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An enquiry into the causes of the vanishing rivers in West Bengal, India

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Summary

The delta region of Ganga-Brahmaputra-Padma is characterized by very fertile land and dense population. West Bengal; a province/ state of India is part of this delta; — is also known as *nadi-nala r desh* (country of rivers and canals). Land-water-human nexus formed the basis of lives here. Despite this intimate social and cultural connections with nature, people are mindlessly exploiting natural resources. This study aims to understand this dichotomous relationship between human-biophysical system. It tries to do so by testing Elinor Ostrom's theory of effective commons governance in a specific condition. In this case, *Anjana* river is chosen as case. The research tries to investigate and explain to what extent the five prerequisite conditions of "effective commons governance" are satisfied for environmental governance of the *Anjana* river. In order to conduct the research, the research focuses on how much of the preconditions of effective commons governance can be applied for ecological governance of *Anjana* river. In order to do so, an in-depth analysis of spatial, social, economic, and environmental conditions over time is done. This analysis involves asking a representative sample of respondents from the area about the changes occurred in the area. The analysis also covers various aspects regarding the changes over 20 years (from 2000 and onwards). Therefore, the research strategy is a single case study which will allow to work with small units and large variables. Also, the research is primarily focus on questionnaire, interview, and content analysis, conforming to case study design. The results indicate that the five factors of *effective commons governance* i.e., *monitoring of resources, rate of changes, social capital, presence of outsiders* and *user support* does not affect *environmental governance* with equal intensity. Also, each factor themselves have nuances. While conducting the research, it is found that the adopted framework proved sufficient for testing. The framework helped to gain deeper insights about individual perceptions about environmental governance. However, a need of larger dataset is felt to justify the width and breadth of the subject. Also, the need of advanced statistical techniques like Neural Network is felt. However, these could not be achieved due to time constraint. At the same time, it is felt that several context specific issues like caste, property rights, politicisation etc. should be investigated. Such studies will help to understand the process of commons governance more accurately in this everchanging world.

Keywords

Commons governance, environmental governance, river, human perception, India

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Foreword

My interest in river governance started when I worked as a relief worker after floods around Kolkata in Sept 2000. The months of waterlogging and subsequent economic loss compelled me to think about it. Later, while working as a volunteer for Canning Juktibadi Sanstha, I had the opportunity to visit more parts of rural West Bengal. I found that small and large waterbodies have vanished due to the pressure of development. I noticed similar things for forests when I worked in a remote area near Durgapur, West Bengal. For four years, I observed how slowly but steadily the local forest is encroached, ground water level dropped, and intense variation in seasons occurred. I also observed the dichotomy of people's association with nature. I also observed the same from the writings of Rem Koolhaas and T. McGee that land plays a major role in climate change. These observations formed the foundation of my research on Anthropocene effects of climate change and its mitigation. As governance is a key factor in deciding the fate of natural resources in developing countries, governance aspect is chosen as the main theme for the current research. The case of *Anjana* river is chosen because of its rich history and current degraded condition due to Anthropocene effects. The current research i the first steppingstone of a larger research which will be about developing an integrated framework for pluvial flood mitigation in Bengal delta region via environmental, social, and economic aspects.

Abbreviations

IHS	Institute for Housing and Urban Development Studies
ECG	Effective commons governance
EG	Environmental governance
EPA	Environmental Protection Act, India 1986
CG	Commons governance
MGNREGA	Mahatma Gandhi National Rural Employment Generation Act
CBO	Community based organisation
NGO	Non-governmental organisation
CBI	Community based initiative
CPR	Common pool resources
SES	Socio-Ecological System
AG	Adaptive governance

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The climate is a common good, belonging to all and meant for all.

— Pope Francis, (2015). Laudato si.

The Bengal delta is so heavily populated. . .. If a ten-foot rise or even a five-foot rise in the seas were to happen. . .. Millions of people would lose their livelihoods. This is something we have to think about; it has to be at the forefront of our minds.

— Amitav Ghosh, (2004) in an interview with US chronicle.

The future lies in the countryside.

— Rem Koolhaas, (2019)

সহজ পাঠ

অঞ্জনা-নদী-তীরে চন্দনী গাঁয়ে
পোড়ো মন্দিরখানা গঞ্জের বাঁয়ে
জীর্ণ ফাটল-ধরা— এক কোণে তারি
অন্ধ নিয়েছে বাসা কুঞ্জবিহারী।
আত্মীয় কেহ নাই নিকট কী দূর,
আছে এক লেজ-কাটা ভক্ত কুকুর।
আর আছে একতারা, বক্ষেতে ধ'রে
গুন্‌গুন্‌ গান গায় গুঞ্জন-স্বরে।
গঞ্জের জমিদার সঞ্জয় সেন
দু-মুঠো অন্ন তারে দুই বেলা দেন।

Photograph 1: Poem on *Anjana* river, Rabindranath Tagore (*Source: Sahaj Path, Vol. II, 2017)*

Chapter 1: Introduction

Where there are formal relationships, there are rights.
Where there are rights, the earth, order reigns.
-Pope Pius XIII, The Young Pope, S1:E1

1.1 Introduction

The delta region of Ganga-Brahmaputra-Padma (Photo 1) is characterized by very fertile land and dense population. The region has been occupied for at least 1500 years (Roy, N., 2005). West Bengal; a province/ state of India is part of this delta; — is also known as nadi-nala r desh (country of rivers and canals). The monsoon brought frequent floods as well as deposited rich alluvial soil for agriculture. Torrents frequently altered the course of rivers giving rise to the concept of impermanence in society (Lahiri-Dut, 2014). Human-land-water nexus formed the basis of lives here. Despite this intimate social and cultural connections with nature, people are mindlessly exploiting natural resources. This study aims to understand this dichotomous relationship between human-biophysical system. It tries to do so by testing Elinor Ostrom's theory on environmental governance (EG) in a specific condition (Sarker & Itoh, 2001).

Photograph 2: 1st printed Map of Bengal; Petrus Kaerius (1598) (*Source: https://mappingbengal.com/first-map-of-bengal*)

1.2 Brief Historical Overview of Bengal delta[1]

The importance of rich alluvial soil of delta was first understood by Mughal kings in the 16th century for revenue generation. They did extensive survey of land and issued land titles to owners (Banerjee, D. N., 1936). In late 18th century, Britishers improved the existing land titling system. After independence in 1947, the same system was followed. However, there are ambiguities in land titling due to overlapping claims (Saxena, 2005). Britishers rejected the fluid landscape and converted the delta in a 'fixed geography' (Gupta, 2020)(Photo 2). Later, this became the starting point of environmental degradation. After India got independence in

Photograph 3: Map showing river system of Bengal; John Dower and Edward Weller (1863) (*Source: https://maps-prints.com/antique-maps-india-ceylon*)

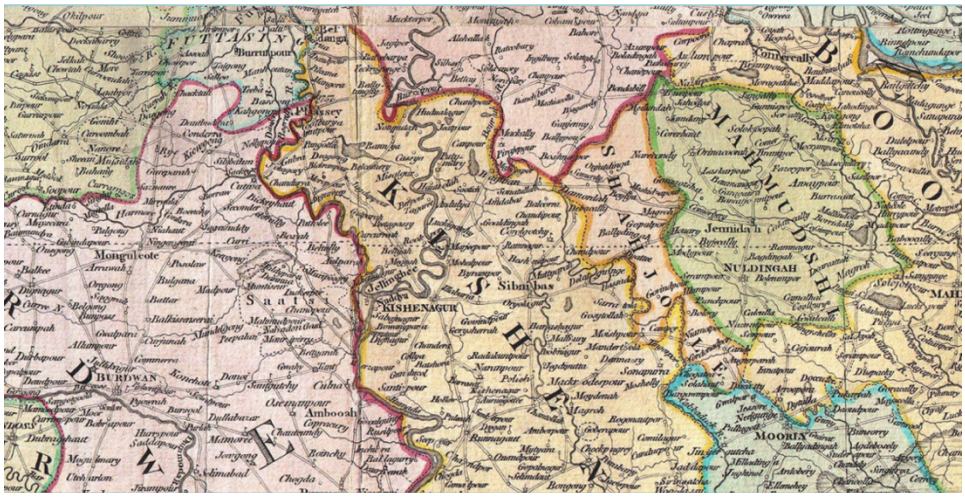
[1] The delta region of the entire Ganga-Brahmaputra-Padma spanning over India (West Bengal) and Bangladesh is known as Bengal delta. Four districts of West Bengal i.e., Nadia, North 24 Parganas, Kolkata and South 24 Parganas forms the Indian part of the delta. Among these, Nadia district lies in the upper Ganga delta region. The current study is restricted to a small area of Nadia district.

1947, the delta was divided into two parts. Major part fell into Bangladesh and West Bengal-India got 15%. In West Bengal, demand of land has increased due to in-migration in 1950s, 1960s and 1970s. In 1980s, leftist government redistributed land titles to marginal farmers (Lieten, Georges Kristoffel, 1996). This land reform, increase in population and migration resulted in fragmented land parcels. The economic slump and falling agricultural prices from 1990s have compelled people to invest more in land. The housing boom in 2000s with the support of State government accelerated land crisis even more (Sengupta, 2006). Today, there is a fierce competition between land-labour-capital in peri-urban regions of Kolkata (Mc Gee & Shaharudin, 2016). Very often, if land is not available, waterbodies are encroached. This practice deteriorates environment.

To protect water, air and land, Environmental Protection Act (EPA) was formed in 1986 (Singh & Misra, 1996). The Act is based on Article 21, 48A and 51A (g) of Constitution of India (India, 1949). The act was formed mostly to prevent exploitation of natural resources also played interesting roles in protecting common good, in this case waterbodies. It is found that, local governments like panchayats (village administration) play more active role in protecting the common good like water (Raman, 2005) (Bijoy, 2006). However, very often EPA is violated. Among these, Govt. of West Bengal committed one of the biggest violations of EPA and Ramsar Convention by constructing a highway in the middle of the East Kolkata Wetlands which is a Ramsar protected site[2] (Banerjee, S. & Dey, 2017).

1.3 Problem Statement

Despite the intricate human-land-water nexus in the region, the history of Bengal delta is riddled with tensions between its ecology, politics, and anthropogenic interventions for economic benefits (Iqbal, 2010). The once fertile region has seen constant population growth and uncontrolled urban expansion. Currently, the region is one of the most populous region in India[3] (*Census of India, 2011*2014). Urban land is acquired by converting agricultural land into



Photograph 4: Map showing Krishnanagar kingdom; Major James Rennell (1776) (Source: *Wikimedia Commons*)

[2] Ramsar Convention on Wetlands of International Importance is an international treaty for the conservation and sustainable use of wetlands. The treaty was signed at Ramsar, a city in Iran in 1971. East Kolkata Wetlands applied for the accreditation in 2002. It was declared as a Ramsar protected site in 2006.

