	Phrase from TWM definition	Discussion	Effectiveness Ranking
Society and environment	The exercise of stewardship of water resources for the greatest good of society and the environment	This statement provides a general organizing framework for balancing. It is adequately understood, but needs more explanation	1
Stakeholder	Requires the participation of all ... stakeholders in decision-making through a process of coordination and conflict resolution	Process is known as stakeholder and public involvement. Good and improving. A central issue of democratic government	2
Watersheds and natural water systems	Encourages planning and management on a natural water systems basis	It is recognized and currently popular that water management on a basin or watershed basis is desirable. Further progress will require more effort	3
Means of water management	Promotes water conservation, reuse, source protection, and supply development	This means to coordinate different ways to meet needs and sustaining the environment. A central planning and engineering issue.	4
Time-wise	Through a dynamic process that adapts to changing conditions	This requires valid planning methods to preserve institutional memory and keep processes on track and requires much improvement	5
Intergovernmental	Requires the participation of all units of government .... in decision-making through a process of coordination and conflict resolution	Intergovernmental coordination is given as separate from stakeholders because of the different kinds of authorities that government has	6
Water quality and quantity	To enhance water quality and quantity	This is handled through water quality law and regulation. Many problems still require solution	7
Local and regional concerns	Taking into consideration local and regional variations	This is a difficult issue requiring intergovernmental cooperation in arenas which lack adequate incentives and often cannot be mandated. It is not working too well	8
Competing uses	Balances competing uses of water through efficient allocation that addresses social values cost effectiveness, and environmental benefits and costs	This is handled through state and federal water law, regulations, court decisions, and other institutions. A very difficult arena.	9

Source: (Grigg, 1998)

2.4 Policy Arrangement

The term ‘policy arrangement’ is defined as a “temporary stabilization of the content and organization of a particular policy domain” (Arts, van Tatenhove, et al., 2000). The policy domain can be described through the concept of policy arrangement (Immink, 2005). The notion of policy arrangement has two important aspects which are, the substance and the organization. The organizational aspect is distinguished into three elements namely; agents (coalitions), responsibilities and resources among the actors, and the rules of the game. Similarly, the substance aspect of policy arrangement is conceptualized as discourse pertaining to solve the problems in terms of policy (Hajer, 1995). The concept of policy arrangement is represented in a tetrahedron as shown in Figure 2-1 Structure of Policy Arrangement.

Figure 2-1 Structure of Policy Arrangement



Source: (Arts, van Tatenhove, et al., 2000, Larrue, Hegger, et al., 2013)

2.4.1 Actor coalition

The first dimension of the policy arrangement is characterized based on the actions of actors that result in the interaction patterns. The coalitions among the actor enable to identify and achieve the collective goals (Arts and Van Tatenhove, 2004). However, during the coalitions, some actors might dominate while some might challenge those. Therefore, the actions of the actor are controlled by the rules of the game.

2.4.2 Resource

The second dimension of the policy arrangement focuses on 'resources' that an actor holds to exercise its power (Arts and Van Tatenhove, 2004). When the actors are linked with the resources, they grasp a 'relational power' (Larrue, Hegger, et al., 2013). Resources are viewed as a 'weapon' when some actor determines the outcome by holding important resources, while it may be viewed as a 'prize' if the actor utilizes in a condition by altering the distribution of resources. In general, unequal distribution of resources in an organizational routine leads to natural and obvious domination (Frouws and Tatenhove, 1993). However, the unequal power relationships that exist among different actors are dynamic with space and time.

2.4.3 Rule of the game:

The third dimension is concerned with the rules of the game. These rules translate into the notion of 'regulatory power' when it is linked with the resources and power (Larrue, Hegger, et al., 2013). Rules determine the interactions among the actor and delineate the boundaries for policy interaction. They are of both 'substantive' and 'organizational' in nature (Anthony Giddens, 1984). It can even be distinguished into formal and informal rules. The former refers to the legal framework and procedures that are identified and authorized in legal texts or documents such as legislation, laws etc.; whereas the latter refers to 'norms and the political culture' that shape the behavior of the actor.

2.4.4 Discourse:

The fourth dimension of policy arrangement refers to the 'discourse' that arise from the substance. The discourse can be defined as "a specific ensemble of ideas, concepts, and categorizations that are reproduced and transformed in a particular set of practices through which meaning is given to physical and social realities" (Hajer, 1995, Larrue, Hegger, et al., 2013). For example, sustainability discourse brings together the notion of economic, ecological and social integration and transforms these ideas into real-time practices through projects, policies, and rules. Although the term sustainability is no more than catchword, it emphasizes the need for the policy, projects and other relevant practices to structure based on its notions.

2.5 Institutions and Institutional Analysis and Development Framework (IAD)

The term 'institutions' generally is utilized to refer to organizations or entities (van Es, 2017). It is widespread in social science and several definitions exist among the academic disciplines. However, there is no unanimity in the concept of Institutions (Hodgson, 2007). Scientific literature offers countless definitions for the term institutions. Some of the relevant definitions for this research are,

- Hodgson (2007) "defines the institutions as a system of established and prevalent social rules that structure social interactions".
- Koppenjan and Groenewegen (2005) "describe institutions as a system of rules that structure the course of actions".
- Ostrom et al. (1994) "define institutions as the set of rules actually used by a set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others". Ostrom (1999) reforms "the concept of institutions in her paper with Polski: to the institutions as a widely-understood rule, norm, or strategy that creates incentives for behaviour in repetitive situations".
- Williamson (1998) carry forward the definition of North (1992) to "define the institutions as being the humanly devised constraints that structure political, economic, and social interactions. They consist of both informal constraint and formal rules".
- Ghorbani (2010) defines: "institutions as an instrument that influence, guide and limit the behaviour of actors".

For this research, the definitions of North (1992), Ostrom (1999) and Ghorbani (2010) are combined. Based on the combined definitions the Institutions is "*considered as the rule, norm or strategy that are humanly devised to structure the political, economic and social interaction and guide the behavior of the actors".* The key element of institutions is the rules that govern the relationship among the actors (Ostrom, 2011). In a system governed by a rule of law, the legal framework such as constitutional, legislative framework forms the sources of the rules. In a system not governed by rule of law, there may be central regulations enforced by the open community. Therefore, it is important to understand not all the rules are formulated in a document. Some rules have evolved over a period of time and can be understood implicitly by participating with the users.

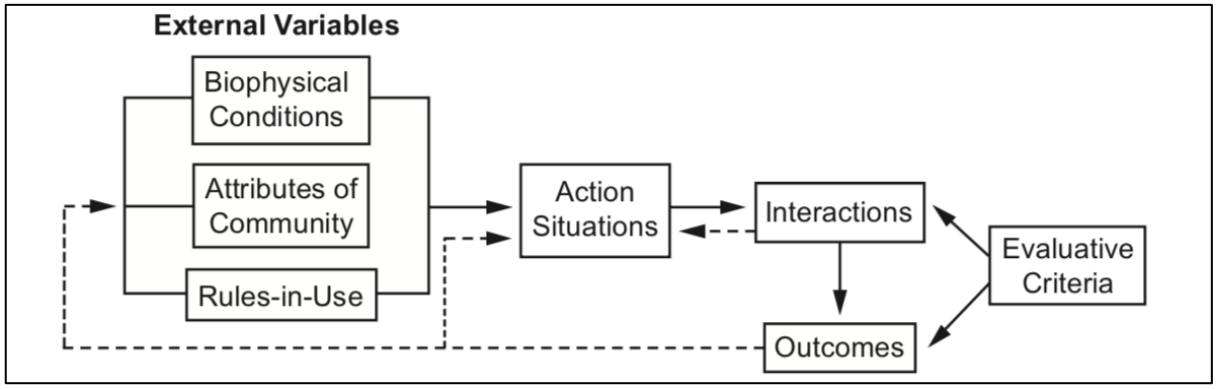
The rules and norms are crucial for the research as they structure and influence the actor interaction pattern. Ostrom (2011) a famous scholar utilized the Institutional Analysis and Development (IAD) framework to analyze such complex interaction patterns and simplify into practical activities. IAD framework was identified to be one of the most successful and sophisticated attempts to link the theories of institutions to the empirical assessment (Polski and Ostrom, 1999). Within the framework of IAD, Ostrom (1999) has defined the external

variables that affect the actions of the actors in the action situations as shown in Figure 2-2 Institutional Analysis and Development Framework.

External variables: The external variables include the contextual factors such as the attributes of the community, biophysical conditions and the Rules in Use that encompasses all the aspects of the social, cultural, institutional and physical environment. Each of the external variables is explained briefly below,

- **Biophysical conditions** are concerned with "physical and material conditions that influence the action arena". The physical and material condition refers to the physical and human resources that include capital, land, labour, technology, finance, distribution channels etc (Polski and Ostrom, 1999).
- **Attributes of community** describe "the socio-cultural context of the action situation". It includes features such as trust, reciprocity, common understanding and social capital and cultural repertoire and norms. The features of socio-cultural context are utilized for deliberation and implementation of the actions in the action situation.

Figure 2-2 Institutional Analysis and Development Framework



Source: (Ostrom, 2011)

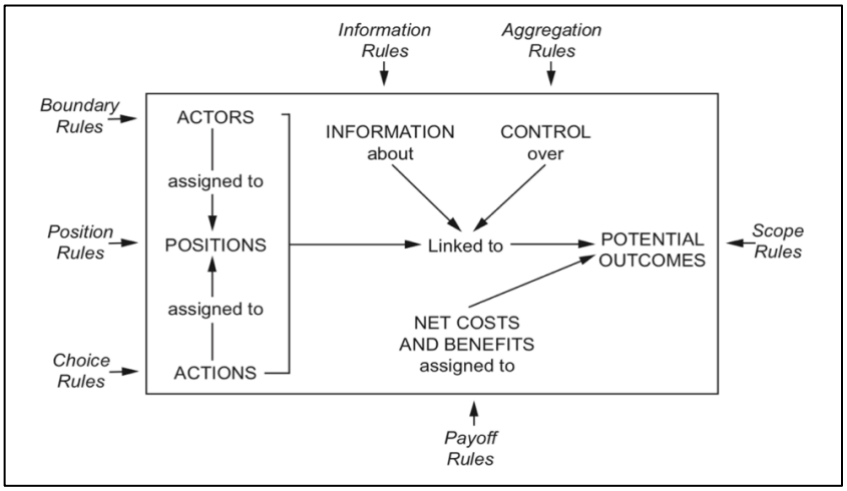
- **Rules-in-use** is concerned with the institutional aspects that affect the action situations. It includes formal rules and repertoire strategies such as norms that are used on regular basis by the actors. These rules explain the interaction pattern and might evolve over time due to the interaction patterns itself. Ostrom (2011) classifies the rules in use into seven categories that are explained below. The seven rules are essential in order to structure the actions of the actor in the action situation.
    i. **Position rules** establish the position of the actor in the action situations. For instance, it specifies the position difference from just being a member or a specialized task holder such as chair of the committee
    ii. **Boundary rules** specify how the actors are chosen for the position (criteria). It details out the members who should be part of the committee in managing the common resource, and why is it limited to a certain group and not others. This rule affects the number of participants and their resources.
    iii. **Choice rules** specify actions of each actor that can take place in a certain circumstance. It details out the various choices of actions that can take place for achieving the outcomes. When choice rules are combined with the law it affects the actions of the actor.

iv. **Information rules** affect the network of communication flow among the actors. It details out what type of information should be secretly held and what should be made public.
v. **Scope rules** determine the outcomes that could be affected and specify the actions linked to the potential outcomes. It stresses the reasons behind the off-limits, historical rules that restrict the possible outcomes.
vi. **Aggregation rules** affect the level of control that an actor exercises in the selection of action at a point. Its stress the need for acquiring consent from the relevant actor before selecting the choice of actions.
vii. **Payoff rules** affect the benefits and costs associated with the combination of actions and outcomes. It is concerned about the size of sanction that can be imposed against breaking any of the rules and mentions an authority responsible for endorsing the nonconformers. It also mentions how the actors are monitored in regard to conformance to the rules.