[3] The population density of delta portion in West Bengal: Kolkata (24306 pp/sq km), North 24 parganas (2445 pp/sq km), South 24 parganas (817 pp/sq km) and Nadia (1316 pp/sq. km). (*Census of India,2011,* 2014).

habitable land (Chadchan & Shankar, 2012). West Bengal, the province where part of delta is located has experienced loss of 55194 hectares of agricultural land between 2001-10 due to urban conversion (Pandey & Seto, 2015). Along with this, recurrent cyclones in recent past have also destroyed 0.3 million hectares of arable land in the delta (Das, S., 2020). The cyclones are also triggering climate induced migration. Reports say that almost 70% people migrate from delta region of West Bengal due to crop loss, flooding, salination, poverty, political unrest, and malnutrition (Garg et al., 2021). Many migratory people is resettling in the peri-urban areas of the state capital Kolkata. As a result, the peri-urban areas of Kolkata are experiencing tremendous demand in land. To meet the demand, often waterbodies are encroached, and the traditional human-land-water nexus is altered (Mitra & Banerji, 2018)(Cornea et al., 2016) (News Correspondent, 2021).

Historically, ownership of waterbodies is divided between individuals (Photo 3 shows boundaries of kings defined by rivers), small groups (large families, informal water boards) and large groups (based on kinship). After independence, waterbodies are owned by government. However, to meet ever-increasing demand of land for urbanisation, waterbodies are encroached frequently by individuals due to lack of proper EG. This is most evident in the peri-urban region (Allen et al., 2017). As of 2021, communities still informally govern the waterbodies and plays a dichotomous role. People whose livelihood are dependent on the waterbody tries to protect it, while others try to exploit it and permanently alter the human-land-water nexus. One such example is seen in the case of *Anjana* river (Biplab et al., 2015) located at Krishnanagar, an important agricultural town in peri-urban Kolkata. Anjana river is located between 23°25′11.46′′N, 88°28′57.92′′E and Lat 23°16′56.25′′N, 88°35′01.51′′E (Fig 4). The river originates from Jalangi river. Then the river passes through the Krishnagar Municipality and rural areas such as Dogachhi (census town), Khirpuli, Hatboalia, Jalalkahali, Dharmmadaha, Patuli, Ballabpur, Badkula (census town), Gangni, Anjangarh, Chandandaha, Mugrail, Gagakhali, and Byaspur. After flowing 29 km it meets River Churni at Vyaspur village. The river is both distributary river as well as a connecting river as it distributes the excess water of Jalangi, and it is also connecting Jalangi and Churni. Today, Anjana has turned into a connecting rivulet full of water hyacinth and garbage.

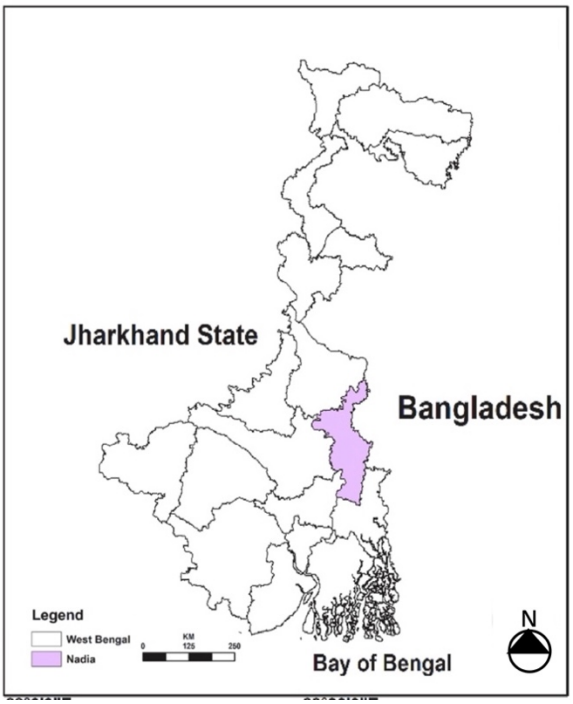


Figure 2: Map of West Bengal showing Nadia district (*Source: Author*)

Figure 1: Map of India showing West Bengal (*Source: Author*)

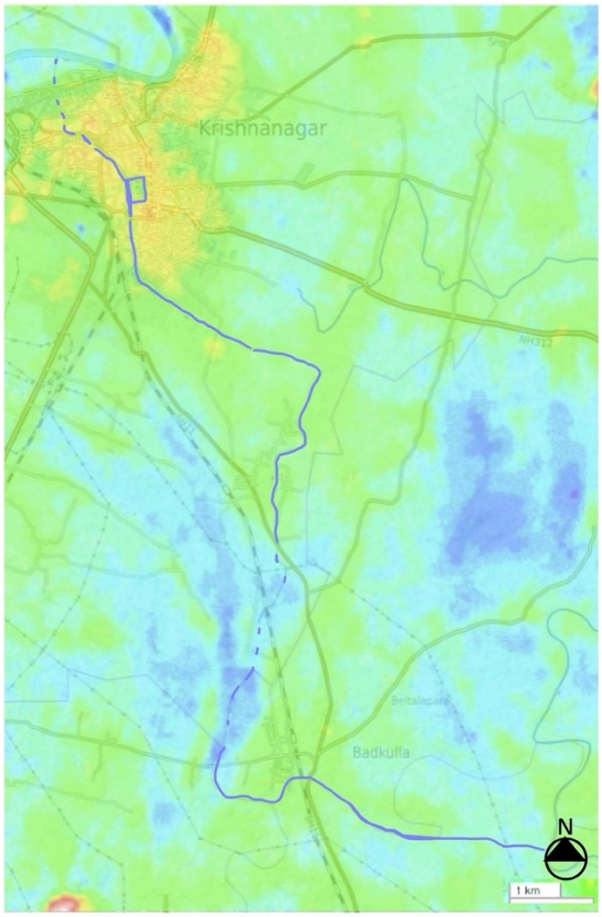


Figure 4: Elevation map of study area (*Source: Author*)

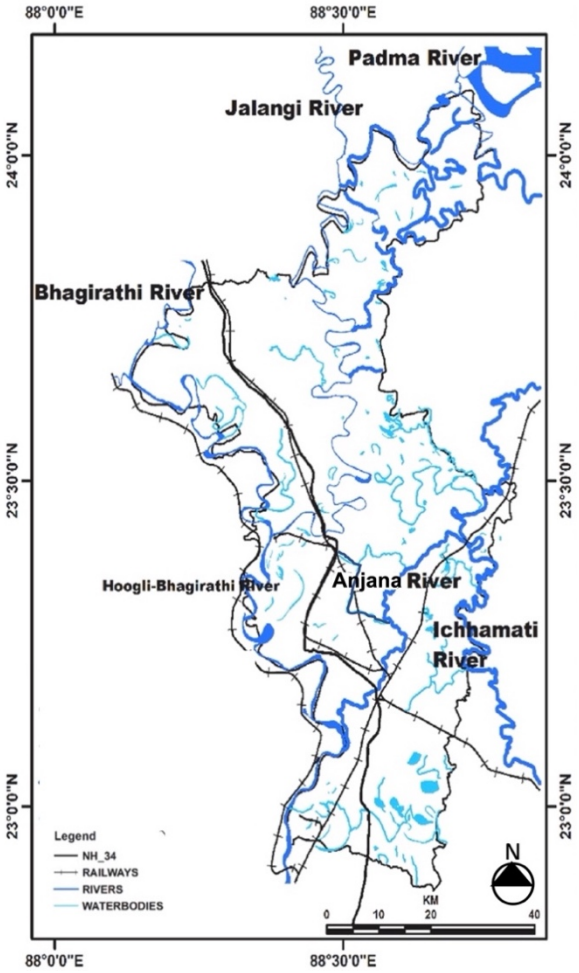


Figure 3: Map of Nadia district showing Anjana river (*Source: Author*)

Between 16th to 21st century, *Anjana* river was an important inland trading route in lower delta. The beauty of the river has been immortalised by poets (Photo 1) (Tagore, 2017)(Respatio, 2017). However, today in 29 km stretch of the river has been reduced to a stagnant drain (Sheikh, 2014). Encroachments have been made to build both houses, roads, bridges etc. This change has altered the local livelihood of local fishermen who switched livelihood as there is no water. In monsoon, the area gets flooded and remains waterlogged for months (Das, B. C. & Shaik, 2014). Several local community-based organisations (CBO) are campaigning about the vanishing river. Several media have visited the area. Local government finally tried to clear the riverbed in December 2020. The workers cleaning the riverbed are met with huge resistance from the encroachers (NFN NETWORK, 2020). The problem still lingers.

1.4 Research objective: commons governance as solution?

The complexity of the situation compels to think about the relationship between common good and community (Roy, A., 1999). One might argue that the case of *Anjana* river is a tragedy of commons as the government owned river is exploited by individuals. However, the tacit knowledge in the area contradicts this. Everybody understands the implications of the encroachment. Still, some are encroaching while others are trying to resist. This form of social cohesion resonates with Elinor Ostrom's theory of environmental governance which is diametrically opposite of Garrett Hardin's theory (Araral, 2014). According to Hardin, common properties can only survive under absolute government/ private ownership. Ostrom refutes the idea by demonstrating examples where communities or user groups tend to govern

the common properties in a successful way. In the case of Anjana, both aspects are present. According to Ostrom, EG[4] is easier to achieve if five prerequisite conditions are met. These conditions are if a) resources are monitored easily, b) there are moderate changes in resources, c) dense social networks are present d) outsiders can be easily excluded and e) users support the monitoring of resource (Dietz et al., 2003). It is acknowledged that these conditions are ideal and cannot be exercised altogether in real world.

In case of *Anjana* river, several the above-mentioned conditions are satisfied. The length of the river is considerably short, the changes are well documented through tacit knowledge, the stakeholders all known to each other, there is a dense social network and there are civil society organisations who support the river. Despite all these advantages, the river is still dying. The situation demands attention. Therefore, this study is proposed to assess the causes of demise of *Anjana* river through the lens of effective commons governance (ECG). It investigates why despite some conditions for ECG are present, EG is insignificant for the river. It tries to conduct the research over a period of 20 years (2000-2020) as the much of the spatial-socio-economic changes happened during this period. Thus, the objective of the study is to investigate and explain to what extent the five prerequisite conditions of "effective commons governance" are satisfied for environmental governance of the *Anjana* river.

1.5 Relevance of the Research topic

The specific context of the *Anjana* river has been chosen because i) pressure of urbanisation is less on the river, ii) non-existence of EG is more noticeable in these rivers, iii) historical precedents of communal river governance is still present, and iv) the usage of the river is influenced by these factors. Thus, it is assumed that ECG is present in the case of *Anjana* river. In the hydrological regime of delta, small rivers are equally important as main tributaries (Sarkar, B. et al., 2020). The small rivers contribute to drainage and water retention of the delta. They also serve large population by providing food and water. However, current human activities are threatening their existence. In addition, the nature of human-land-water in these rivers are evolving. In this context, a research gap exists on why there is lack of proper EG for the river despite the community fulfils many conditions of ECG. This research tries to fill this gap by understanding the exact nature of human-land-water nexus via checking the conditions of ECG and how they influence the EG of the river. By doing so, the research aims to find what can be done improve EG for sustainable development.

1.6 Research Question

To what extent are the five prerequisite conditions of "effective commons governance" satisfied for environmental governance of the *Anjana* river?

1.6.1 Research Sub-questions

The research sub-questions are derived from Ostrom's idea of effective common governance. Each sub-question tries to address one of the five prerequisite conditions mentioned by Ostrom (Dietz et al., 2003). This study tries to investigate each of those

[4] According to Dietz et al. (2003) to achieve Environmental Governance, Adaptive Governance is proposed. Its five requirements are discussed as providing information, conflict resolution, rule compliance, infrastructure, and adaptation. For the current study, it is assumed that Adaptive Governance is a method to achieve Environmental Governance. Also, current study emphasises on Environmental Governance. Thus, Environmental Governance is used synonymously with Adaptive Governance for the current study while using the same five requirements of Adaptive Governance. This approach is maintained throughout the study.

prerequisite conditions with environmental governance of *Anjana* river. Therefore, the sub-questions are as follows:

1. To what extent the use of the resources i.e., land, water and fish are being monitored easily, and the information regarding the same are verified and understood at relatively low cost for better environmental governance of *Anjana* river? *(Easy monitoring of resources)*
2. What is the rate of changes occurring around *Anjana* river regarding resources (land, water, and fish), resource-user populations, technology, and economic and social conditions changes that affect the environmental governance of the river? *(Rate of change)*
3. How the social network among stakeholders in terms of level of communication, density of social networks, potential for trust, participation and rule compliance affects environmental governance of the river? *(Social capital)*
4. What are the different roles of district government, state government and other user groups in terms of excludability, engagement and position that influences environmental governance of the river? *(Presence of outsiders)*
5. What kind of physical, financial, technical support and capacity building activities are available by various user groups for better environmental governance of the river? *(User's support)*

Figure 5: Hydrological map of West Bengal showing Anjana river (*Source: Banglar Nodi kotha, 2011*)

Chapter 2: Literature review/theory

I have only two wheels and only one vehicle.
Lord, you have put three stories on it.
The car moves on ponds, rivers, and land.
The vehicle is not on the water in the noon.
Lord, tell me how I can lose the burden of house.
-Bard Lalon Fakir, 18th Century Bengali folk song

2.1 Introduction

To understand the question on EG of Anjana river; a state-owned property used collectively by local people; — first, it is very important to understand the idea of human-land-water nexus. For the delta region of Bengal, rivers are not only an economic resource or a mean of transport; they are embedded in the life of the people. Here the relationship between human and water is physical, cultural, economic, and philosophical. The relationship is experienced simultaneously through "remembered past" and "witnessed present" (Ghosh, Amitav, 2005). Therefore, it should be understood in its own merit.

Secondly, the study of commons governance has historically progressed from collectivism to individualism to neo-collectivism. This phenomenon should be studied chronologically to understand the evolution of commons governance. Thirdly, the nature of relationship between river and human should be studied in the form of common pool resource. Fourthly, the prerequisite conditions of the ECG should be studied to deepen the understanding of requirements of good governance. Fifthly, the concept of environmental governance should be understood. Finally, alternative contextual approaches should be studied to understand the nature of governance of common pool resources.

2.2 On Human-Land-Water Nexus

The question of what land is traditionally addressed by saying land is something that exists in opposition to water. Oxford dictionary says land is "part of earth's surface that is not covered by water". This idea of land as *terra-firma* or dry land comes from a binary worldview congruent with Latin-Christian European cosmology (Thiele & Kaiser, 2017). It projected the supreme notion of "Sprit/ Flesh" on the Earth (Le Goff, 1992). It divided the earth into two parts; habitable areas around Jerusalem with "God's Providential Grace" and inhabitable rest which were "outside the Grace, had to be unhabitable" (Wynter, 2003) (Wynter, 1995).

Unlike the above, the cosmology of Delta region has embraced the ephemeral quality of nature from very beginning (Ray, 1901). Here, humans had to adjust to the constant flux between land and water and in between (Sinha, 1978). The constant reshaping of land by torrential rivers left deep mark in structural, social, economic, and cultural belief systems of the inhabitants. So much so, sometimes life is thought as a vehicle crossing through perilous river or *vobo-nodi*.

The exploration of these ephemeral *terra incognita* has been recently become a subject of academic interest. Geographers, anthropologists, and historians have taken interest in human-land-water nexus studies. The pioneers of these studies talked about social construction of nature to focus on evolving relationship between human and nature (Radkau, 2008).The study then moved forward to the concept of social nature, problematizing the relationship between indigenous communities and nature (Agrawal & Sivaramakrishnan, 2001). In South Asia, scholars have highlighted the interdependence of biophysical and socio-cultural domains. They researched on the deep connections between livelihoods of poor and local ecology (Gadgil & Guha, 1993).

Such studies have given rise to the concepts of flux, hybridity, liminal spaces, and co-existence. Firstly, the idea of nature in equilibrium is challenged; an alternate idea of ecological processes is described as dynamic processes shaped by path dependences and historical conditionalities (Zimmerer, 2000)(Zimmerer, 2007). This emphasis of flux gave rise to the second concept named hybridity. This second concept is based on anti-essentialism (Bhabha, 2012). This concept explores the idea of role of humans to construct environment along with natural ecological processes. The third concept emerged by introducing time. It is understood in two ways. First, the time is considered momentary. Here, the land is expressed as a liminal space between various degrees of wetness (Mathur & Da Cunha, 2009). This concept explains the previously inhabitable lands of swamps, marshes, shoals, islands and subsequently adapts to constant flux of chronological and topographical incidents of the area. Secondly, time is considered as a long-term force. It is said that built environment of delta region is moulded by the pressure of time, sediment, and human design (Bhattacharyya, Debjani, 2018). The role of time is and its impression on history and culture is also explored. In this regard, Amitava Ghosh's idea of experiencing phenomena simultaneously through "remembered past" and "witnessed present" is important (Ghosh, 2005).

For the current study, the relationship between human-land-water nexus is explored through the lens of hybridity and co-existence. It is assumed that facts cannot be understood based only on empirical evidence. Thus, oral history and human perception are also important to fully comprehend the reality. Therefore, this study will focus on both "factual" and "perceived" explanation of phenomena.

2.3 On Collectivism-Individualism-Neo-collectivism

The Western approach to collectivism starts with Marx's approach to class division and conflict theory. Later institutional economists like Thorstein supported the idea by saying that while the working class are expected to be diligent, efficient, and co-operative for better means of production (collectivism), the owners of the businesses show conspicuous consumption and leisure (individualism) (Veblen & Mills, 2017). This idea was further expanded by Galbriath on his study on how American private sector was flourishing while the public sector was weakening (Galbraith, 1998). This idea of institutional economics was always countered by neoclassical economics, where it is assumed that maximization of individual interest can be aggregated to maximization of common interest. Individualism/ neoclassical economics took the first hit when Hardin published his seminal paper on tragedy of commons (Hardin, 1968). According to Hardin, the maximization of individual interest leads to overuse of common pool resources like grazing fields rather that leading to maximizing common interest and public benefit. This gave rise to the New Institutional Economics (NIE). Soon NIE branched into six different parts. They are New Economic Theory, Public Choice and Political Economy, New Social Economics, Transaction Cost Economics, Theory of Collective Action and Law of Economics. It further developed into social capital, property rights literature and economics of information (Sheaff, 2000). Among these, The Theory of Collective Action (TCA) became very important to understand the behaviour of the beneficiaries/ actors engaged with the common pool resources (Ostrom, 2007). The NIE reinstated the importance of role of collectivism in the progress of society. More importantly, NIE, especially TCA have shown the weaknesses of neoclassical economics i.e., the progress of society is dependent on collective actions, rather than maximization of individual interest.

Since the current study is concerned with the environmental governance, which is a subset under the concept of governance, the idea of neo-collectivism is explored. Subsequently, common pool resources are selected as focus area of study.

2.4 On Common Pool Resources (CPR)

Common pool resources (CPR) are natural or man-made goods which a) have low excludability and b) show high rivalry (Ostrom, 1994). The inherent nature of low excludability implies how individual needs and self-interest might influence the governance of CPRs. It also shows how local governance and social dynamics can stimulate the governance due to the rivalrous nature (Udéhn, 1993) (Kuhn, Steven, 2017) (Kuhn, S. & Zalta, 2003). Hardin published the seminal paper on common pool resources called Tragedy of Commons in 1968. The paper discussed how natural common pool resources like fisheries, river, mountains, forests etc. can get destroyed if left to maximization of individual interests. This paper triggered research on characteristics of common pool resources (CPR), what are the behaviours of beneficiaries of CPRs and how to manage or govern CPRs. Among these, the first theory emerged to counter the tragedy of commons is prisoner's dilemma (Kuhn, S. & Zalta, 2003) (Kuhn, Steven, 2017). It says that, sometimes all beneficiaries intentionally defect in their self-interest and underuse the CPR. As a result, the CPR remains usable for a long term. In other cases, the beneficiaries intentionally overuse the CPR, and the CPR gets destroyed. Olson also supports this idea that beneficiaries are not naive, they act on self-interest. According to Olson, groups act over self-interest or altruism occurs only when the following conditions are met a) group size: number of the beneficiaries is small/ stronger ties, b) coercion: beneficiary must follow an external or internal mandatory commitment, c) action: beneficiaries must do some "action" (acts to produce collective goods) and d) incentive: every beneficiary is rewarded materially or socially (Udéhn, 1993).