Action Arena: On the other hand, is the action situations which is a black box that is composed of actors stimulated by the three external variables. The term 'actions situation' refers to a social space where actors dynamically interact, share and exchange information. It is considered as the core of IAD to describe, predict and explain the behavior of actors (Ostrom, 2011). It is a space for solving problems, domination and fight in order to realize the outcomes from their interactions. Ostrom (2011) identified seven sets of variables that describe the system of action situation. The cumulative effect of seven rules mentioned above affects the variables in the action arena as shown in Figure 2-3 Internal Structure of Action Arena. The variables of the action situation are,

a) Characteristics of the actors involved
b) Positions that the actor hold
c) Set of actions that an actor can (potentially) take
d) The amount and nature of information available to an actor at certain moments
e) The outcomes of the interaction
f) The level of control that an actor has over their choices
g) Costs and benefits of actions and outcomes

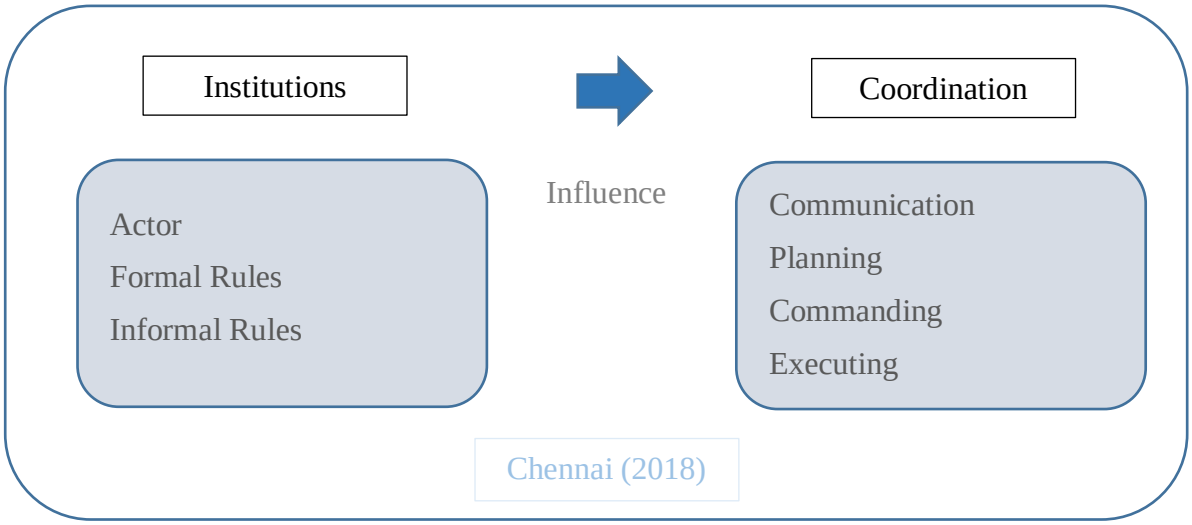
Figure 2-3 Internal Structure of Action Arena



Source: (Ostrom, 2011)

2.6 Conceptual Framework

Figure 2-4 The Conceptual Framework



Based on the literature review on the concepts of *institutions* and *coordination* through various theories and concepts, it is understood that the inter-organizational coordination is encouraged as a result of institutional norms, legal framework, cultural, social and situational conditions. Mintzberg (1981) also stresses on the need for a strong spokesman/leader at an organizational level for the coordination. Grigg (1998) has also mentioned the importance of local politics as an important component of the local and regional coordination. However, Ostrom (2011) has collectively combined all the concepts of the social, cultural, institutional and physical environment into the external variable of the IAD framework. These collective components in the external variable influence the behavior of the actor to coordinate/interact in the action situation. Thus, the framework of IAD is utilized to develop the conceptual framework of the research as it theoretically conveys the relationship between the '*institutions*' and '*coordination*'. The external variables of the IAD on one hand that includes the institutional norms, legal framework, social and cultural conditions segregated into formal and informal mechanisms. On the other hand, it the social space where actors dynamically interact, coordinate and exchange information. In order to analyze the *social space* where actions of actors take place, Fayol's concept of management is adopted which considers coordination the function of management. Fayol viewed management as "to forecast, to plan, to organize, to command, to coordinate and to control". Though Coordination is highlighted as a separate function, Fayol (1916) stresses the necessity of Coordination in all the functions of the management. Thus, the social space is deliberated as the arena for the actor's communication, planning, commanding, executing and controlling with coordination in all the functions.

Despite the external variable of the IAD framework includes the biophysical conditions as one of the variables that influence the actor's social space, the research limits the external variable to the socio-cultural and institutional aspects. In this research, the '*institutions*' is synthesized as the actor and their rules segregated into formal and informal mechanisms while the coordination as the social space where the actor communicates, plan, command, execute and control to achieve their goals.

Chapter 3: Research Design and Methods

3.1 Introduction

This chapter presents the operationalization of the variables identified in the conceptual framework and discusses the methods undertaken by the researcher to gather and analyze the information needed to conduct the study. Based on the review of the literature presented in chapter two, the main research question and sub-research questions have been revised.

3.1.1 Revised Research Question

To what extent do the ***institutions*** influence ***co-ordination*** among different actors involved in the course of flood management in Chennai?

3.1.2 Sub-research questions

i. What is meant by institutions (formal and informal rules) in flood management in Chennai?
ii. How does coordination take place among the actors involved in flood management?
iii. Which are the factors that enable or constrain coordination among actors involved in the flood management in Chennai?

3.2 Operationalization: Variables and Indicators

This section is intended to show the transition from the conceptual framework presented in chapter 2 to measurable indicators. The measurable indicators are developed based on the definitions and theories presented by various authors. Table 3-2 Definitions of Independent Variable Table 3-3 Definitions of Dependent Variable presents the summary of definitions for the independent and dependent variables for this study.

Table 3-1 Dependent and Independent Variable

Independent Variable	Institutions
Dependent Variable	Coordination

Table 3-2 Definitions of Independent Variable

Authors	Institutions – Independent Variable
(Hodgson, 2007)	"institutions as systems of established and prevalent social rules that structure social interactions".
(Koppenjan and Groenewegen, 2005)	"institutions as a system of rules that structure the course of actions that a set of actors may choose. However, he adds that rules are considered as institutions only when they are accepted by the involved actors."
(Ostrom, Gardner, et al., 1994)	"institutions as the set of rules actually used by a set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others".
(Ghorbani, Ligtvoet, et al., , 2010)	"institutions that influence, guide and limit the behavior of actors".
(Williamson, 1998)	"institution as being the humanly devised constraints that structure political, economic, and social interactions. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights)".
(Polski and Ostrom, 1999)	"institution as a widely-understood rule, norm, or strategy that creates incentives for behavior in repetitive situations".

Table 3-3 Definitions of Dependent Variable

Authors	Coordination – Dependent Variable
(Gulati, Wohlgezogen, et al., 2012)	"as deliberate and orderly alignment or adjustment of partners' actions to achieve jointly determined goals".
(Verhoest and Bouckaert, 2005)	"as the alignment of tasks and efforts of units or actors in order to achieve a defined goal"
(Mintzberg, 1981)	"as the need for strong spokesman/leaders to tailor specific coordination standards and procedures".
(Sehested and Groth, 2012).	"as a result of institutionalized norms, rules and logic of appropriateness"
(Malone and Crowston, 1994)	"an act of managing interdependencies between activities".
(Reff Pedersen, Sehested, et al., 2011)	"as a persistent interaction and communication between the actors in the governance process"
(Thompson, 1967)	"as produced through plans, schedules, formalized rules and procedures, as well as standardized information"
(Hood, 1990)	"as the process through informal logics of appropriateness and the development of rules and norms in the coordination process "
(Gabriel, 2000)	"as for how storytelling and story work contribute to coordination through the creation of common meaning."

Table 3-4 Operationalization of Dependent and Independent Variable

Variable type	Variables	Sub-variables	Indicators	Descriptions	Data Collection methods
Independent Variable - Institutions	Actor	Diversity of actor	Whom are the actors involved	Inventory of varieties of actors involved in flood management and knowing whether one actor is aware of another actor's involvement	Semi-structured interviews and secondary Data
		Roles	Clearly defined roles and responsibilities	Any duplication or overlaps that may lead to conflicts	Semi-structured interviews and secondary Data
		Resources	Sharing of resources	Extent to which inter-dependencies among the actors involved in the flood management	Semi-structured interviews and secondary Data
			Equal distribution of resources	Identifying the power relations between the actors (no domination)	
	Formal Rules	Legal framework	Presence of rules, regulations, law or policies for flood management	To find if legislations are available and do they guide actor behavior for interaction	Semi-structured interviews and secondary Data
	Informal Rules	Organizational connections	The Direction of connection	Extent to which organization is vertically or horizontally connected	Semi-structured interviews and secondary Data
		Political culture	Political priorities or pressure	Control over decision making and implementation	Semi-structured interviews and secondary Data
		Norms	The behavior of the actor	Norm of a behavior that encourages actors of flood management to corporate with others – in response to the previous situation	
Dependent Variable - Coordination	Communication		The Frequency of information sharing between actors	Extent to which one actor communicates to another actor, and to measure how efficient is the communication among actors	Semi-structured interviews
			Timely receipt of information		Semi-structured interviews
			Type of information shared between actors		Semi-structured interviews
	Planning		Presence of a shared strategic plan	Presence of common plan which ensures participation of all actors to achieve a common goal	Semi-structured interviews and secondary data
			The mechanism for joint participation of actors in developing a common strategic plan		
			Presence of synchronized schedule of activities		
	Commanding		Presence of central authority that gives order and direction	Presence of central authority enables negotiation and unity among multiple actors	Semi-structured interviews
	Executing		Cooperation and coalitions during implementation	Implementation of the joint action plan by the actors in an individual or joint manner	Semi-structured interviews
	Controlling		Ensuring conformity for a joint plan	Pertains to the monitoring and evaluation processes of the implemented program	Semi-structured interviews

3.2.1 Research Strategy

This research applies to a case study strategy. A case study is a suitable strategy when the research aims to explain the relationship between the independent and dependent variable within the specific context (Van Thiel, 2014). A case study strategy is "a real inquiry of topical events from everyday life within its real-life setting". It explains "the contemporary phenomenon with the small number of units and a relatively large number of unknown variables". It is a suitable strategy "when the contextual factors are vital for the phenomenon being studied". In this research, the phenomenon of study – institutions and coordination among actors are extremely embedded within the context. Thus, the research requires an in-depth understanding of the unknown aspects of institutions that affect the coordination among the actors. In addition, the case study is suitable when the research intends to collect rich qualitative data on the case. The dependent variable co-ordination is more related to behaviour, perception, and interdependencies which is best understood by the use of the qualitative approach. Therefore, the case study is valid for the research. Within the case study approach, co-variation is the suitable style for the research. Co-variation draws a causal inference between the cause and the effect within the specific context (Blatter and Blume, 2008). It is suitable when the researcher has deduced the co-variational relationship between the variables through theory and able to frame a hypothesis. In this research, the relationship between the independent and dependent variables are deduced through the IAD framework of Ostrom.

This study uses a single case study approach where the city "Chennai" is considered as the case and the different initiatives for flood management are considered as the units of the city. So, different initiatives in the same case are compared to identify the differences in the independent variable that influences the dependent variable. Without a comparison, it is impossible to firmly explain what elements of institutions influence coordination. The advantage of the comparison allows the researcher to explore factors outside the initial scope of the research (Blatter and Blume, 2008). The research is limited to only certain initiatives for flood management as there were several initiatives indirectly focused on the flood management. All the initiatives could not be studied within the given time framework and available resource. Further, there is no specific integrated flood management project identified in Chennai. Therefore, initiatives such as the provision of micro and macro drainage facility, preparation of Masterplan and RWH (Rain Water Harvesting) were analysed in the case of Chennai.

3.2.2 Challenges of Case study

Though the case study strategy provides with the rich qualitative data it has limitation. It offers a limited choice for statistical testing. This approach faces difficulty in proving the internal validity. Further, external validity is limited as it is hard to generalize the findings of the case study (Van Thiel, 2014). Apart from validity, the openness in the data collection methods may reduce reliability. Furthermore, a case study approach undertakes a prolonged process and places a demand on the researcher in terms of time and commitment. It also requires the willingness of the organisation and individuals to allow outsiders to come and take a peep at their effort.

3.3 Data collection methods

Data collection is the critical part of the research process. The methods applied to data collection states the type of data to be collected and the instruments used for data collection. The research is mainly reliant on primary qualitative data collection as the main method. The secondary qualitative data was used to triangulate the data source where ever necessary.

3.3.1 Primary Data

In general, primary data are referred to as first-hand data directly collected by the researcher. The primary qualitative data are real-time and can be collected through observations, interviews and focus group discussions. This research is limited to interviews for the primary qualitative data collection. There are three types of interviews namely, structured, semi-structured and open-ended interviews. Semi-structured interviews are suitable when there is diminutive knowledge on the phenomenon of the study and the research needs to collect more insights (Van Thiel, 2014). Therefore, this research applies to semi-structured interviews as the instrument for primary data collection. Semi-structured interviews were conducted with key informants who have been engaged in the provision of micro and macro drainage facility, preparation of Masterplan and RWH (Rain Water Harvesting). The semi-structured interview questionnaire is attached in annex 1. The interview questionnaire was divided into three parts, namely introduction (that contains the name of the interviewer and basic details), questionnaire part and lastly conclusion (where it mentions the above-collected information are solely used for academic purpose). The questionnaire was prepared in two languages one in English and the other in Tamil (local language). These questions prepared were not asked in an ordered manner. Rather, it was asked in a different order based on the type of respondent and the knowledge they possess about the subject of study. Further, at specific places, no questionnaires were used as privacy was a concern rather I was allowed to freely have a conversation. These interviews were conducted between the month of June 2018 and July 2018. It is important to state the time of collection due to the subjective nature of the phenomenon of study.

3.3.2 Secondary Data

Secondary data refers to relying on data collected by someone else or referring to documents and policies (Van Thiel, 2014). In this research, secondary data includes information from the reports, policies, laws, legislation, newspapers, conference proceedings, articles, websites of government departments and previous research on the same theme. The secondary data were acquired mostly from the websites of government organisations, NGOs, academic institute, reputed journals, and newsletters. The review of secondary data was used to triangulate the information acquired from the interviews and to strengthen the internal validity. The list of secondary data used in the research in attached in the bibliography.

3.3.3 Sampling

Apart from the methods adopted for the data collection, it is important to limit the sample of the study as it is hardly ever possible to study all the potential samples. There are several methods that could be utilized for sampling depending on the type of the research. This research applies to purposive sampling. Purposive sampling is often suitable for the research that has undertaken the case study approach and primarily relies on the qualitative data (Van Thiel, 2014). The purposive method allows the researcher to make the selection of the samples purposely based on the respondent's knowledge on the subject of the research. Therefore, the selected respondents can provide insights into the relationship between institutions and coordination. The selected samples for semi-structured interviews are presented in Table 3-5 Organisations for Semi-structured Interview. These informants are believed to be able to provide the required information. The selected sample size was further stratified into three categories namely, government actors, NGO's and academician. The stratification ensures representations from different characteristics of the organisation involved in the process of flood management (Van Thiel, 2014). Though the final stratified sample for the interviews

does not represent the entire population of the stakeholder, they have been selected on the basis where most possible information could be availed from the limited number of respondents.