Later, Ostrom refutes Olson's Theory of Collective Action (TCA) by saying that coercion is necessary for a group of beneficiaries to act. She says that under certain conditions, the group of beneficiaries self-organize themselves to manage or govern the CPR. According to Ostrom, this managing or governing of natural CPR via self-organization can happen by a) defining clear group boundaries, b) matching rules governing use of common goods to local needs and conditions, c) ensuring that those affected by the rules can participate in modifying the rules, d) making sure the rule-making rights of community members are respected by outside authorities, e) developing a system, carried out by community members, for monitoring members' behaviour, f) using graduated sanctions for rule violators, g) providing accessible, low-cost means for dispute resolution and h) building responsibility for governing the common resource in nested tiers from the lowest level up to the entire interconnected system (Walljasper, 2011). This theory of Socio-Ecological System (SES) does not talk about group size, rather it talks about group boundary; it does not talk about action, rather it talks about rules and rights and finally it does not talk about incentives, rather it talks about sanctions. Ostrom's theory on Governing of Commons concerns about the characteristics of natural CPR based on its interaction with owners' behaviour.

For the current study, emphasis is given on Ostrom's theory on Governing of Commons in order to understand environmental governance of *Anjana* river. The further study concerns with conditions of effective commons governance, environmental perception, and environmental governance.

2.5 On Commons Governance (CG)

More than 30 years have passed since Ostrom proposed the theory of CG in 1990s. Since then, the study has taken diverse routes in both theoretical and applied fields. Many scholars have criticized the theory; only to enrich the same. The definition of commons has evolved from only natural resource to anything which is a type of shared resource (natural resource, knowledge, urban, electronic or any other type of shared resource) (IASC,). Since its inception, Ostrom's idea is used to understand the various types of institutional governance that is

necessary for sustainable forms of resource extraction. The core problem of Ostrom's TCA is to determine the collective outcome by accounting all possible individual action in a particular context. Study of such actions have intensified since 1990s. Studies have evolved from field observations to quasi-experimental studies and meta-analysis (Poteete et al., 2010). At the same time, global and local applications of CG have branched into new studies (Stern, 2011). It has also become a core element of studying complex socio-ecological systems (SES). The complexity in the studying natural resource lies not only in the heterogeneity of the resource, but also the complexity in the culture associated with the resource. The discourse of CG has developed into several new areas. First of them is negating the tragedy of commons. It was proposed that the solution of tragedy of commons themselves will produce tragedy of public domain and tragedy of private property (Young, 2011). The issue of trust and rule compliance between stakeholders are also widely discussed (Van Laerhoven, 2010). Here the complexity lies in trust in action (cooperative behavior among stakeholders) and trust in information (trustworthiness of the information) (Henry & Dietz, 2011). The question of how property rights affect CG has also become important (Carol M. Rose, 2011). In this regard, the emergent idea of anti-commons and semi-commons is also important (Heller, 1998) (Smith, 2000). Some scholars have expressed their concerns about the debauched characteristics of informal governance of commons (such as male dominant customary laws). The emphasis on exclusion and boundaries are also criticized since it does not fit with the bundle of rights metaphor (Fennell, 2011). This criticism is overturned by five resource control rights i.e., access, withdrawal, management, exclusion, and alienation (Schlager & Ostrom, 1992). Later these five controls rights are updated and clubbed into use rights, control rights and authoritative rights (Sikor et al., 2017). Others have underlined the importance of the heterogeneity of actors, politics, incomplete information, and self-interest on outcome of CG (Eggertsson, 2011). Regarding the aspect of governance, the role of power, knowledge and conflict has been discussed (Burns & Stöhr, 2011). The difficulty of governance is due to the complexity of SES and mistrust between actors. These difficulties lead towards polycentric governance. The role of social capital in CG is also discussed. It is found that the role of government and social capital is not well discussed theoretically. Later it is found that for developing countries, at community level social capital requires both bonding and bridging (Rudel, 2011). It is also said that commons, common property institutions, and development can be merged together to form new research avenues.

The current study is restricted to Ostrom's (2003) theory of effective commons governance (ECG) which concerns five factors— *easy monitoring of resources, moderate change in resources, good social capital, no presence of outsiders and high user support*.

2.6 Trends in Environmental Governance (EG)

Studies on EG started in early 1960s. The subject became important in 1990s. By 2006, several discourses in the subject are discussed. Redefining EG has a wide set of customary and regulatory processes rather than international governance mechanisms, hybrid forms of governance (co-management, public-private partnership, and social-private partnership), utilization of individual incentive-based market-instruments, local funding/ self-funding of EG, efficiency and resilience (Lemos & Agrawal, 2006). For the current study, a systematic literature review is done for 10 years (2011-2020) to understand the trends of the discourse on EG (Table 1). It is done using the Scopus. Among the 16 most cited literature studied, some recurrent themes emerged. First, the importance of community-based approach and the importance of local knowledge in EG is explored (Conrad & Hilchey, 2011) (Tengö et al., 2014). This approach later evolves into collaborative environmental governance with social-ecological fit (Bodin, 2017). Secondly, the relationship between complex theory, wicked problem and EG studied (Levin et al., 2012) (Sayer et al., 2013). Incremental and process-

oriented governance is discussed as solutions. Thirdly, definition of EG and contemporary challenges are studied (Chaffin et al., 2014). Fourthly, to overcome the barriers of successful implementation of EG, especially market failure due to non-incentivised non marketed systems, incorporating natural capital and ecosystem services in EG is advised (Guerry et al., 2015). This later expanded into incorporation of context-based nature-based solutions in EG (Kabisch et al., 2016). In this regard, application of nature-based solutions to tackle pluvial flooding in Chinese cities became important. The role of continuous research, knowledge sharing, participatory governance network, increased role of government for creating favourable conditions, and adaptive spatial planning and policy development is recommended (Jiang et al., 2018). On the other hand, the limitation of applicability of nature-based solutions are discussed and called for an integrated system-thinking based framework for achieving climate goals (Seddon et al., 2020). Fifthly, the importance of land on successful EG in investigated and scalable context based adaptive governance is proposed (Carter et al., 2015) (Bren d'Amour et al., 2017) (Keesstra et al., 2018). Finally, the impact of COVID on EG is explored. A solution is proposed for better management of cities which is a hybrid of technology driven approaches and human driven approaches (Sharifi & Khavarian-Garmsir, 2020).

As the literature review suggests, there is a growing interest among scholars regarding complex systems, system thinking, context-based approach and participatory governance. However, the human perception on EG and condition of EG in peri-urban areas are underestimated. The literature on Asia suggests that both are very important to understand the complexity and

Table 1: Chronological literature review of Environmental Governance between 2011-2020 (*Source: Author*)

Year	Author	Name	Area of research	Contribution	Importance
2011	Conrad and Hilchey	A review of citizen science and community-based environmental monitoring: issues and opportunities	Community-based monitoring, Social capital	Identifies different types of monitoring (commodity-based, non commodity based, status assessment, impact assessment etc.), different types of governance (consulttive, collaborative, transforamtive) and the benefits and challaenges of community-based monitoring	Explores the different aspects of community-based monitoring; shows the importance of community-based monitoring in environmental governance
2012	Levin et al.	Overcoming the tragedy of super wicked problems: constraining our future selves to ameliorate global climate change	Wicked problems, Climate change, Path dependency	Identifies four types of 'wicked problems' related to climate change: lack of time, provider of solution is same as creator of problem, lack of central authority and quick fixing of policies. Gives solution to these 'tragedies' through progressive increment, long-term support and expanding the stakeholders.	Explores the relationship between complex theory and climate change; provide adaptive and incremental solutions for environmental governance
2013	Sayer et al.	Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses	Food security, Integrated development approaches, Environment tradeoffs	Tries to provide social, economic and environmental solution for land management in rural areas w.r.t. agriculture. Tries to give 10 principles to through 'landscape approach' as solution. The principles include adaptive management, stakeholder involvement, and multiple objectives	Explores the wicked problem of climate change, food demand and conservation; shifts the discussion from e "what" and "where" to "how" and "why" of managing the agriculture–environment nexus.
2014	Tengo et al.	Connecting Diverse Knowledge Systems for Enhanced Ecosystem Governance: The Multiple Evidence Base Approach	Local knowledge, Co-production of knowledge, Ecosystem assessments	Presents multiple evidence base (MEB) approach which promotes indigenous, local and scientific knowledge systems for generation different manifestations of knowledge regarding socio-ecological systems. Identifies the need of inter-cultural dialouges, collaborative institutional culture, scalable indicators, synergy and contextualisation and new methods of assessment	Explores the importance of local knowledge, scale, cultural aspects and contextualisation in socio-ecological systems
2014	Chaffin et al.	A decade of adaptive governance scholarship: Synthesis and future directions	Adaptive governance, Environmental governance, Resilience	Reviews a wide range of literature on adaptive governnce. Defines adaptive governance as a range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems. Discusses ambiguities in adaptive governance scholarship. Proposes alternatives to entrench adaptive governance in existing socio-ecological systems for resilience.	Summarises 10 years of literature on adaptive governance/ environmental governance. Opens up three new avenues of research: adaptive governance and good governance, method of successful adaptation and barriers regarding adaptative governance
2015	Guerry et al.	Natural capital and ecosystem services informing decisions: From promise to practice	Sustainble development, Decision making, Resilience	Tries to understand social, economic and environmental systems for poverty alleviation and sustainable consumption. Tries to incorporate natural capital and ecosystem services in decision making/ adaptive governance. Proposes to develop more empirical evidence regarding impact of inclusion of natural capital and ecosystem service on governance, develop stronger ties with existing governance systems and transforming existing governance to better align private short-term goals with societal long-term goals.	Introduces natural capital and ecosystem services in adaptive governance systems. Tries to correct the market failure (no incentives for nonmarketed ecosystem services or the sustainable use of natural capital that supports these services) by incorporating natural capital and ecosystem services in susatinable development goals.

Year	Author	Name	Area of research	Contribution	Importance
2015	Carter et al.	Climate change and the city: Building capacity for urban adaptation	Climate change, Urban planning, Adaptation	Tries to understand appropiate governance structures for adaptive capacity building. Proposes to develop a collaborative, sociotechnical agenda for meeting the climate change adaptation challenge in cities	Incorporates spatial planning in adaptive governance systems. Tries to build a contextualised, adaptive, resilient infrastructure. Suggests proper scalable adaptive governance for that.
2016	Bennet, N.	Using perceptions as evidence to improve conservation and environmental management	adaptive management, conservation social science, environmental governance, evidence-based conservation	Brings out the deficiets of auditing of conservation projects. Proposes perception as alternative and gives definition. Identifies four distinct categories of insights that studies of local perceptions can provide to improve conservation policy and practice: social impacts of conservation, ecological outcomes of conservation, legitimacy of conservation governance, and acceptability of conservation management	Introduces human perceptions and local knowledge in environmental govrenance. Contributes to the research on perceptions of conservation to improving adaptive and evidence-based conservation.
2016	Kabisch et al.	Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action	climate change; cobenefits; governance; nature-based solutions	Explores the various contexts in which nature-based solutions are relevant for climate mitigation and adaptation in urban areas. Understands existing barriers and potential opportunities for increasing the scale and effectiveness of nature-based solution implementation. Highlights three factors for future successful implementation, i) producing stronger evidence on these solutions, ii) introducing context based reflexive solutions and iii) consider socio-environmental justice and social cohesion while implementation	Explores the impact of nature based solutions on environmental governance. Talks about more robust, contextual, inclusive solutions for climate mitigation with additonal cobenefits
2017	d'Amour et al.	Future urban land expansion and implications for global croplands	urbanization, global land use change, livelihoods, agricultural productivity	Explores the relation between urban expansion and cropland reduction. Highlights four areas: compensating cropland loss, transtioning food system, good govrenance and livelihood and food security. Regarding governance, highlights the importance of urban governance, political will, transfer of development rights and pollution fees. Gives emphasis on urban policy makers to contain the urban expansion for sustainable development.	Explores the impact of cropland reduction and urban expansion on environmental governance. Talks about role of urban good governance in the overall sustainable development.
2017	Bodin, O.	Collaborative environmental governance: Achieving collective action in social-ecological systems	Collaborative environmental governance, social-ecological systems	Talks about collaborative governance arrangements in addressing collective action problems. As environmental problems are inherently complex problems, a network based approach is proposed. The network works on strengthening the existing database by learning among actors. These learnings will increase the social-ecological fit of the network. Also talks about the contextual and need based approach.	Explores a new idea of collaborative environmental governance for better environmental governance. Also talks about social-ecological fit for the governance.
2018	Keesstra et al.	Soil-Related Sustainable Development Goals: Four Concepts to Make Land Degradation Neutrality and Restoration Work	land degradation neutrality; regenerative economy; nature-based solutions; land use planning	Talks about importance of land in addressing SDG problems. Proposes systems thinking, connectivity, nature-based solutions, and regenerative economics as an integrated solution to stop land degradation. Puts emphasis on awareness of different types of governance, economy and landscape and land-use planning and management to achieve this.	Puts land in the forefront of environmental governance. Talks about solutions based on a socio-ecological systems analysis.
2018	Jiang et al.	Urban pluvial flooding and stormwater management: A contemporary review of China's challenges and "sponge cities" strategy	Urban pluvial flooding, Stormwater management, Urban planning, Governance	Talks about China's sponge city strategies to tackle urban pluvial flooding. Talks about its challenges including technological and governance. Proposes four solutions—i) continuous deep learning through peer learning, 2) establishment of participatory, coordinated and integrated governance, 3) increased government role in creating favorable conditions for investments, and 4) appropriate spatial planning and an adaptive approach for policy implementation.	Explores a specific nature based solution for climate mitigation. Addresses the various challenges for implemneting such solutions. Gives importance on adaptive governance to facilitate such solutions.
2019	Carvalho et al.	Protecting and restoring Europe's waters: An analysis of the future development needs of the Water Framework Directive	Water policy, Assessment, Monitoring, Governance	Analyses Water Framework Directive as a mean to protect and enhance aquatic ecosystems and promote sustainable water use across Europe. Proposes to enhance the Directive by using trait-based approaches and e evidence-driven decisions in river basin management. Talks about mainstreaming water policy to reduce flood, better waste water management, better irrigation etc. Argues for a a permanent framework for river basin management.	Explores framework for transboundary solution for water govrenance. Addresses the various stressors, policy integration problemas for implemneting such framework. Gives importance to a permanent framework to abosorb changes.
2020	Sharif and Khavarian-Garmsir	The COVID-19 pandemic: Impacts on cities and major lessons for urban planning, design, and management	COVID-19, Environmental factors, Smart cities, Urban planning	Analyses the impact of COVID-19 on urban areas regarding environmental quality, socio-economic impacts, governance, transportation and urban design. Regarding governance, it is found that lack of contingency planning is a major reason for failure in governance. Technological aspects like contact tracing, contactless delivery and payment etc. has impoved the containing of COVID.	Explores relationship between COVID and urban planning. Suggests a hybrid of technology driven approaches and human driven approaches for better management of cities.
2020	Seddon et al.	Understanding the value and limits of nature-based solutions to climate change and other global challenges	adaptation, mitigation, sustainable development, ecosystems	Analyses the cost-effectiveness and reliabilty of nature based solutions. Also studies impacts of highly sectoralised climate policy on nature based solutions and barriers for implementations. Proposes a safe and responsible consumption pattern with biophysical limits, systems-thinking approach taking account for multiple ecosystems and benefits.	Explores the current limitations of nature-based solutions. Calls for a integrated system-thinking based framework for achieving climate goals.

challenges regarding the successful implementation of EG. Thus, the current study focuses on how human perceptions affect the EG in peri-urban areas. Another underestimated aspect is

the perspective of looking river as a complex system of land, water, fish and human. They should not be separated. Thus, the current study focuses on all those systems.

2.7 On Effective Commons Governance (ECG)

Humans, to maintain a certain quality of life, make certain rules under uncertain conditions constrained by belief systems and biophysical systems. Common pool resources become more susceptible to these rules because of their low excludability and highly rivalrous nature. Therefore, effective commons governance is required. According to Dietz and Ostrom (2003), governance of common pool resources is easier when there is *easy monitoring of resources, moderate change in resources, good social capital, no presence of outsiders and high user support*. These aspects are discussed below.

1. *Easy monitoring of resources*: This aspect concerns about if a resource can be monitored easily and the information regarding monitoring can be verified and understood at low cost. In this regard, land, water, and fish should be studied together as they all contribute to the EG of the river.

2. *Rate of change*: This aspect mentions that if there are moderate changes occurring around resources, resource-user population, technology, and economic and social conditions changes then it can be assumed that the resource can be easily governed. Among these, socio-economic conditions like daily income, dynamics of occupation etc. are very important. As many scholars have noticed, environmental condition in India is deeply interdependent with livelihoods poor people. Thus, socio-economic conditions are important to understand their impact on EG of the river.

3. *Social capital*: This aspect assumes that if there is a strong social capital among stakeholders in terms of level of communication, density of social networks, potential for trust and participation and rule compliance, then resource can be easily governed. Many literatures suggests that tacit knowledge about the river should be considered. Thus, the local knowledge is important for understanding the EG of the river.

4. *Presence of outsiders*: This aspect put emphasis on the roles or lack of that of outsiders. It is assumed that if outsiders can be excluded at a low cost the resource can be better governed. As all natural resources are governed by some form of formal governance, the roles or rather lack of it of district government, state government and other user groups in terms of excludability, engagement and position should be studied to their influence on EG of the river.

5. *User's support*: This aspect talks about active support by users of the resource. It assumes if users actively support physical, financial, technical capacity around the resource, then it will be easier to govern the resource. For the current study, such activities are available around the river. Therefore, it is relevant to see to what extent these factors influence the EG of the river.

2.8 On Environmental Governance/ Adaptive governance

According to Dietz, Ostrom and Stern (2003), few areas in the world satisfies the above-mentioned conditions of effective commons governance. Therefore, the key challenge is to meet the main challenges of governance. The challenge, in this case, is the expansion of commerce and its subsequent influence on environmental governance. Today, trade and

commerce has acquired global scale. Numerous institutions are created to facilitate this commerce. These institutions, although not designed to manage environmental impact, influence heavily on the same. They also influence the environmental governance (Dietz et al., 2003). Furthermore, they also ignore the use of traditional tools of governance like informal conversations and sanctions. They also tend to fail to diversify governance at horizontal and vertical levels. This creates a gap in the environmental governance of CPRs (Fig. 6). According to Dietz, Ostrom and Stern (2003), good environmental governance can be achieved when the following conditions are fulfilled:

1. *Providing information*: This aspect assumes that the level of information about stocks, flows, and processes of the resource systems, human-environment interactions affecting those systems and the scale/ fit of the information. It is expected that, if adequate information is available to all stakeholders, good EG can be achieved easily.

2. *Conflict resolution*: This aspect talks about conflict resolution in terms of number of existing legal disputes, synergy between communities and local government, level of informal conflict resolution and public participation in environmental governance (de Faria et al., 2009). This aspect is very important for the current research. Scholars have pointed out that, environmental governance in India has always been riddled with class struggle (Pattanaik, 2003)(Gadgil & Guha, 1993) (Guha, 1992). As there exists a high competition between land-labour-capital in the area involving multiple user groups, it is expected that addressing conflict, or rather lack of it, is highly influential for EG of the river.

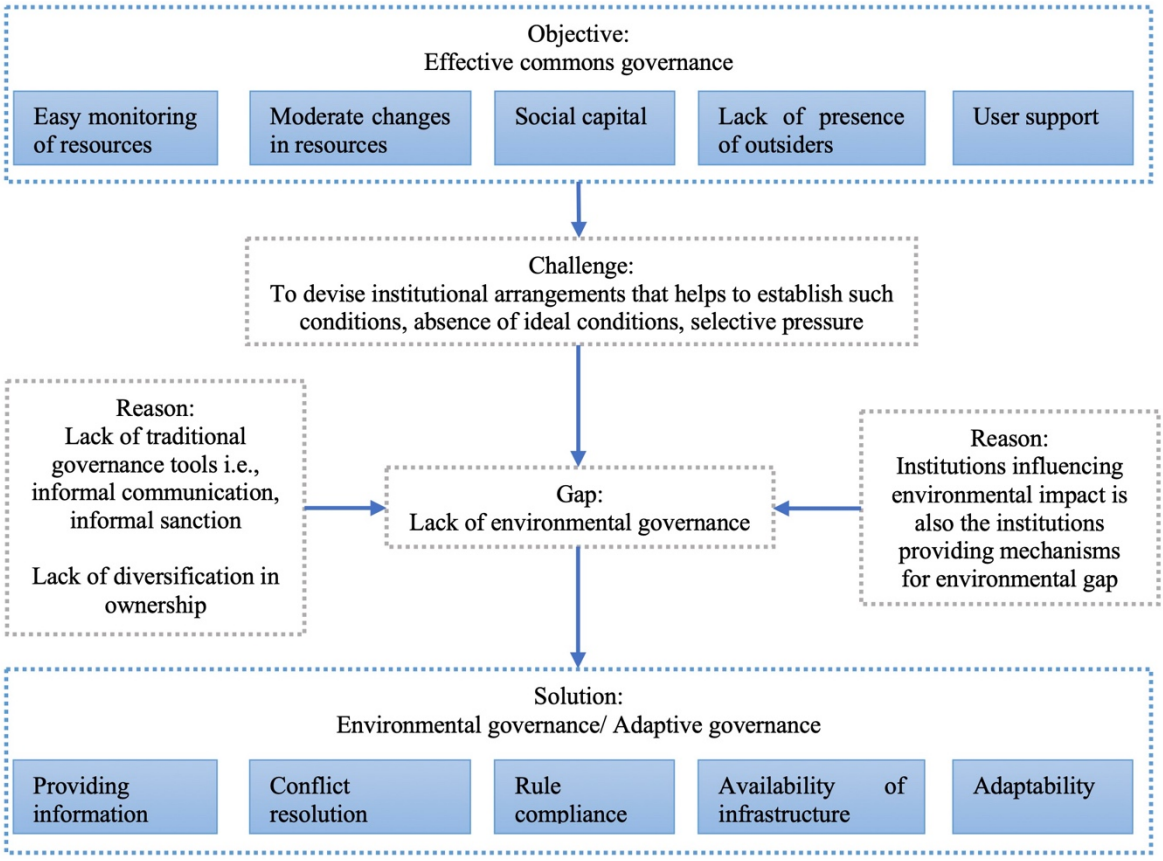


Figure 6: Ostrom's framework of ECG and EG. (*Source: Author*)

3. *Rule compliance*: This aspect mentions of rule compliance among actors and user groups in terms of awareness, eagerness to rule formation, rule enforcement, rule compliance, sanction, and rewards. Literature suggests that there can be huge gap between actual experiences and perceived reality. It is also expected that, people will be more inclined towards rule formation rather complying the rules. Thus, rule compliance affects EG of river.