Table 3-5 Organisations for Semi-structured Interview

Organisation	Number of Respondent	Role
Chennai Metropolitan Development Authority (CMDA)	2	Chief Town Planner, Ex-planner
Corporation of Chennai (CoC)	1	Superintend Engineer
Public Work Department (PWD)	1	Executive Engineer
Zonal Department	1	Zonal officer
Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB)	-	Not willing to answer
The Rain Center	1	Founder
The Nature Trust	1	Director
Center for Water Resources (CWR)	1	Ex-researcher
IRS (Institute for Remote Sensing)	-	No appointment
MIDS	2	Professor, Ex-Chairman

3.3.4 Validity and Reliability

The validity of the research is classified into the external and the internal validity. Internal validity refers to the determination of results that shows the change in the dependent variable are caused by the independent variable, while the external validity refers to the extent to which the findings can be generalized to other cases (Van Thiel, 2014). In this research, the generalization of findings is limited as the study is carried only within a single case. The findings attained from the research are highly embedded within its context, so it is not possible to generalize. Therefore, the findings attained are explained within its context. With the use of semi-structured interviews as the technique for primary data collection, it is hard to prove the internal validity. Yin (2009) highlighted the concept of triangulation as a method to prove the internal validity. Triangulation is referred to as the collection of data from different sources to prove and ensure the collected data is valid (Van Thiel, 2014). In this research, the data collected through semi-structured interviews are triangulated with the data from secondary sources. The drawback of reliability was encountered by documenting all the steps undertaken in the research and storing it in a database. This database was used to review and check the whole process of the study at the later stage. The case study even needs acceptance from the respondents to allow to peep into their undertakings (Van Thiel, 2014). Therefore, prior appointments were placed with the respondents. However, even after prior appointment, some organizations refused to respond in such case data were collected from their website and secondary source.

3.4 Data Analysis Methods

The primary collected data was in a handwritten format. It was not permitted to record the interviews due to the privacy and the fear of blame culture that exists in the government office. The collected primary data was initially translated from Tamil and transcribed into the word document format. Later, the word document was cleaned and transferred to Atlas ti program. The Atlas ti is useful for interpretation of a large amount of text ideally data such as the interview scripts and the field notes.

Using Atlas ti, the data collected was coded with the list of codes prepared by the researcher. Later, the analysis tools available in the Atlas ti were applied to the coded interviews to generate various outputs that were useful to script the analysis section. It is

important to note that the research is oriented towards qualitative data, hence there were no other tools used for analysis. Apart from the primary data, secondary data were used in the research. However, the use of secondary data was to support the interviews and confirm the information provided by the respondents.

Chapter 4: Research Findings

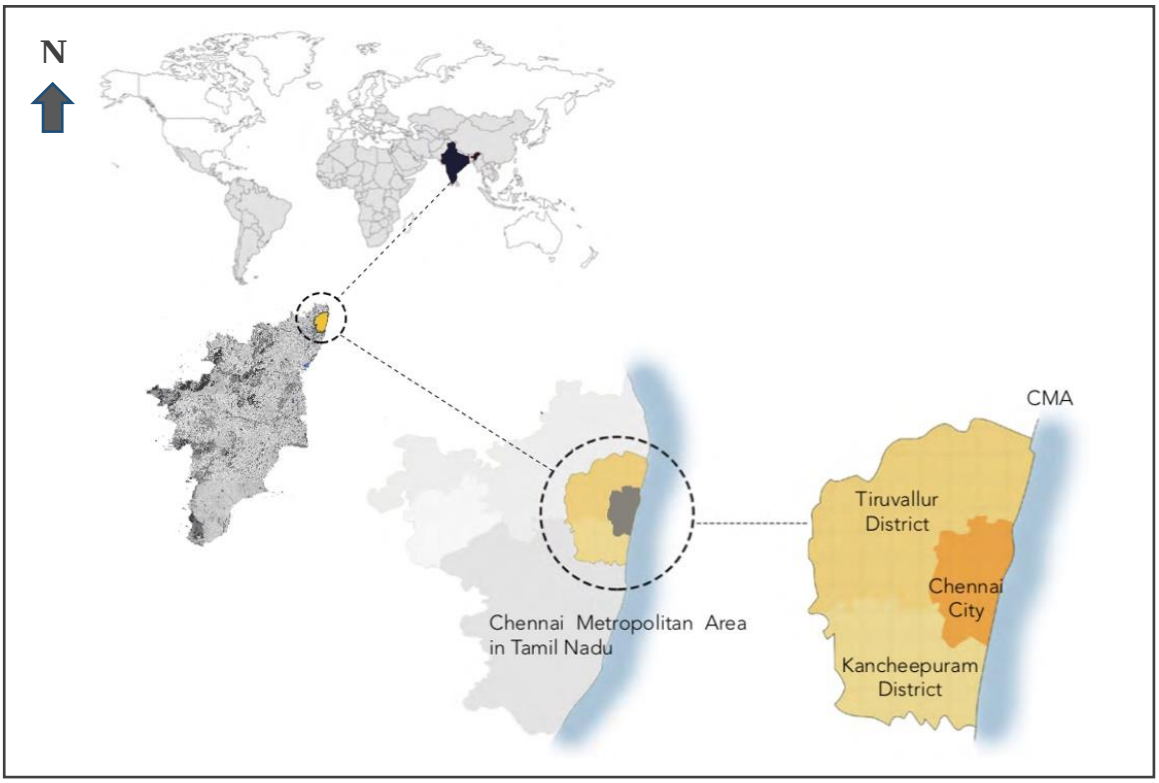
This chapter presents the analysis of the independent variable and the dependent variable of the research. The data collected through semi-structured interviews with different respondents were processed, analyzed and correlated for generating theoretical information. The collected information through field visit focuses on initiatives such as the provision of micro and macro drainage facility, preparation of Masterplan and RWH (Rain Water Harvesting) that address the flooding problems. Chapter four is organized in four section; Firstly, Section 4.1 presents the context of the city and study area. Section 4.2 presents the analysis of the institutions. Section 4.3 presents the analysis of inter-departmental coordination among the actors and finally, Section 4.4 presents the relationship between the independent (Institutions) and the dependent variable (Coordination).

4.1 Research Context

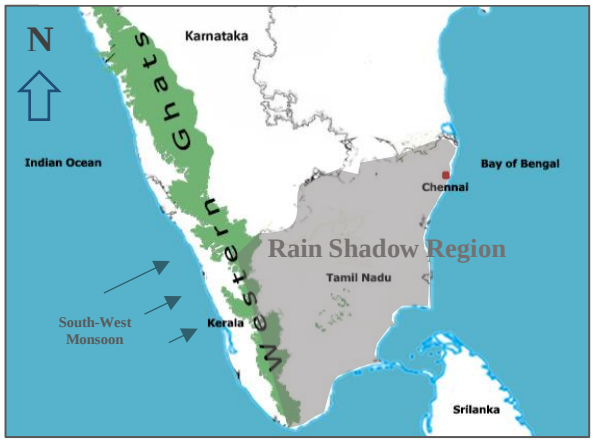
4.1.1 Context

Chennai is one of the largest Metropolitan cities in Southern India. It is the provincial capital for the state of Tamil Nadu (Chennai Metropolitan Development Authority (CMDA), 2008). Chennai is exactly located on the Coromandel Coast off the Bay of Bengal. The Chennai region falls under the rain-shadow region of a mountain that runs in the north-south direction parallel to the western coast of the Southern-India. Thus, rains originating from the South-West monsoon is blocked by the physical barrier of Western Ghats. Yet the city receives the full force of monsoon through North Eastern Monsoon that occurs mostly between the month of October and November.

Map 4-1 Location of Chennai



Map 4-2 Representation of Rain shadow Region



As per 2016 rainfall data, the Annual rainfall of Chennai is far above the national average of 119 cm per year (Kaur and Purohit, 2016). Most often the rainfall received from North-East Monsoon is short but occurs with intense burst triggering into flash floods and stagnations all over the city. There is hardly any porous surface that allows the water to penetrate to the ground surface (Chandan, Bharath, et al., , 2014). The rainwater received during the monsoon is not harvested properly and thus the Corporation could not counter the issues in the shortage for drinking. Additionally, with the increasing irregularity of rain, the scarcity is growing severe (Kaur and Purohit, 2016). Thus, Chennai's relationship with water is peculiar with either too much or too less (Jameson and Baud, 2016). Being deltaic in nature, Chennai is inherently prone to floods (Kumar and Kunte, 2012). Chennai lies a mere 2.5 meters above the sea level on average, with a few hillocks such as St. Thomas Mount, Pallavaram and Tambaram (Chennai Metropolitan Development Authority (CMDA), 2008). The diminutive natural gradient makes it difficult for the drainage system to flow towards the sea. However, Chennai's has a well-organized natural drainage pattern with two rivers running in the west-east direction and a man-made canal cutting the rivers perpendicularly in the north-south direction. The two rivers are namely, the 'Cooum' that runs in the center of the city and the 'Adyar' to the south of the city and finally flows into the Bay of the Bengal. These two rivers divide the city into Northern, Central and Southern segments. The man-made canal is a 796 km long navigational channel running parallel to the coast of the Bay of Bengal and named 'Buckingham'. A short stretch of the Buckingham Canal (4 km) runs within the city linking the Adyar and Cooum river. Though the channel was originally used for navigation at present it serves as the major flood carrier and drainage channel.

Apart from the rivers and canal, there are several lakes of varying size located at the different places of the city. The Cholavaram lake, the red hills lake, and Chembarambakkam lake are the most important lakes within the CMDA limits that form the main source for drinking water supply for the Chennai Metropolitan Area (CMA). Chennai is also dependent on the groundwater resources to augment the drinking water supply. The Adyar and Cooum river plays a major role during the time of floods. They collect surplus water from the lakes which are about 75 lakes for the 'Cooum' and 450 lakes for the 'Adyar' and discharge to the Bay of Bengal (Gupta and Nair, 2010). Thus, the flood water discharge from Adyar river is four times more than Cooum as it is connected to an excess lake compared to Cooum. Additionally, Marina beach is one of the longest urban beaches in the world with 13 km in length.

4.1.2 Urbanisation

Chennai is one of the largest million-plus cities in India with the population of 8.7 million in the CMA and 4.6 million within the Corporation of Chennai (CoC) (Chennai Metropolitan Development Authority (CMDA), 2008). The CMA is around 1190 km^2 that encompass of Chennai corporation, 16 municipalities, 20 town panchayats and 214 villages in 10 panchayat unions. Likewise, the CoC is about 176 km^2 sub-divided into 15 zones consisting of 200 wards. Chennai has always been politically and economically important since its establishment of Port in the colonial era. After the liberation of the Indian economy economic growth has been the forefront goals of the State of Tamil Nadu. The State administration actively promoted policies

and regulations that enabled the inflow of Foreign Direct Investment (FDI) into the capital city of Chennai. By the early 2000s, the ruling government sought to 'Globalise Chennai' and develop its industrial sector by setting up Special Economic Zones (SEZ). This led to multiple automobile and information technology giants to set up their base in Chennai. The region is considered as a heaven for automobile industries and it is been popularly referred to as the 'Detroit of India' (Afza Tajuddin, 2017). Due to the massive development and economic opportunities, the population of Chennai has constantly grown as shown in Table 4-1 Population and Area of Chennai. In 2011, Chennai had a population density of 247 persons/ha and 59 persons/ha in the CoC and the CMA respectively (Chennai Metropolitan Development Authority (CMDA), 2008).

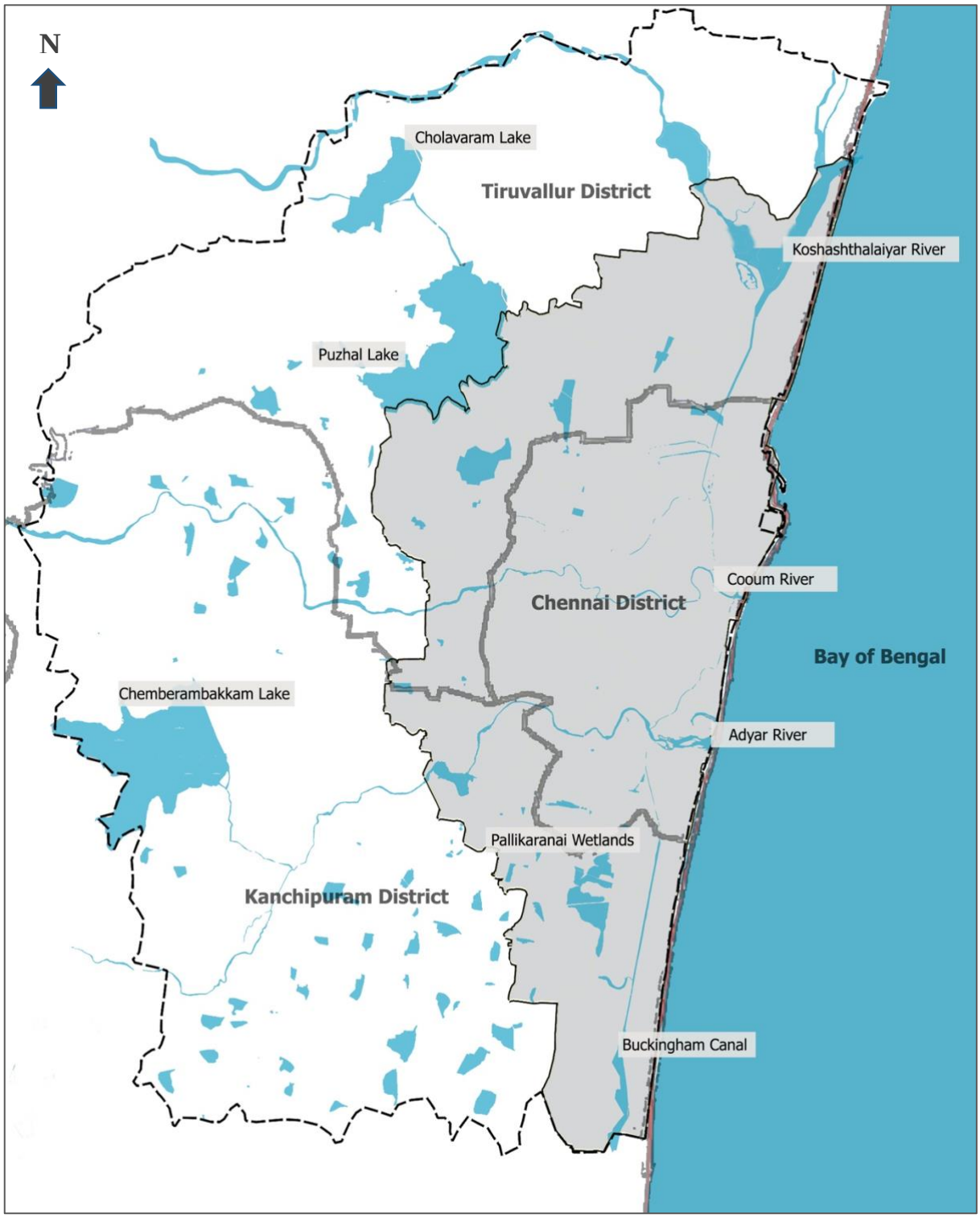
The Chennai Metropolitan Development Authority (CMDA) is the statutory body responsible for urban planning in the CMA. The CMA is the outer administrative boundary of Chennai while the CoC is the inner administrative boundary (refer to Map 4-3 Map of Chennai with its administrative boundaries and water bodies). The Masterplan 2026 prepared by CMDA estimates the city to have 333 persons/ha by 2026 as the city expansion is Geographically limited by the Bay of Bengal on the eastern side and the administrative boundary of Andhra Pradesh (another state) on the Northern side.

Table 4-1 Population and Area of Chennai

	Population					Area (in Sq.km)
	1971	1981	1991	2001	2011	
Chennai City	2,642,000	3,285,000	3,843,000	4,343,000	4,681,087	176
CMA (Chennai Metropolitan Area)	3,504,000	4,601,000	5,818,000	7,041,000	8,696,010	1189
Source: CMDA Second Master Plan, Vol 1-Demography, based on Census 2001 and Census 2011						

Tamil Nadu has become the most urbanized state of the Indian Union (48.5% of urban dwellers against 28% of the National) (National Informatics Center, 2018). Within the state of Tamil Nadu, Chennai is one of the districts where urbanisation rate is above the State's average. The rise in the urbanisation has caused several consequences for flooding in the city. First and foremost, urbanisation has increased the percentage of land covered by the impervious surface which reduced the capacity of water infiltration in the ground and increased the runoff (Chandan, Bharath, et al., , 2014). The runoff can either cause flooding at the macro level or stagnation at the micro level (Gupta and Nair, 2010). Further, urbanisation has led to an increase in the land values that have limited only a few classes of people to afford a home at a reasonable price. Unaffordability resulted in encroachment in terms of slums and squatter settlements along the floodplains and vulnerable zones which amplified the flooding problems.

Map 4-3 Map of Chennai with its administrative boundaries and water bodies



Legend	
	Water Body
	Chennai Corporation Area
———	Chennai Corporation Boundary
- - - -	Chennai Metropolitan Area (CMA)
———	District Boundary

4.2 Analysis of Institutions (Independent Variable)

The Analysis of Institutions is composed in two sections, the first section presents the actors involved in the flood management with their roles, responsibilities, and resources. The second section presents the formal and informal rules that shape the behaviour of the actor.

4.2.1 Actor Analysis

The Empirical investigation from the interviews shows that there are diversities of actors at different levels built around the flood management practice in Chennai as shown in Table 4-2 List of Actors involved in flood management. However, the study is limited to the provision of micro and macro drainage facility, preparation of Masterplan and RWH (Rain Water Harvesting) to address the flooding problems. Thus, actors who are responsible only for the provision of the above-mentioned utilities are studied.

Table 4-2 List of Actors involved in flood management

List of Actors of involved in flood management at different levels				
International Level	WB	JICA	UNEP	ADB
	UNDP			
	Government Institutions		Academician	NGO
National Level	MoHUA	MoDWS	ICSSR	
	Niti Aayog	MoWR		
	MoHA			
	MoEFCC			
State Level	HUD	MRTS	IRS	Care Earth Trust
	PWD - WRD	TNPCB	CWR	TC
	DTCP	TNEB	SAP	
	SFC	TNHB	MIDS	
	TNUIFSL	Agriculture	Anna university	
	TWAD	Forest		
	TNUID	TNSTC - MTC		
Metropolitan Level	CMDA			SWARAN
	CMWSSB			The Nature Trust
Local Level	CRRT	SWMD		Rain Center
	SWDD	Revenue		
	Zonal	Health		

Local Government	
CRRT	Chennai River Restoration Trust
SWDD	Strom Water Drain Department
SWMD	Solid Waste Management Department
Zonal	Zonal Department that represents Corporation
CoC	Corporation of Chennai
Revenue	Revenue under Corporation (holds land)
Health	Public Health Department
Metropolitan Government	
CMDA	Chennai Metropolitan Development Authority
CMWSSB	Chennai Metro Water Supply and Sewerage Board
Academician	
IRS	Institute of Remote Sensing
CWR	Center for Water Resources
SAP	School of Planning and Architecture
MIDS	Madras Institute of Development Science
ICSSR	Indian Council for Social Science Research
International Actors	
WB	World bank

State Government	
H&UD	Housing and Urban Development Department
PWD	Public Works Department
DTCP	Directorate of Town and Country Planning
SFC	State Finance Commission
TNUIFSL	Tamil Nadu Urban Infrastructure Financial service ltd
TWAD	Tamil Nadu Water supply and Drainage Board
TNUID	Tamil Nadu Urban Infrastructure Development
MRTS	Metropolitan Rail Transport Service
MTC	Metropolitan Transport Corporation
TNEB	Tamil Nadu Electric Board
TNHB	Tamil Nadu Housing Board
TNPCB	Tamil Nadu Pollution Control Board
TNSTC	Tamil Nadu State Transport Corporation
WRD	Water Resource Department
National Government	
MoHUA	Ministry of Housing and Urban Affairs
MoHA	Ministry of Home Affairs (Disaster Management)
MoWR	Ministry of Water Resources

UNDP	United Nations Development Programme
ADB	Asian Development Bank
UNEP	United Nations Environment Program
JICA	Japan International Cooperation Agency

MoEFCC	Ministry of Environment, Forest and Climate Change
MoDWS	Ministry of Drinking Water and Sanitation
NGO's	
TC	Transparent Chennai

The first and most commonly repeated story about flood management was consistent with most respondents. *"Chennai City is provided with SWD (Storm Water Drain) to solve the problems of flooding. Further, the rivers and larger water bodies are maintained by the PWD (Public Works Department) who will ensure the protection from flooding at the macro level".* Thus, the flood is primarily tackled with the provision of SWD network and maintenance of the macro drainage network (rivers, canal, and lakes). Apart from the provision of SWD and maintenance of larger water bodies, academicians and NGOs specified "*the traditional methods of using 'ery' for macro-level flood management and RWH*". *'Erys' are nothing but a connected system of the man-made traditional tank that catches the run-off water with the slope of the land on one side and walls on the other sides*. However, today the role of ery is divorced from flood management. CMDA the ultimate planning authority has sanction land use conversions from agriculture zone (1,229 hectares), Open Space and Recreation (O&R) zone (345 hectares) and sensitive areas such as water bodies (14 hectares) in violation with the town and country planning act, 1971 (Comptroller and Auditor General of India, 2017). Most erys were converted into development sites for the thriving demand for economic opportunities. Today, RWH is implemented at a micro level where installation of RWH structures are mandated at all the building premises and at the streets (Chennai Metropolitan Water Supply and Sewerage Board, 2018). Additionally, a Masterplan prepared by the urban planning authority intends to ensure planned development in the city. The Masterplan is supplemented with the Development Control Regulations (DCR) which is a consolidated regulatory plan for the city of Chennai. The DCR mandate guidelines for the development work that is planned within the limit of CMA. Thus, the study aims to investigate the actors responsible for the provision of SWD network, maintenance of macro drainage, preparation of Masterplan and installation of RWH. The actors involved the provision of the above-mentioned utilities includes both the Governmental and Non-governmental actors with varying power, strength and size. The government actor-network involved has more biophysical and economic understanding of flood risks whereas the non-governmental actors are societal and ecological in their discourse.

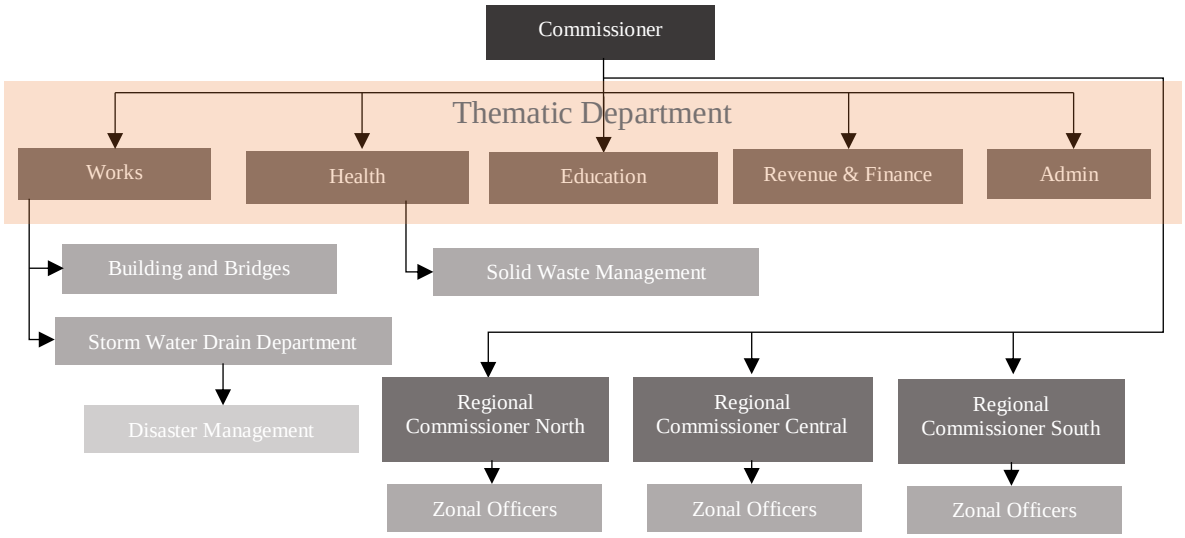
4.2.1.1 Governmental Actors

There are five governmental actors distinctly responsible for the provision of SWD network, maintenance of macro drainage, preparation of Masterplan and installation of RWH. Each of the actor and their roles, responsibilities, and resources are explained detailly in the following sections.

4.2.1.1.1 Corporation of Chennai (CoC)

The CoC is the local government with the political and administrative wing (Greater Chennai Corporation, 2018). The administrative wing is headed by the Commissioner and the political wing is headed by the Honourable Mayor. The administrative wing is divided into thematic departments as shown in the Chart 4-1 Thematic Departments of the Corporation of Chennai (CoC) Each of the thematic department has distinct priorities and mandates. The SWD Department under the Works wing of CoC is responsible for the provision of the SWD network within CoC.

Chart 4-1 Thematic Departments of the Corporation of Chennai (CoC)



Apart from the provision of SWD, the CoC is also responsible for providing building permit license for the buildings less than or equal to Stilt + 2 floors or 15 meters in height lying within the jurisdiction of CoC (Greater Chennai Corporation, 2018). The CoC also holds a special Disaster Management Department mandated under the section-31 of the Disaster Management Act, 2005 where each District Disaster Management Authority (DDMA) shall prepare a City Disaster Management plan that contains a set of guidelines for effective disaster management at the district level.

4.2.1.1.2 Zonal Department

The zonal department act as an integration hub to carry all the activities of CoC at the zonal level. Within the CoC, there are fifteen zonal departments headed by the zonal officer (Greater Chennai Corporation, 2018). These zonal officers will prioritize and manage all the mandates of CoC. The Zonal department is responsible for maintenance of the SWD network at the zonal level. Though the CoC is responsible for the provision of the SWD network, it is the responsibility of the zonal officers to periodically maintain and clean the SWD network before the monsoon.

4.2.1.1.3 Public Work Department (PWD)

The Public Work Department is the state-level institution and one of the oldest departments, that can be traced back to the period of East India company in the 1820s (Water Resource Department, 2018). The PWD is bifurcated into two wings namely; the Building Organisation that is concerned with the construction and maintenance of Government buildings, Government colleges, and Memorials. Secondly, the Water Resource Department (WRD) that is concerned with irrigation, reservoirs, flood control, and diversion, framing regulation for groundwater and surface water and maintenance of larger water bodies in the state of Tamil Nadu (Water Resource Department, 2018).

Within the WRD, there are several project teams of which a separate team dedicated to flood management is set up in a building located discretely from the main WRD building. In concern with flood management in Chennai, the WRD is responsible for maintenance of the macro drainage such as the Adyar, the Cooum, and the Buckingham canal. It is also responsible for the larger lakes such as the Cholavaram lake, the red hills lake, and Chembarambakkam

lake etc. Nevertheless, the maintenance of a short stretch of the Buckingham canal is handed over to Metro Rail Project as a consequence of Metro Rail Encroachment over the canal.