4. *Availability of Infrastructure*: This aspect emphasizes on the availability infrastructure regarding the resource monitoring technology, communication technology, physical infrastructure, and research infrastructure. It is assumed that presence of adequate infrastructure will result in good environmental governance.

5. *Adaptability*: This aspect concerns with the adaptability in terms of preparedness for biophysical change, user group change, change in governance, change in demographics etc. This is a very important aspect for the present research. It is expected that high level of adaptability will be present in informal and small-scale institutions while the level will decrease as the institutions will become more formal and become larger in size.

2.9 Conceptual Framework

Based on the above-mentioned literature, a conceptual framework is proposed to describe the intent of the research (Fig 7). Here, the five prerequisite conditions of ECG are chosen as independent variables and EG is chosen as dependent variable to be measured in this study. The independent variable describes the ideal conditions for ECG. The dependent variable searches for how these conditions can be applied to achieve better EG. For the current study the null hypothesis is, *rise in ECG does not increase the amount of EG for river*. In other words,

H_0: The independent variable has no significant effect.

Symbolically, $H_0 : y_1 = y_2 = y_3 \ldots\ldots\ldots = y_k$ ….(Sharma, 2002)

Where y_1, $y_2 \ldots$ y_k is dependent variable. In this regard, various literature on EG; especially in Indian context; —suggests contextualizing the sub-variables, especially the factual vs. perceptive ideas of governance. Together, these variables comprehensively define the scope of the research within the context of *Anjana* river. The operationalization of current research design is based on this framework (Section 3.4).

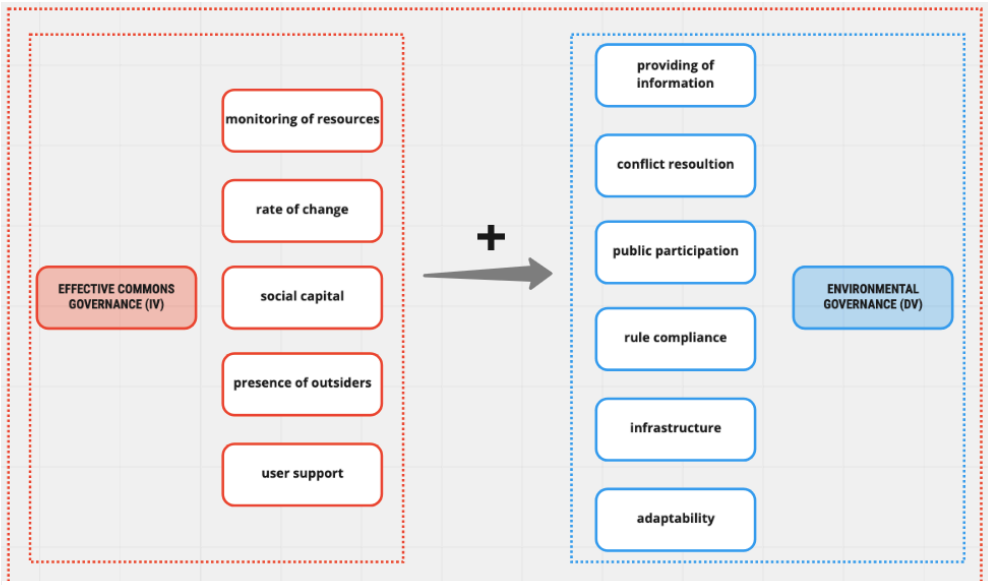


Figure 7: Conceptual framework of present study (*Source: Author*)

Chapter 3: Research design, methods, and limitations

Whiskey is for drinking— water is for fighting.
-Mark Twain

3.1 Introduction

In March 1984, Bruce Babbitt used the above-mentioned adage attributed to Mark Twain to describe water crisis in Arizona[5]. It is presumed that Twain visited Arizona at the turn of the century and summarized the belligerent situation in that adage. This proves that conflict around water is not new, and the phenomena should be studied comprehensively.

In order to do so, this research deepens the above-discussed conceptual framework. This section describes how this empirical research will be carried out using a case study strategy. The research will be based on *mixed method* approach combining both qualitative and quantitative data analysis techniques.

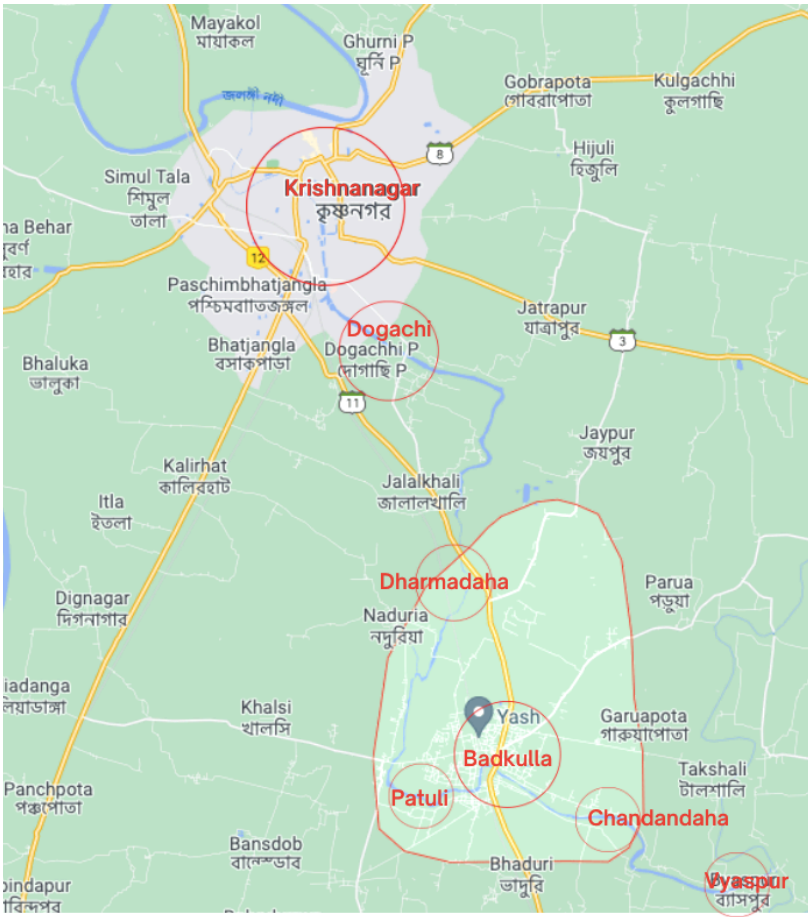


Figure 8; Map showing 7 representative study areas (*Source: Author*)

[5] There is no written proof that, Mark Twain said the adage. However, Bruce Babbitt ascribed the adage to Twain. See 1985, U.S. Congressional Hearing: House, Hoover Powerplant Act of 1984: Hearings Before the Subcommittee on Water and Power Resources of the Committee on Interior and Insular Affairs, House of Representatives, Ninety-Eighth Congress, First and Second sessions, on H.R. 4275, Serial Number 99-2, (Hearings held in Washington, DC, November 17, 1983 and March 6, 1984), (Panel with Bruce Babbitt, Governor of Arizona on March 6 1984; the excerpt is spoken by Bruce Babbitt), Quote Page 49, U.S. Government Printing Office, Washington, D.C. (ProQuest)

The following describes the methodology adopted for the current research. First, timeline of research is determined. Secondly, the sub-questions are further broken down into indicators. The indicators are listed categorically to form an operationalization table. Specific, measurable, and relevant indicators are chosen. Thirdly, specific research strategies and methods are proposed to justify the 'case study' strategy and 'mixed method' approach adopted for the research. Fourthly, proposed data collection method and research instruments are discussed for the current research. Fifthly, the question of sample size is discussed in detail. Sixthly, the validity and reliability of the overall strategy based on the adopted methods are discussed. Seventhly, proposed data analysis method for the collected data is discussed. Finally, the expected challenges and limitations the research might meet is discussed.

3.2 Description of study area

Preliminary visual survey of all the 16 administration areas through which *Anjana* river flows reveals that bio-physical condition of the river is widely varying in different areas. Spatially the river flows through urban, peri-urban, and rural areas. In urban areas, the river is reduced to almost non-existent to stagnant pool of water. In peri-urban areas, the river is encroached and is converted into fisheries. In rural areas, some areas are choked with water hyacinth. Only 5 km stretch from Vyaspur to Dashan is wide and fishing is visible (Table 2). Preliminary survey also reveals that heterogenous bio-physical condition of the river also produces different levels of association with the river. These varied conditions compel one to study multiple points on the river to better understand the various conditions of human-land-water nexus and conduct a comparative analysis of the same. For the purpose of the current study, 7 representative areas are chosen. They are Krishnanagar (urban), Dogachi (peri-urban), Dharamadaha (rural), Patuli (rural), Badkulla (peri-urban), Chandandaha (rural) and Vyaspur (rural) (Fig 8) (for details see Annex 1). Both quantitative and qualitative surveys are done in these seven areas. The seven areas are chosen purposively as each of the areas exhibit unique biophysical conditions along with different levels of people's association with the river (Table 3). Among these 7 representative areas, Badkulla's case is exceptional. Generally, spatial order of urbanisation goes from urban to peri-urban to rural. In case of Badkulla, presence of railway station changes this order and Badkulla emerges as peri-urban area in otherwise rural zone.