4.2.1.1.4 Chennai Metropolitan Water Supply and Sewerage Board (CMWSSB)

The CMWSSB is the nodal agency for the provision of water supply and sewerage network in the CMA (Chennai Metropolitan Water Supply and Sewerage Board, 2018). Apart from the provision of water supply and sewerage network, recently the provision of RWH was added as one of the functions of CMWSSB owing to the severe drinking water crisis in 2004. Therefore, the board has constituted a "Rain Water Harvesting Cell" which is entrusted to create awareness and provide technical assistance to the residents for installation of RWH structures at the household level. Further, the board has also mandated to install RWH structures at all the streets to reduce the runoff and enhance the groundwater recharge.

4.2.1.1.5 Chennai Metropolitan Development Authority (CMDA)

The Chennai Metropolitan Development Authority (CMDA) is the planning authority entrusted for the preparation of Masterplan and DCR for the CMA (Chennai Metropolitan Development Authority (CMDA), 2018). The recent Masterplan prepared by CMDA was approved in 2007 and made public in 2008. The vision of recent Masterplan 2026 is to "*make Chennai a prime metropolis which will become more liveable, economically vibrant, environmentally sustainable and with better assets for the future generations".*

Based on the prepared Masterplan and the DCR, CMDA is responsible for approval of the Building Permit license for all types of buildings within the jurisdiction of CMA. However, due to the lack of human capacity, CMDA has delegated the powers to the CoC for the building that is less than or equal to Stilt + 2 floors or 15 meters in height lying within the jurisdiction of CoC.

4.2.1.2 Non-Governmental Actors

The non-governmental actors encompass a small agglomeration of NGOs and academicians. The following section describes the roles, responsibilities, and resources of the academicians and NGOs.

4.2.1.2.1 Academicians

The academician plays an important role in knowledge dissimilation. However, the kind of knowledge domain for each academician varies from the spectrum of techno-scientific to the societal. For instance, there are two research centers concerned with the different domain of knowledge inside the same campus of Anna University. Firstly, the Institute of Remote Sensing (IRS) that creates the satellite imagery of the city with the funding from the Department of Science and Technology (DST) (Institute of Remote Sensing). Secondly, the Center for Water Resources (CWR) that works with a more diverse group of disciplines, especially focusing on sociology (Anna University, 2018). The type of knowledge dissimilation between the varies between the two academic institutions and often government department is in favour of the techno-scientific knowledge.

Similar to CWR, MIDS (Madras Institute of Development Science) which is a National Institute under the Indian Council of Social Science Research (ICSSR) also works on the social science perspective of the flood management (Madras Institute of Development Science, 2018). However, often government departments consider MIDS research to be more theoretical and the findings from the research could not be applied in the practical situations.

Despite the hindrance from the government department, the dissimilation of knowledge from the academicians through publishing their research in the International and renowned journals aids to build the social capital resources. For an academician, building on the social

capital resource from an International arena is an important resource as it aids to bring attention to the problems in the International arena. For example, through a personal contact from MIDS, SaciWaters which is large Asian academic network, brought CWR into the "Crossing Boundaries" project funded by the Dutch government insisting on Integrated Water Resources Management (SaciWATERs, 2011).

4.2.1.2.2 NGOs

The NGO plays a significant role in creating awareness and campaigns about the conservation of biodiversity, research on civic issues and facilitates public participation. Broadly, it could be recognised that NGOs are more concerned with ecology. However, the domain of interest differs among each of the NGOs. For instance, 'the Nature trust' and 'the Care Earth' NGOs consists of a small group of ecologist and naturalist who are working on the conservation of biodiversity and natural resources (The Nature Trust, 2018, Care Earth Trust, 2018). While, 'the Rain Center' and 'The Save Water and Recharge Aquifers Network (SWARAN)' is a group of graduates and middle-class civil network who are concerned about the water problems and hence insist in RWH education, awareness and campaigns (Citizen consumer and civic Action Group (CAG), 2016, Rain Center, 2017). The Rain Center acts as the connection between the CMWSSB and the civil network for RWH education and implementation of RWH structures at the household level.

The NGOs have a strong informal connection and social capital strength as they are often prominent in the local newspapers and working directly with people. The common strategy of NGOs is to erect the social strength outside the government network through constant campaigns and awareness programs to lobby the government. Despite the enormous efforts of the NGOs, the government department often provides attention only after a long and persistent pressure.

4.2.2 Formal and Informal Rules

The formal rules are the legal framework such as the laws, legislation, and rules whereas the informal rules are the organisational relationship, norms, and the political culture. The section below discusses in detail about the formal and informal rules.

4.2.2.1 Formal Rules (Legal Framework)

The empirical investigation shows that spatial planning and water management are the responsibility of the State government as land falls within the legislative competence of the State. The function of the National government in spatial planning and water management is limited to evolving policies, guidelines, and legislation. Thus, most formal regulations, policies, and guidelines are evolved at the National level. However, the Government of Tamil Nadu (GoTN) has also framed acts and rules to support the policies of National Government.

4.2.2.1.1 Legislation at National Level

I. *The Water (Prevention and Control of Pollution) Act, 1974* "aims to prevent and control the water pollution by establishing the Central and State Pollution Control Board". They are also responsible for providing technical assistance, coordinating and solving the disputes among different State departments.

II. *The Coastal Regulation Zone (CRZ)* framed by the Ministry of Environment, Forest and Climate Change (MoEF&CC) imposes "restrictions for any kind of development for a minimum distance of 500 meters from the High Tide Line (HTL)". This rules also apply to the case of rivers, creeks, and backwaters. However, this distance shall be

modified based on the case by case and cannot be less than 100 meters or width of the creek, river or backwater, whichever is less.

III. *The Building bye-laws of the Town and Country Planning* Organisation *(TCPO)* reserves "right to penalize the town planner, Engineer, Supervisor or Plumber if found deviating the building bye-laws or defaulting either in authentication of a plan or in the supervision of the construction against the building bye-laws".

IV. *The environment (protection) Act, 1986* "aims for the protection and improvement of the environment which includes water, air, water, land, human beings, other living creatures, and micro-organisms". This act forms an umbrella covering all the aspects of the environment.

4.2.2.1.2 Legislation at the State Level

I. *The Tamil Nadu Protection of Tanks and Eviction of Encroachment Act, 2007* provides "measures for monitoring and eviction of encroachment along the water bodies and tanks which are under the jurisdiction of the PWD".

II. *The Tamil Nadu Rivers Conservancy of Rivers, 1884* "aims to preserve the rivers within the State of Tamil Nadu by imposing restrictions on cultivation in contravention along the lands within the limits of the river bed".

III. *The Tamil Nadu Groundwater (Development and Management) Act, 2003* "aims to protect the groundwater resources and ensure proper groundwater management in the state of Tamil Nadu". This act reserves right to penalize any person for extraction of groundwater by bore well or drilling without obtaining the license. The act also mandates installation of RWH structures in all the buildings including the existing ones.

IV. *The Tamil Nadu Combined Development Regulation and Building Rules, 2018* "frames guidelines based on the provisions under *the Town and Country Planning act, 1971* for development of building within the state of Tamil Nadu".

V. *The Tamil Nadu Water (P&CP) rules, 1983* "aims to mandate the functions authorised under *the Water (Prevention and Control of Pollution) Act, 1974".*

In sum, there are several regulatory frameworks in place for the protection of the ecosystem and for ensuring planned development in the city. Nevertheless, significant rules mentioned by Ostrom (2011) for facilitating interaction are absent. These rules framed stresses the importance of protection but fail to provide information on how to protect, who is responsible, what to be done if the actor has defaulted and who will be responsible to monitor etc. The lack of clear and detailed information in the regulatory framework has become the reasons for the poor management. For instance, *the project report prepared for the provision of SWD network neglects CMWSSB as one of the members of the committee though installation of RWH structures is a part of the SWD network project* (Corporation of Chennai, 2015). The project report prepared lacks the boundary and aggregation rules that mandate consultation and approval from the relevant actors. It also fails to provide clear information on the monitoring methods and hence it is not familiar among different actors about who should be in charge of the maintenance.

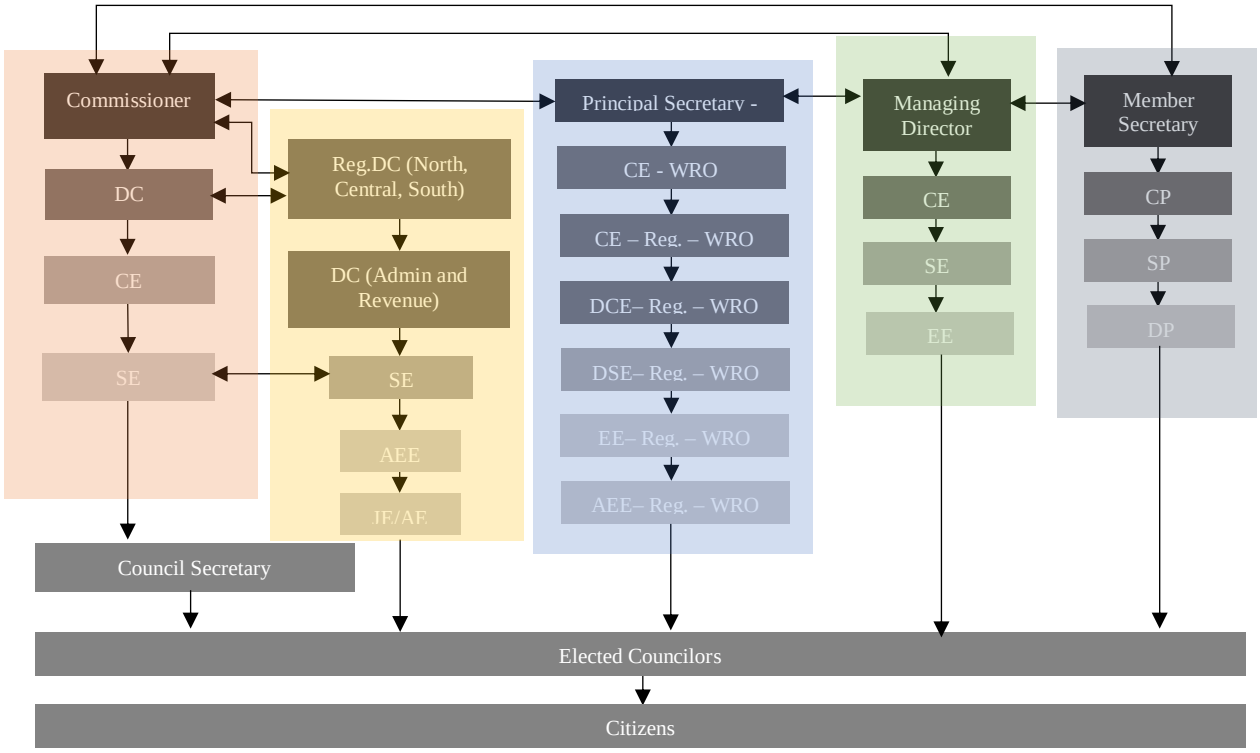
Similarly, the rules framed for monitoring the program and policies planned under the Masterplan is found to be weak as it lacks information on the list of indicators to monitor and fails to provide information on the size of sanction that will be imposed against breaking the rules. *For instance, from October 2013 to December 2016, ten meetings should have held against of which only two meetings have happened* (Chennai Metropolitan Development

Authority (CMDA), 2018). The rules have no information to enforce sanction against the actor for the lack of meetings. In total, the regulatory framework is not strong enough to improve the flood management process.

4.2.2.2 Informal Rules (Organisational Connection, Political Culture and Norms)

The empirical investigation clarifies that the organizational connection within the government network is shaped by the rigid bureaucratic hierarchy as shown in the Chart 4-2 Bureaucratic hierarchy of the government network. Basically, if one needs information from the government office a proper letter addressed to the head of the organization with the right title next to their name requesting permission for data is compulsory. Also, a formal presentation of a business card was asked and only then I was moved down the administrative hierarchy.

Chart 4-2 Bureaucratic hierarchy of the government network



Expansion	
DC	Deputy Commissioner
CE	Chief Engineer
SE	Superintend Engineer
AEE	Assistant Executive Engineer
JE	Joint Engineer
AE	Assistant Engineer
WRO	Water Resource Organisation
Reg	Regional
DCE	Deputy Chief Engineer
DSE	Deputy Superintend Engineer
EE	Executive Engineer
CP	Chief Planner
SP	Senior Planner
DP	Deputy Planner

Legend	
	Grade 1 officer
	Grade 2 officer
	Grade 3 officer
	Grade 4 officer
CoC	Corporation of Chennai
Zonal	Zonal Department that represents Corporation
WRD	Water Resource Department
CMWSSB	Chennai Metro Water Supply and Sewerage Board
CMDA	Chennai Metropolitan Development Authority
◄►	Double side Connection
►	One side Connection

Within the government network (CoC, CMWSSB, CMDA, Zonal, and WRD) most inter-departmental connections occur at the top-most levels of administration. Often, decisions made at top-level are imposed and informed to the lower level. For instance, the provision of SWD network under the Tamil Nadu Sustainable Urban Development Project (TNSUD) has been planned without the involvement of the zonal officer (Corporation of Chennai, 2015). The zonal officer stated, "*no discussion was made regarding plan preparation […], but we are questioned only when there is a problem*". Once the major plan was approved by the Commissioner of CoC, a public consultation was conducted and then the project was implemented by the SWD department engineers of the CoC (Corporation of Chennai, 2015). Subsequently, the maintenance of SWD network was passed on to the concerned zonal departments. During the maintenance, major inter-connections happen between the zonal officers and the SWD engineer. The zonal officers are the head of the specific part of the larger zones while the SWD engineers are nodal officers who directly implement the project and knows the ground realities. The zonal officer stated that *"often, the SWD engineer does not communicate with zonal officers except in the events of the problem*". Thus, the maintenance of SWD network becomes difficult as the zonal officer who is responsible to maintain has no knowledge on the SWD network. It becomes additionally complicated by the territorial overlaps among the different zones.

In the case of the relationship between WRD and CoC, WRD engineer stated that "*the canal and rivers are kept ready to receive the floodwater* [..] *so it's the responsibility of the SWD department to connect the drains to the river*". The interdepartmental connection between CoC and WRD becomes about knowing the limits of other departments. The WRD engineer does not recognize the importance of collaboration with the SWD Department to understand the ground realities in connecting with the rivers. Similarly, the relationship between CoC and CMDA is stalled by lack of flexibility between them. An ex-planner at CMDA explained that "*the approval process for building permission is complex for the building that shares the boundary of CMDA and CoC*". Though the building is a single unit the builder is supposed to avail the permission from the CoC for a portion that falls in CoC jurisdiction and avail the permission from the CMDA for a portion that falls in CMA. Thus, the inter-departmental connection is glued by simply adhering to the mandates and making the approval process complicated. Further, the relationship between CMWSSB and CMDA has weakened due to the lack of participation from CMWSSB in the monitoring meetings conducted among the CoC, CMDA, and CMWSSB. The ex-planner stated that "*though CMWSSB is part of the monitoring meetings they have never attended any meetings over the past two years".*

Apart from the organizational relationship, the relationship between the top-most bureaucrat and the people is ideally negligible. People are considered the lowest level of the bureaucratic hierarchy. *"Saravanan one of the coastal community leader recorded "that communities have resolved their own problems through themselves. […]. The current power structure has not involved participation and decision making by people* (Citizen consumer and civic Action Group (CAG), 2016)*".* Thus, the organizational connection between and within the organizations becomes a linear top-down relationship where lower officer follows to the orders of the higher-level officer and thus reinforces the strong rigidity and hierarchy in the system.

The strong bureaucratic hierarchy and rigid relationship are aligned by the respect for the political leaders. The entire city is decorated with the political murals and the pictures of the Chief Minister and the Deputy Chief Ministry of Tamil Nadu to show the respect the political leaders as shown in Figure 4-1 Posters of Tamil Nadu Chief Minister. Since the elected

Figure 4-1 Posters of Tamil Nadu Chief Minister

Source: The News Minute

representatives are more sensitive to the votes, the prioritization of projects at a top-most bureaucratic level often happens through the persistent pressure from the elected leaders. A newspaper report stated that "*the way the Government runs in Tamil Nadu by both the ruling (AIADMK) and opposition party (DMK) is no concern of rules and regulations. Everything is centralized around one person, especially with the ruling party (AIADMK) it is worse* (rediff NEWS, 2015)". For instance, there are many reports emerging about the delay in decision-making for releasing the water from the Chembarambakkam reservoir that led to flooding in 2015. *"Former Public Works Department minister for many years, Duraimurugan said, the decision of lifting the sluice gates of Chembarambakkam need not have been waiting at the Chief Secretary's office, who in turn was sending a note across to the chief minister for approval"* (The Times Group, 2015).

From the political perspective, the flood management is considered to have less political benefit compared to the water scarcity issues. Resolving the water scarcity problems has a political incentive when the state election outcomes are unsure. Therefore, prioritization is stressed on short-term benefits rather than long-term. Likewise, a person from the NGO expressed that "*politicians also take flooding an opportunity to pretentiously show their generosity and gather votes through providing flood relief measures"*(Citizen consumer and civic Action Group (CAG), 2016). Therefore, the behavior of political actor reinforces the divide between the long and short-term goals.

Despite the strong rigidity and linearity in the organizational connections, there are some informal personal level meetings held with other actors if necessary through either phone calls or meeting in person. However, the fear of blame culture developed due to the essence of the rigid hierarchical network dominates and limits the persons to experiment or advance their personal discussion.

4.3 Analysis of Coordination (Dependent Variable)

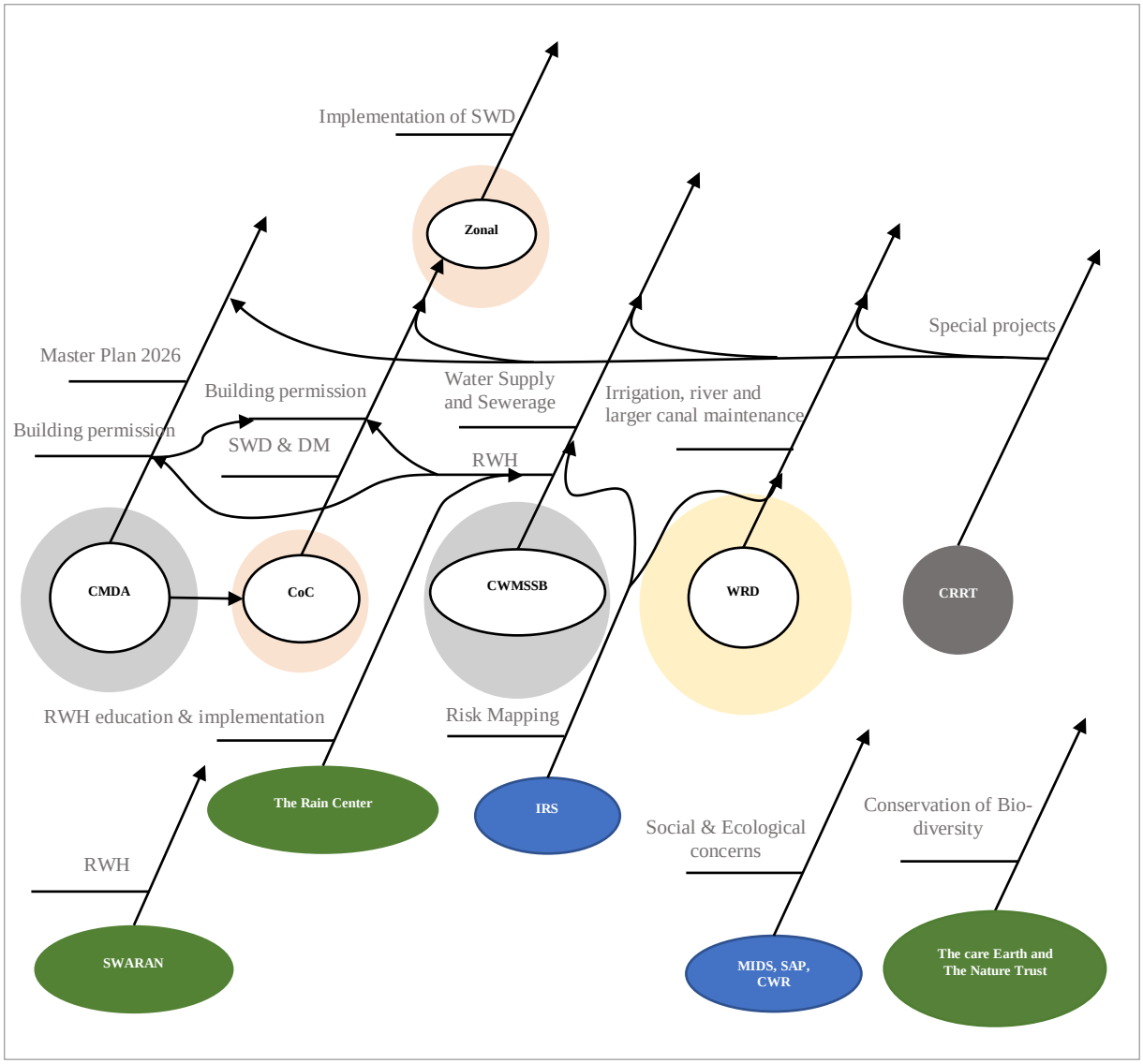
The Analysis of Coordination presents the five dimensions (communication, planning, commanding, execution and controlling) of the Fayol's management theory through empirical investigation. Investigating the different processes of communication, planning and reporting about the provision of SWD network and maintenance of macro drainage, preparation of Masterplan and provision of RWH to address the flooding problems reveals a much clearer picture on the actor's interaction. The analysis of Coordination is composed in three sections; Section 4.3.1 presents the actor's communication process. Section 4.3.2 presents the manner through which the actor plan, execute and control the projects and finally, the Section 4.3.3 presents the process through which negotiation among multiple actors occurs.

4.3.1 Communications

The empirical investigation shows that major communications among the actors occur in a parallel line with few points of intersections as shown in the Chart 4-3 Communication pattern

among the actors for flood management. The black arrow in the chart represents the functions of each actor that travel parallelly to the functions of the other actors. The few points of intersection that could be visible in the chart occurs owing to the territorial division or on the necessity basis. For instance, the communication between CoC and CMDA is visible as they share responsibility for providing building permit license in a different territorial jurisdiction. Similarly, there exists communication between WRD and IRS owing to the WRD dependency for the satellite map prepared by IRS. Hence, communication across the actors are not really planned but thrive based on the needs.

Chart 4-3 Communication pattern among the actors for flood management



Expansion	
CMDA	Chennai Metropolitan Development Authority
WRD	Water Resource Department
CoC	Corporation of Chennai
CWMSSB	Chennai Metropolitan Water Supply & Sewerage Board
CRRT	Chennai River Restoration Trust
SAP	School of Architecture and Planning
CWR	Center for Water Resources
IRS	Institute for Remote Sensing
SWARAN	The Save Water and Recharge Aquifers Network
MIDS	Madras Institute of Development Science

Legend	
	Predominant Government Network
	NGOs
	Academic institutions
	State Level Actor
	Metropolitan Level Actor
	Local level Actor
	Coordinating agency

RWD	Rain Water Harvesting
SWD	Storm Water Drains
DM	Disaster Management

As previously said, the provision of SWD is the primary methods applied to address the flood management. Therefore, it is important to understand the process of communication involved in the provision of SWD network. In 2008, the CoC engaged a consultant for preparation of a DPR (Detailed Project Report) for SWD network under the National Mission (Comptroller and Auditor General of India, 2017). The major communication for the plan preparation happened between the consultant and the CoC. The value of rainfall intensity and flood risk mapping was crucial for the preparation of SWD network. The consultant considered two methods for arriving at a rainfall intensity based on which SWD network was to be designed. They arrived at a rainfall intensity of 31.39 mm per hour under one method and 49 mm per hour under another method (Comptroller and Auditor General of India, 2017). The CoC adopted 31.39 mm per hour as the rainfall intensity and constructed the SWD network for 345 km. It was recognized that the second value worked by CoC's own consultant was almost similar to the values worked out by the CMDA and National Institute of Hydrology, Roorkee. This clearly indicated that the rainfall intensity adopted by CoC was incorrect leading to the lower construction of capacity SWDs that lead to the flood in 2015. The CoC has ignored the value of rainfall intensity per hour recommended by the Masterplan for SWD design. However, CoC has selectively taken up some recommendations from the Masterplan such as new canal and strengthening SWD network.

Similarly, the flood risk mapping which is one of the other primary inputs for the SWD design was prepared by IRS since 2005. These flood risk map prepared by IRS used the most modern method (Airborne Laser Terrain Mapping (ALTM)) and also spotted potential location for aquifer recharge. These maps were in prepared digital format and handed over to the government department so that it could be updated every year. However, due to lack of technological resources and lack of expertise the digital maps were not updated by the government offices. Further, the bureaucratic culture considers hard copies as more official rather than using the digital format. Thus, the use of modernistic approaches was found clashing with the bureaucratic culture.

Likewise in the case of the communication involved for the preparation of Masterplan 2026, CMDA did engage all the actors (CMWSSB, CoC, TNEB, WRD etc.) through the formation of committees (Chennai Metropolitan Development Authority (CMDA), 2018). The committee formed were responsible for the analyzing the existing data in their relevant arena and identifying the proposals. Subsequently, the identified proposals and analyzed data were submitted in the committee meetings to prepare a long-term Masterplan for the city. However, often the communication in the committee meetings was hampered due to the absence of the members. In some case, the members who attended the first meeting did not attend the second meeting and sometimes the meetings were attended by the lower-level officers of the organization who is inept (Comptroller and Auditor General of India, 2017). Consequently, the result of the Masterplan that intends to provide planned development for almost 8 million people stemmed with inadequate information. The Masterplan did not even provide for Flood Plain Zoning (FPZ), that specifies the distance from the water body up to which development/construction activities were to be restricted. It did not stipulate any rules for FPZ even in the DCR. When asked about it, the planner stated that *"if you depend on others [..], it's very difficult to get the data here and the plan could not be completed in the stipulated time. We don't have the proper information system"* Therefore, the communication between the actors has become completely distinct and selective. Further, the process of communication

among the actors has weakened by the lack of information sharing systems and technological resources, lack of participation and coalition.

4.3.2 Planning, Execution and Controlling

The empirical examination shows that the process of planning, executing and controlling are independent with each actor. The independent nature of planning, executing and controlling ignores the room for prioritizing and harmonizing the activities all the actor. For instance, the Chennai River Restoration Trust (CRRT) which is a trust formed in 2010 with an extended mandate to develop, maintain and conserve eco-parks in Chennai was supposed to dredge the Adyar river mouth to manage flood discharge (Comptroller and Auditor General of India, 2017). But, the Coastal Regulatory Authority, Government of India (GoI) restrained CRRT from dredging till the illegal sewage outfalls into the Adyar river were identified and plugged by the CMWSSB.