Table 2: Condition of river across 16 administrative zones of study area (*Source: Author*)

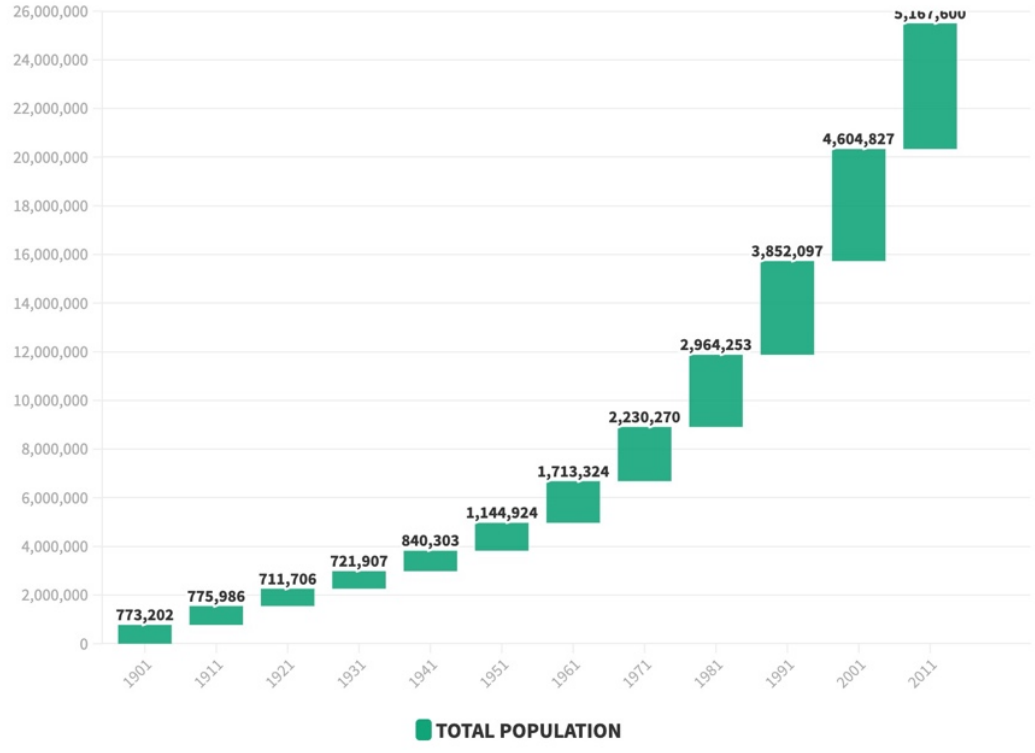
Sl No.	Name of area/ village adjacent to Anjana river	Type	Condition
1	Dharmanagar	Urban	Non-existent river, origin is choked
2	Christianpara	Urban	Non-existent river, garbage dumping
3	Krishnanagar Church area	Urban	Stagnant pond, garbage dumping
4	Collegiate area	Urban	Stagnant pond, garbage dumping
5	Rajbari	Urban	Converted to moat, water is visible
6	Chowdhuripara	Urban	Very narrow, hyacinth, garbage dumping
7	Raypara	Peri-urban (cencus town)	Water is visible, hyacinth, encroachment
8	Badkulla	Peri-urban (cencus town)	Encroachment, hyacinth, flooding
9	Dharmadaha	Peri-urban	Encroachment, hyacinth, flooding
10	Udoypur	Peri-urban	Water is visible, hyacinth, small fishery
11	Gagni	Peri-urban	Water is visible, small fishery
12	Chandandaha	Peri-urban	Water is visible, small fishery, flooding
13	Mirpur	Rural	River is wide, small fishery, brick kiln
14	Tayebpur	Rural	River is wide, large fishery, encroachment for agriculture
15	Bora kulta	Rural	River is wide, hyacinth
16	Vyaspur	Rural	River is wide, fishing

Table 3: Condition of river in 7 selected representative area (*Source: Author*)

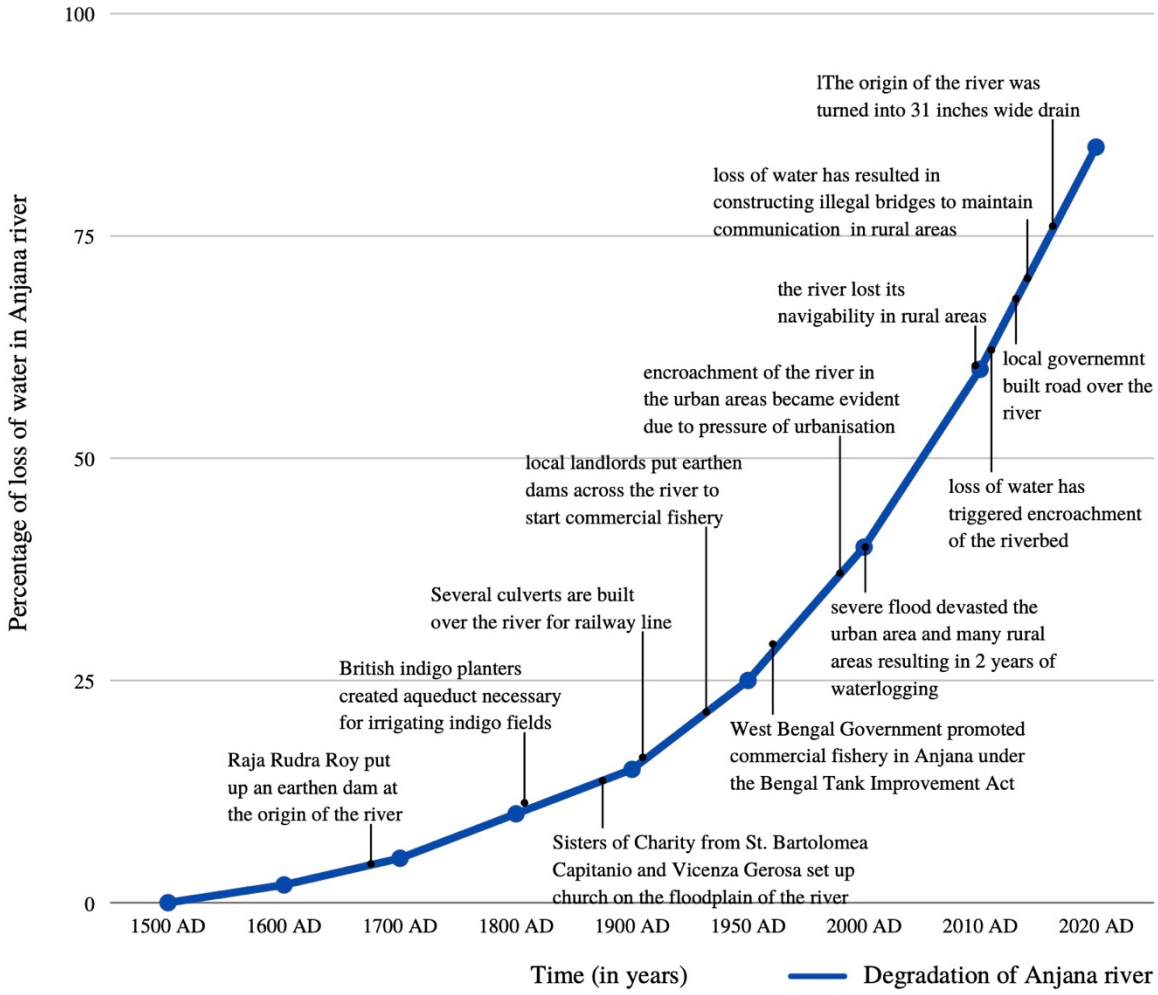
location	type	condition of river	reason	people's response
Krishnanagar	Urban	Very poor	Previous encroachment, garbage dumping	Indifferent
Dogachi	Peri-urban	Poor	Pisciculture, creating dam in river	Not interested
Dharmadaha	Rural	Very poor	Previous encroachment for agriculture	Not interested
Patuli	Rural	Poor	Water hyacinth, construction of bridge	Interested
Badkulla	Peri-urban	Moderate	Water hyacinth, construction of bridge	Moderately interested
Chandandaha	Rural	Moderate	Water hyacinth	Interested
Vyaspur	Rural	Good		Moderately interested

3.3 Timeline of research

Krishnanagar and the surrounding area in Nadia District are quite old (Garrett, 1910). The district served as an important agricultural and handicraft producing centre. The district experienced in-migration from Bangladesh in 1950-80. Since 2000, population is rising drastically in the area (Graph 1). At the same time, rapid socio-economic changes are observed. (Bureau of Applied Economics & Statistics, 2015). The biophysical degradation of the river has also augmented from this time (Nath, N., 2021) (Graph 2). These three factors contributed to select the base line of time-period of research as 2000. Thus, the timeline of the research is 20 years from 2001 to 2020.



Graph 1: Decadal growth of population, Nadia District- 1901-2011 (Source: *District Statistical Handbook, Nadia District, 2013*)



Graph 2: Anthropogenic intervention on *Anjana* river over between 1500-2020 AD. (Source*: Author*)

3.4 Operationalization: variables, indicators

In order to operationalize the current research, the independent variable/concept ECG is broken down into five dimensions i.e., *Easy monitoring of resources*, *Rate of change*, *Social capital, Presence of outsiders* and *User's support*. Similarly, the dependent variable/concept EG is broken down into five dimensions i.e., *Providing information, Conflict resolution, Rule compliance, Infrastructure and Adaptability*. Both independent and dependent dimensions correspond to Dietz, Ostrom & Stern's framework (2003) (Section 2.7, 2.8). However, as unified indicator set is not found (Biswas, A. K. & Tortajada, 2010), indicators from different relevant sources are used.

3.4.1 Independent Variable

Literature on EG suggests that generally, river as natural resource is considered as one unified resource (Section 2.6). In reality, rivers in South-East Asia are treated as a combination of land, water, and fish. Thus, for the current study, all dimensions are studied for three resources of *Anjana* river i.e., land, water, and fish. First, the aspect of land is treated as the floodplain of the river which is subjected to constant encroachment and land use change (Das, B. C. et al., 2020). Secondly, the aspect of water is considered as the flowing surface water of the river. Currently, the flow of the river is obstructed due to several geographical, hydrological, and anthropogenic actions. However, the water of the river is important for irrigation, vegetation, groundwater recharge, pisciculture, jute production and drainage of runoff water (Nath, 2021).