First of all, there is no holistic plan that engages all actors in the plan to work against flood management. All the actor prepares a distinct plan for flood management and executes it based on their own knowledge about flood management. For instance, CoC acts by preparing SWD network, CMWSSB acts by the installation of RWH structures at the street level, the WRD by the maintenance of larger water bodies and CMDA by restricting development along the environment sensitive zones through the Masterplan. The approach of distinct plan preparation is aligned through the division of each organization under a separate Ministry with separate funds. Thus, the organizational plans are bounded by the Ministry's order and fund. Further, implementation and monitoring are also bounded by their own Ministry's order and fund.

However, when there is a need for involvement from all the actors, a committee is constituted with representation from all the relevant actors required. For instance, the CMDA constituted a Masterplan committee and the sub-committee with representation from all the relevant organization such as CMWSSB, CoC, WRD, TNEB, TNHB, etc. The constitution of committee with the members of the relevant organization ensures the participation of the actor. Nevertheless, there are infrequent meetings and lack of response from the members of the committee (Comptroller and Auditor General of India, 2017). For instance, from October 2013 to December 2016, only two meetings only have happened out of ten meetings that should have been held (Chennai Metropolitan Development Authority (CMDA), 2018). Despite, providing a monetary incentive for attending meetings, there was no improvement in the attendance.

Thus, the planning, executing and controlling plans are independent of each actor. There is no cooperation between the various plans of the actors which could provide space for prioritizing and harmonizing the activities. The lack of cooperation is attributed to the absence of a holistic plan for flood management and the division of organizations under a distinct Ministry with separate funds.

4.3.3 Commanding

The investigation of commanding shows that the mechanism for negotiation among different actors is centralized. Often, when there is a need for negotiation within the organization the administrative head of the organization is capable of handling it. For instance, the commissioner of CoC handles the negotiation when there is a problem between the zonal officers and the SWD engineer. However, if there is a need for inter-organizational negotiation then the responsibility is transferred to the administrative head of the Tamil Nadu 'the Chief Secretary of Tamil Nadu' who is the steering head of almost all the committees. The responsibility of inter-organizational is centralized as the administrative head of each organization holds the same rank which makes it tough to arrive at a solution among the officers with the same rank. Hence, in 2010, CRRT was constituted to plan, coordinate, fund and

monitor along with other agencies for rehabilitation of Chennai waterways and water bodies (Government of Tamil Nadu, 2018). The CRRT is headed by the Chief Secretary of Tamil Nadu and forms the central commanding agency to negotiate the issues among the multiple actors.

Thus, inter-organization negotiations are centralized with the state government of Tamil Nadu while the intra-organization negotiation is controlled by the top-most official. There are no opportunities for the lower level officers to negotiate the problems and solve it themselves.

4.4 Relationship between the Institutions and Coordination

4.4.1 Summary of Institutions

The short summary of institutions is presented in Table 4-3 Summary of the Findings. The institutions in the flood management are characterized by a diversity of actors with varying strength, size, and power, the formal and the informal rules. The governmental network built around the flood management in Chennai has a broadly clear role and responsibility with distinct mandates. However, observing them closely reveals the complex problems due to overlaps in the responsibilities and territorial jurisdictions. On the other hand, the Non-government actors are a loose agglomeration with the strong informal connections and social capital resource at the local as well as the International arena. Despite restrictions from the government, the non-governmental actors have constantly brought attention to the ecological and civic problems. The government actors are independent as each actor is equipped with sufficient resources to plan, implement and monitor the projects. The independent nature of government actor has ignored the essential inputs from the non-governmental actors as well as inter-dependencies within the government departments.

The formal rules assembled around flood management consist of several regulatory frameworks at the central as well as state level to ensure the protection of the ecosystem and for ensuring planned development in the city. However, the policies and guidelines prepared at the local level for flood management lack of clear and detailed information on how to manage, who is responsible, what to be done if the actor has defaulted and who will be responsible to monitor etc. It also lacks the detailed implementation framework, monitoring methods and essential rules such as aggregation rules, payoff rules, and boundary rules. The weak regulatory framework opens the doors for the actors for flouting the mandates.

Further, the informal rules assembled around flood management is shaped by the rigid bureaucratic hierarchy and strong linear top-down relationship. The inter-organizational connection is limited to top-level bureaucrats and it becomes knowing the mandates of the other departments. The rigidity and narrow-mindedness among the organization have reduced the flexibility and perpetuated a fear of blame culture among the lower level officers. People have been positioned at the lowest level of the bureaucratic hierarchy and decision-making process. The strong bureaucratic hierarchy in the organization is aligned by the macro governance problem of political prioritization and centralization. Since political actors are sensitive to votes, prioritization at the top-most bureaucratic level is imposed by the pressure from political actors. The prioritization behavior of the political actors has reinforced the divide between the long and short-term goals and stressed the goals that have more political benefits.

4.4.2 Summary of Coordination

The short summary of coordination is presented in Table 4-3 Summary of the Findings. The coordination among the actor is characterized by the communications that occur parallelly with few points of intersection, independent planning, executing and controlling and centralized commanding. The communications across the actors are often not planned but occur selectively

based on the necessity. In some cases, the lack of technological resources and lack of expertise within the government network has made communication ineffectual. The local bureaucratic culture is recognized to be one of the obstacles to the use of modern methods of communication. Even though the committee has been constituted with the representation of the relevant actors, the communication has been not productive owing to the absence of members in the meetings and participation of inept officers. Overall, the communication among the actors is considered as a burden and a lengthy process due to lack of information sharing system and technological resources, lack of participation and coalition.

Similarly, the process of planning, executing and controlling are self-governed by each actor. The independent nature among the actor ignores the arena for discussion that is essential to prioritize and harmonize the activities all the actor. Most importantly, there is no holistic plan for flood management in the city that could engage all actors. All the actor prepares a distinct plan based on their own knowledge about the flood management and resource availability. The distinction in the plan preparation process among the actors is backed by the separation of each organization under a separate Ministry with separate funds. However, in the case of Masterplan preparation slight cooperation among the actors are noticeable but the strengthening of the regulatory framework is necessary to prevent the infrequent meetings and to make the members of the committee responsible and committed.

Further, the liability of commanding is centralized and limited to the top-most officials. The negotiation power within an organization is limited to the top-most administrative head of the organization. While the inter-organizational negotiation power is with the administrative head of the Tamil Nadu 'the Chief Secretary of Tamil Nadu'. Often it is tough to arrive at a solution when there is a negotiation among the officers with the same rank. Thus, the liability of commanding is always with the top-most level in the hierarchical order that ignores the chances for the lower level officers to negotiate the problems and solve it themselves.

Table 4-3 Summary of the Findings

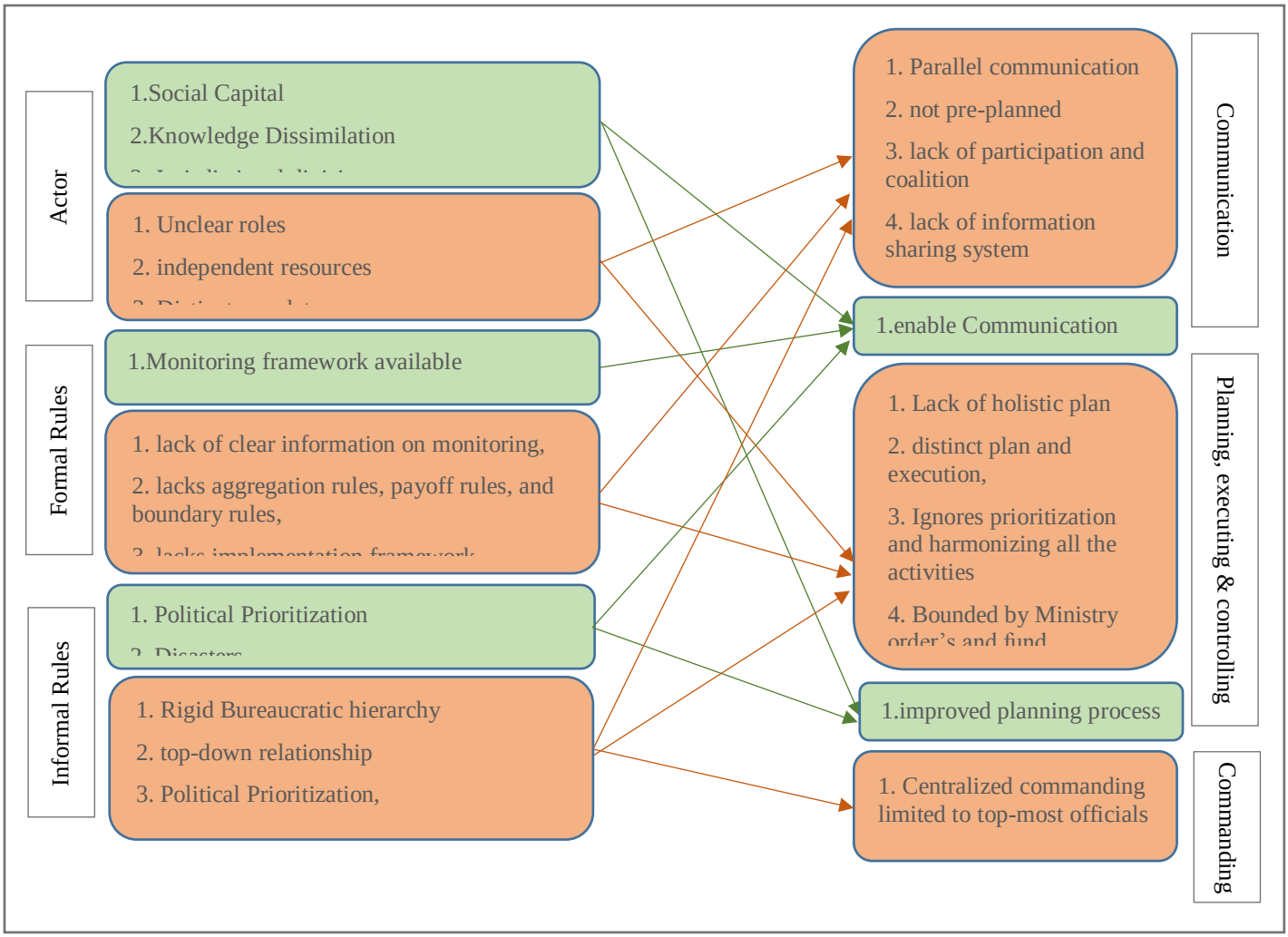
Variables	Sub-variables	Findings
Actor	Diversity	Variety of government and non-governmental actors
	Roles	Government actors with distinct mandates and overlaps in the responsibilities and territorial jurisdictions, non-governmental actors – knowledge dissimilation & creating awareness and campaigns
	Resources	Governmental actors - independent equipped with sufficient resources, lack inter-dependencies, Non-government actors with the strong social capital resource and informal connections
Formal Rules	Legal Frameworks	Lack of detailed and clear information, lack the systematic implementation framework, monitoring methods, lacks essential rules such as aggregation rules, payoff rules, and boundary rules
Informal Rules	Organizational Connection	rigid bureaucratic hierarchy and strong linear top-down relationship, narrow-mindedness, lack of flexibility, knowing the limits of others mandates
	Political Culture	political prioritization and centralization, sensitive to votes, stress on short-term goals,
	Norms	fear of blame culture, lack of participation, disrespectful behavior

Communication		parallelly with few points of intersection, not pre-planned but occur selectively and need-based, the lack of technological resources and skilled expertise – ineffectual communication, stress on local bureaucratic culture, lack of participation and coalition, a burden and a lengthy process due to lack of information sharing system
Planning		no holistic plan, distinct plan preparation and execution, self-governed by each actor, ignores prioritize and harmonize the activities all the actor, bounded by the Ministry's order and fund, lack of cooperation
Controlling		
Executing		
Commanding		centralized and limited to the top-most officials, ignores the chances for the lower level officers to negotiate

4.4.3 Relationship between Institutions and Coordination

The following sub-section presents the relationship between Institutions and Coordination. It explains detailly how each of the sub-variables of institutions influences the coordination among the actors. The Chart 4-4 Relationship between the independent and the Dependent Variable demonstrates the relationship between the independent variable and the dependent variable.

Chart 4-4 Relationship between the independent and the Dependent Variable



4.4.3.1 The Influence of actors on Coordination

The actors in the institutions part are characterized by the diversity of actors, their roles, responsibilities, and resources. Traditionally governance is carried out only with the governmental actors. However, there can also be involvement of private or non-governmental actor in the governing the public domain, for instance, as happened in the Dutch nature policy since the 1900s (Arnouts, van der Zouwen, et al., 2012). Kooiman (2003) states the essence of governance where both the governmental and non-governmental actors are involved in the process of governing is called "the totality of interactions, in which the public, as well as the private actors, participate, aimed at solving societal problems". Lockwood et al. (2010), identified interactions as one of the essential principles for coordination between the organisations. The Chennai flood management process is assembled with the diversity of actors which includes both the governmental and non-governmental actors. Despite the role of non-governmental actor is subservient due to the lack of encouragement from the government actors, their strong informal connections, and social capital resource has improved the communication and the planning process. For instance, the persistent and continuous efforts of the NGOs to prevent the development in the Pallikaranai Marshland has been recognised. In 2007, the Government of Tamil Nadu with the support from the Chief Minister declared the Pallikaranai Marshland under the Forest authority and set up a Conservation Authority of Pallikaranai Marshland (CAPML) with members of NGOs and the Government actors (Jameson and Baud, 2016, Jameson, 2014). However, the unclear roles, distinct mandates and independent nature of the government actors made the communications dynamics drive parallelly without cooperation with other actors. The exchange theory argues relationship among actors occurs when one actor is dependent on the resources of another actor (Hoffmann, Schiele, et al., , 2012). Similarly, agency theory perceives coordination as an instrument for conflict resolution that may arise due to sharing of responsibilities over a common resource (Brosius, Haki, et al., 2016). Since the government actors have distinct mandates, no shared responsibilities and equipped with sufficient resources to perform their functions, they do not have the notion of inter-dependencies. Thus, the government actors are independent in nature, self-reliant with no notion of interdependencies to perform their functions in a collaborated way.

4.4.3.2 The Influence of formal rules on Coordination

The formal rules assembled around the flood management in Chennai consist of several regulatory frameworks at the state as well as the central level to protect the ecosystem and establish planned development in the city. Despite having a robust regulatory framework, the policies, and guidelines are prepared at the local level lack clear and detailed information to facilitate communication, planning, implementation, and monitoring. The policies and guidelines lack sufficient information on the implementation framework, monitoring methods and essential rules such as aggregation rules, payoff rules, and boundary rules. Ostrom (2011) clearly specifies the importance seven rules for the actor's interactions to take place in the action situation. Notwithstanding the lack of information, the presence of monitoring enables the communication between the CMDA and CoC. But the effectiveness of the communication is weak due to the lack of participation from the members. The narrative organization theory highlights the necessity of formalized rules, procedures, plans, schedules and standardized to strengthen coordination by gluing the fragmented organizational structures (Sehested and Groth, 2012). Similarly, Ghorbani (2010) defines "rules as an instrument that influences the behavior of the actor". The formal rules lack strong controlling methods and penal rules, standardized information that allows the actors to default the meetings, violate the guidelines that obstruct the planning, implementation and monitoring process.

4.4.3.3 The Influence of Informal rules on Coordination

The informal rules assembled around flood management in Chennai is shaped by the rigid bureaucratic hierarchy and strong linear top-down relationship. The rigid bureaucratic hierarchy and linear top-down relationship are embedded through the political prioritization and centralization. The organizational theory states that when the system has a strong vertical integration then the horizontal integration will disintegrate (Kożuch and Sienkiewicz-Małyjurek, 2016, Mintzberg and Westley, 1992). The political pressure on the top-most level of bureaucrats has made the actors narrow-minded, bounded by the Ministry's order and fund, and perpetuated a fear of blame culture among the lower level officers. The main problem with the vertical power structure is that the distribution of power is uneven and unbalanced with most decision-making powers with the superiors of the organization (Olsen, 2006). Thus, each actor work focused only within their mandates and communicate only if there is a necessity. The actor neglects the room for harmonization of the activities of different actors. The political actor's nature of sensitiveness to vote has made the commanding system centralized and reserved with the state government. However, the political pressure has a positive impact in the case of conservation of Pallikaranai Marshland. Because the interview from the NGO stated that "*beyond* anything the disaster plays a vital role in improving the planning process and conservation of the ecosystem" The 2004 tsunami along with severe water scarcity issues has persuaded the last Chief Minister of Tamil Nadu to prioritize the Pallikaranai Marshland as the forest land. Thus, the effect of disaster combined with the political pressure has speeded and improved the communication, planning, executing, monitoring and commanding process. The political pressure has a dual effect where it can be viewed as a prize as well as a weapon based on the manner through which it is functional.

Chapter 5: Conclusions and recommendations

This chapter presents the final answers to the research the main research question and the sub-research questions based on the empirical findings and offers recommendations for further research.

5.1 Research Objective

The main purpose of the research was to understand the relationship between the institutions and coordination among the actors and explain how the aspects of coordination are influenced by the institutions in the context of Chennai flood management. Therefore, the research described what is meant by institutions and coordination through theoretical knowledge and then correlated with the empirical analysis. The empirical analysis outlined the institutions built around the flood management and explained the manner in which coordination among the actors occurs in Chennai. Finally, the relationship between the individual analysis of institution and coordination is correlated with the theoretical evidence.

5.2 What is meant by institutions in flood management in Chennai?

Theoretically, institutions are "*considered as the rule, norm or strategy that are humanly devised to structure the political, economic and social interaction and guide the behavior of the actors".* However, the empirical analysis of flood management in Chennai reveals that the institutions built around Chennai flood management are characterized by a diversity of actors with varying strength, size and power, the formal rules and the informal rules. The diversity of actors, the formal rules and the informal rules assembled around the flood management in Chennai are humanly constructed constraints or enablers that have structured the actor's communication, planning, executing, monitoring and commanding process. The engagement of diversity of actors drives the coordination through its strong informal connections, social capital resources and bring the attention to the problems in the international arena. However, the government actors lack cooperation among others due to the unclear roles, distinct mandates and no shared responsibilities or resources, weakness in the regulatory framework, rigid bureaucratic hierarchy and political prioritization. The formal regulation fails to structure the behaviour of the actor to enable cooperation owing to its weakness. The formal rules lack strong controlling methods and penal rules, standardized information that can alter the behavior of the actor to improve the participation, make the actors more accountable and responsible to cooperate with each other. However, the rigid bureaucratic hierarchy and top-down connections embedded through political prioritization have made the actors narrow-minded with lack of flexibility. The political actor's prioritization has made the distribution of power uneven and unbalanced with most decision-making powers with the superiors, especially retaining all the commanding powers with the state government. Notwithstanding everything mentioned above, the political pressure has also a positive impact in some cases such as the conservation of Pallikaranai Marshland. But, the positivity in the political pressure was influenced due to the disaster that struck the city. Thus, the institutions assembled around the flood management is built by the diversity of actors, the formal rules and the informal rules that structure the political, economic and social interaction and guide the behavior of the actors.

5.3 How does coordination take place among the actors involved in flood management?

The empirical evidence shows that coordination among the actors is characterized by the communications that occur parallelly with few points of intersection, independent planning, executing and controlling and centralized commanding. The few points of intersection that could be visible occurs owing to the territorial division or on the necessity basis. The

communications across the actors are often not pre-planned but occur selectively based on the necessity. In some cases, such as the communication between IRS and WRD, the lack of technological resources and lack of expertise within the government network has made communication ineffectual. The local bureaucratic culture recognizes the use of hard copies as more official thus blocks the use of modern methods of communication.

There is no holistic plan for flood management in the city that could engage all actors. All the actor prepares a distinct plan based on their own knowledge about the flood management and resource availability. Thus, the process of planning, executing and controlling are self-governed by each actor. The independent nature among the actor ignores the arena to prioritize and harmonize the activities all the actor. The actor communication, planning, executing and monitoring are bounded by the Ministry's order and fund. The liability of commanding is centralized and limited to the top-most officials. Thus, the actor's communication, planning, executing and controlling bounded by the Ministry's order that neglects the possibility of the actors to harmonize their activities.

5.4 Which are the factors that enable or constrain coordination among actors involved in the flood management in Chennai?

The empirical evidence reveals the list of possible institutional factors that affect the coordination among the actors involved in the flood management in Chennai. The list of factors includes that influences both positively and negatively. Firstly, the list of factors that positively influence coordination are the social capital strength, jurisdictional division, shared responsibility, monitoring framework, and political prioritization. The above-mentioned factors have improved or enabled the coordination among the actors. However, political prioritization is one of the factors that has the more positive impact.

Secondly, the list of factors that negatively influence coordination are the unclear roles and responsibility, distinct mandates, lack of sharing resources, weakness in the regulatory framework, lack of information, rigid bureaucratic hierarchy, and political prioritization. The above-mentioned factors have constrained the coordination among the actors. It is evident that political prioritization is repeated in both the constraining as well as the enabling factor. Because the political prioritization has a dual effect where it can be viewed as a prize as well as a weapon based on the manner through which it is functional. If the political actors are committed and accountable to the public then it could be viewed as a prize or it could be seen as a weapon when the political actors act for political benefit.

5.5 To what extent do the *institutions* influence *co-ordination* among different actors involved in the course of flood management in Chennai?

The findings from the empirical analysis correlated with the theoretical concepts uncover the explanation for the institutional factors that influence the coordination among different actors involved in the course of flood management in Chennai. It is understood that institutions built around Chennai flood management are characterized by a diversity of actors with varying strength, size and power, the formal rules and the informal rules. On the hand, the empirical analysis on coordination unveils that coordination among the actors is characterized by the communications that occur parallelly with few points of intersection, independent planning, executing and controlling and centralized commanding.

The institutional variable such as diversity of actors which includes both the governmental and the non-governmental actor in the process of governing the public has brought attention to the civic and ecosystem issues caused by the development activities carried

by the governmental actor. Though the role of the non-governmental actor is subservient, their strong informal connections and social capital resource have improved the communication and the planning process in the case of conservation of Pallikaranai Marshland. Further, the unclear roles, distinct mandates and independent nature of the government actors made the communications dynamics drive parallelly without cooperation with other actors. Government actors do not share responsibilities except in a few cases such as the building permit approval between CoC and CMDA. The shared responsibility of providing building permit license between CoC and CMDA has enabled coordination but the effectiveness is a doubt owing to the lack of participation of members in the monitoring meetings. The lack of participation of the members is embedded through the weakness in the regulatory framework. Despite having a robust regulatory framework, the policies, and guidelines that are prepared at the local level to facilitate communication, planning, implementation, and monitoring lack clear and detailed information. It lacks essential rules such as aggregation rules, payoff rules, and boundary rules mentioned by Ostrom to facilitate actor interactions. Since the rules do not provide strong controlling methods and penal rules, standardized information actors easily violate the guidelines and become lackadaisical.

Above all these, the rigid bureaucratic hierarchy and linear top-down relationship embedded through the political prioritization and centralization has made the actor narrow-minded and perform actions bounded by the Ministry's order and fund. The hierarchical rigidity in the organization has perpetuated a fear of blame culture among the lower level officers. Thus, each actor work focused only within their mandates and communicate only if there is a necessity. The actor neglects the room for harmonization of the activities of different actors. The main problem with the vertical power structure is that the distribution of power is uneven and unbalanced with most decision-making powers with the superiors of the organization. The political actor reserves the commanding functions with the Chief Minister of the state as they are sensitive about the votes. Thus, the chances for the lower level officers to negotiate the problems and solve it themselves is ignored. However, the political pressure also has a positive impact as seen in the case of conservation of Pallikaranai Marshland. The political prioritization has helped to convert the Pallikaranai Marshland into the forest land. Therefore, the political pressure has a dual effect where it can be viewed as a prize as well as a weapon based on the manner through which it is functional. Conclusively, the institutional factors mentioned above has positively as well as negatively influenced the coordination process among the actors.

5.6 Recommendations

The research uncovers the potential institutional factors that enable coordination and constraining factors that impede coordination among the actors. Considering those factors, the following are recommended:

- Shared responsibilities are essential instead of entertaining distinct mandates.
- Flexibility among the government department must increase for effective sharing
- Need for strengthening the regulatory framework in terms of more detailed information on monitoring, executing, payoff rules, aggregation rules, boundary rules
- Political actors needed to accountable to the public and committed
- Decentralization of powers to the lower level organisation is required
- Participation of people, NGOs and Academician needed to be encouraged

Further, to exactly describe to what degree the institutions influence coordination among actors, the research requires more detailed analysis and time for the data collection. This could

be an opportunity for the upcoming researcher to further dive into the research and explore the degree to which it affects coordination. Thus, the research on coordination from the institutional perspective has enabled the researcher to gain insights on the institutional factors that obstruct and enable coordination. The research has highlighted the importance of regulatory framework and the elements that are essential in the regulatory framework to structure coordination.

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Annex 1: Research Instruments - Interview Guide

Title: The Influence of Institutions on Coordination among the actors managing flood: A case of Chennai

Date: .....

Introduction: My name is Arunkumar Natarajan Subramanian, a Master student at Erasmus University in the Netherlands. I am basically from Paramakudi, a small town in Tamil Nadu, India. I am currently doing a research for my thesis. My thesis topic is about how institutions influence coordination among actors managing flood. As one of the individual working for an organization which is actively involved in managing the flood in this area, you are better placed to give an insight that can help in understanding this relationship. All the information I need is merely for academic purpose and will be treated as confidential. I would also like to inform you that this interview is dependent on your will and you are free to answer only questions you feel comfortable with.

If you are okay with this, we may commence the interview.

Name: Mobile: Email:

Organization: Designation:

Institutions

1) Can you mention the list of actors involved in the flood management?
2) What are your roles and responsibilities related to flood management?
3) Are your roles clear? Are there any overlaps or duplication of roles and responsibilities between your organization and others?
4) What kind of resources do you hold to manage flood? How do you share the resources with different actors involved in flood management?
5) In your opinion do you think are the resources equally distributed among the actors involved in flood management? Or is there one actor who holds important resource and dominate?
6) Which are the current laws, rules and regulation that govern the flood management? Which laws support your activities in flood management?
7) How are the relationships among different actors involved in flood management?
8) Does political pressure influence coordination among actors in flood management?
9) What kind of practices do you use to coordinate apart from the formal procedures? Personal phone numbers? Different than office hours?

Coordination

1) How often do you communicate with another actor? How do you communicate or share information or plan activities?
2) What do you communicate about flood management policies?
3) What is your comment on the effectiveness of communication?
4) Is there a strategic plan for flood management in this area?
5) What kind of technique are involved to engage all the actor? How effective are these techniques?
6) How are the different schedules of activities in the flood management initiated by various actors synchronized?
7) Is there any central authority responsible for giving order and directions for flood management?
8) Are there any partnership agreements to engage all the actors during implementation of the project?
9) Is there any monitoring mechanism to ensure the accomplishment each actors responsibility?

Conclusion: We have come to the end of the series of questions I prepared for this session. Since you are now familiar with of what this research is all about, do you think there is something else I should know? Something you would like to add?

Do you have any questions for me?

Thank you very much for the time you have accorded me and the important information you have given me. I really appreciate. This will be of great help for my thesis. I may also get back to you from time to time during the data collection process for clarification or additional information if you do not mind. As I stated earlier, the information is purely for academic purpose and will be treated with a lot of confidentiality. Thank you once again.

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