Therefore, it is important resource. Thirdly, currently only some part of the river has fish habitat. The lack of fish in the river have deeply impacted the traditional livelihoods in the adjacent villages. Therefore, fish or rather lack of it (Sarkar, U. K. et al., 2021), is considered as resource for the current study.

Finally, for the current research, effective commons governance is seen as is *a process by which common pool resources like waterbodies, small rivers etc. can be governed subjected to conditions like easy monitoring, moderate change in resources, high social capital, exclusion of outsiders and user's support to decrease the potential for anthropogenic effects on local ecosystems.* The independent variable "effective commons governance" has been operationalized in the following table:

Table 4: Description of independent variables (*Source: Author*)

Concept	Variable	Dimension	Indicator	Scale	Literature	Dataset
Effective commons governance (IV)	Easy monitoring of resources	Land/ Floodplain	whether change in floodplain is monitored	yes/ no	(Andersson et al., 2014) (Nagendra, 2002) (Ostrom, 1994) (Gibson et al., 2005) (Agrawal, 2014)	Interview, Published Govt. reports, Peer reviewd articles,
			Frequency of monitoring	5-point scale		Interview, Group discussion
			Mode of monitoring	tacit/ written		Interview, Group discussion
			Ease of monitoring	5-point scale		Interview, Group discussion
			Cost effectiveness of monitoring	5-point scale		Interview, Group discussion
			Overall level of monitoring	5-point scale		Interview, Group discussion
		Water/ Waterflow	whether change in waterflow is monitored	yes/ no		Interview, Published Govt. reports, Peer reviewed articles,
			Frequency of monitoring	5-point scale		Interview, Group discussion
			Mode of monitoring	tacit/ written		Interview, Group discussion
			Easiness of monitoring	5-point scale		Interview, Group discussion
			Cost effectiveness of monitoring	5-point scale		Interview, Group discussion
			Overall level of monitoring	5-point scale		Interview, Group discussion
		Fish	whether change in fish is monitored	yes/ no		Interview, Published Govt. reports, Peer reviewed articles,

			Monitoring agency (Govt, local govt, fishing cooperatives, large scale fish producer, small scale, individuals)	Yes/ no		Interview, survey
			Frequency of monitoring	5-point scale		Interview, Group discussion
			Mode of monitoring	tacit/ written		Interview, Group discussion
			Easiness of monitoring	5-point scale		Interview, Group discussion
			Cost effectiveness of monitoring	5-point scale		Interview, Group discussion
			Overall level of monitoring	5-point scale		Interview, Group discussion
	Rate of change	Change in Resource/Land/ Floodplain	% Of change in area floodplain	Sq Km	(Gain et al., 2019) (Mahmood et al., 2017) (Sarkar et al., 2021)	LANDSAT, Interview, Published Govt. reports, Peer reviewed articles
			% Of change in encroachment of floodplain	Sq Km		LANDSAT, Interview, Published Govt. reports, Peer reviewed articles
			% Of change in land use of floodplain	Sq Km		LANDSAT, Interview, Published Govt. reports, Peer reviewed articles
		Change in Resource/Water/ Waterflow	% Of change in waterflow	Cu m		Interview, Published Govt. reports, Peer reviewed articles
			% Of change in using riverbed for economic purposes	Sq Km		Interview, Published Govt. reports, Peer reviewed articles
			% Of change in water lifting from river	Cu m		Interview, Published Govt. reports, Census data, Sample Survey data Peer reviewed articles
			% Of change in width of river	M		Interview, Published Govt. reports, Peer reviewed articles
			% Of change in depth of river	M		Interview, Published Govt. reports, Peer reviewed articles

		Change in Resource/Fish	% Of change in availability of fish in river	Mt		Interview, Published Govt. reports, Census data, Sample Survey data Peer reviewed articles
		Change in Resource-user population	% Of change in population dependent on river	Nos.		Interview, Published Govt. reports, Census data, Sample Survey data Peer reviewed articles
		Change in socio-economic conditions	% Of change in population, male, female, primary, tertiary, income, occupation	Various		Interview, Published Govt. reports, Census data, Sample Survey data Peer reviewed articles
	Social Capital	Trust	% Of change in trust over time	5-point scale	(Onyx & Bullen, 2000) (Pelling & High, 2005) (Pope, 2003)	Survey, Census data, Sample Survey data
		Reciprocity	% Of change in reciprocity over time	5-point scale		Group discussion
		Capacity	% Of change in capacity of groups over time	5-point scale		Group discussion
		Knowledge sharing	Presence of knowledge sharing	Yes/ No		Group discussion
		Level of engagement	% Of change in level of engagement of groups over time	5-point scale		Group discussion
		Inter-group connection	Presence of inter group connection	5-point scale		Group discussion
		Awareness of the issue	% Of awareness of the issue in group	5-point scale		Group discussion
		Leadership	% Of change in effective leadership of groups over time	5-point scale		Group discussion
		Excludability	% Of change in presence of actors (e.g., new cooperatives)	Nos.		Group discussion
	Presence of outsiders	Cost effectiveness	% Of change in income per group	Euro	(Cinner et al., 2012)	Interview, Published Govt. reports, Census data, Sample Survey data Peer reviewed articles

		Engagement	% Of change in level of outsider engagement	5-point scale		Interview, Published Govt. reports, Sample Survey data Peer reviewed articles, Group discussion
		Actors	Govt, local govt, fishing cooperatives, large scale fish producer, small scale, individuals, others	Yes/ no		Interview, Published Govt. reports, Sample Survey data Peer reviewed articles, Group discussion
		Physical support	% Of change in level of physical monitoring by user groups	5-point scale		Interview, primary survey
	User support	Technical support	% Of change in level of technical support by user groups	5-point scale	(Bruns, Mar, 2015) (Wang et al., 2019)	Interview, Published Govt. reports, Sample Survey data Peer reviewed articles, Group discussion
		Financial support	% Of change in level of financial support by user groups	5-point scale		Interview, Published Govt. reports, Sample Survey data Peer reviewed articles, Group discussion
		Capacity building	% Of change in level of capacity building by user groups	5-point scale		Interview, Published Govt. reports, Sample Survey data Peer reviewed articles, Group discussion

3.4.2 Dependent Variable

For the current research, environmental governance is seen as is *a continuous process comprised of adequate information, low conflict, compliant with rule, sufficient infrastructural support and high adaptability which can be used to govern common pool resources like waterbodies, small rivers etc.* The dependent variable "environmental governance" has been operationalized in the following table:

Table 5: Description of dependent variables (*Source: Author*)

Concept	Variable	Dimension	Indicator (Actual)	Scale	Literature	Dataset
2.Environmental Governance (DV)	Providing information	Stock	Availability of information about stock of resources among user group	5-point scale	(Madonsela et al., 2019) (Koop & van Leeuwen, 2015)	Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles

		Flow/ user group	Condition of flow of information about stock of resources among user group	5-point scale	(Cookey et al., 2016)	Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Flow/ horizontal governance	Condition of flow of information about stock of resources among horizontal institutions	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Flow/ vertical governance	Condition of flow of information about stock of resources among vertical institutions	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Transparency	Transparency about process of governance	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Human-environment interaction	Availability of information about human-environment interaction	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Congruency	Congruency of the information regarding environmental governance	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Legal disputes	Presence of number of existing legal disputes	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles

	Conflict resolution	Synergy	Level of synergy between communities and local government	5-point scale	(Astawa, Aug 2004) (Nagendra, 2002) (Lobe & Berkes, 2004) (Wischnath & Buhaug, 2014)	Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Informal conflict resolution	Level of informal conflict resolution	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
	Public participation	Public participation (non-participation)	% Of change in level of non-participation over time	5-point scale	(Arnstein, 1969) (Lauria, 2020)	Interview, primary survey
		Public participation (Therapy)	% Of change in level of Therapy over time	5-point scale		Interview, primary survey
		Public participation (Informing)	% Of change in level of Informing over time	5-point scale		Interview, primary survey
		Public participation (Consultation)	% Of change in level of Consultation over time	5-point scale		Interview, primary survey
		Public participation (Placation)	% Of change in level of Placation over time	5-point scale		Interview, primary survey
		Public participation (Partnership)	% Of change in level of Partnership over time	5-point scale		Interview, primary survey
		Public participation (Delegated power)	% Of change in level of Delegated power over time	5-point scale		Interview, primary survey

	Rule compliance	Awareness	Awareness of existing rules	5-point scale	(Mosse, 1997) (Gibson et al., 2005) (Wang et al., 2019)	Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Rule formation	Eagerness level of rule formation	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Rule enforcement	Eagerness level of rule enforcement	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Rule compliance	Eagerness level of rule compliance	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Sanction	Eagerness to accept sanction	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Rewards	Eagerness to accept rewards	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Resource exploitation technology	Presence of resource exploitation technology	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
	Availability of infrastructure	Communication technology	Presence of communication technology for monitoring	5-point scale	(Cookey et al., 2016)	Interview, Published Govt. reports, Sample Survey data, Peer

						reviewed articles
		Physical infrastructure	Presence of physical infrastructure for monitoring including legal	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Research infrastructure	Presence of research infrastructure for governance	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Biophysical change	Preparedness for flood, waterlogging, encroachment, and availability of fish	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
	Adaptability	Actors	Govt, local govt, fishing cooperatives, large scale fish producer, small scale, individuals, others	Yes/ no	(Cookey et al., 2016)	Interview, primary survey
		User group change	Preparedness for change in new user population	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Governance	Preparedness for new law, regulations, and govt. action	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer reviewed articles
		Demographics	Preparedness for new livelihood, protection of old livelihood	5-point scale		Interview, Published Govt. reports, Sample Survey data, Peer

						reviewed articles

3.5 Method

The research focuses on how much of the preconditions of effective commons governance can be applied for ecological governance of *Anjana* river. In order to do so, an in-depth analysis of spatial, social, economic, and environmental conditions over time is done. This analysis involves asking a representative sample of respondents from the area about the changes occurred in the area. The analysis also covers various aspects regarding the changes over 20 years (from 2000 and onwards). Therefore, the research strategy is a single case study which will allow to work with small units and large variables (Van Thiel, 2014). Also, the research is primarily focus on questionnaire, interview, and content analysis, matching it to be a case study (Van Thiel, 2014). For detailed information, see Annex 2.

3.6 Research design

The data collection on independent and dependent variables is done using both quantitative and qualitative methods. The methods and the data sources have been already mentioned in the operationalization table above. The following describes the research design process.

3.6.1 Conducting survey via research assistants

Due to COVID situation and travel restrictions the researcher cannot go directly to do the fieldwork. An CBO called *Badkulla vigyan samiti* (Badkulla Science Club) from the vicinity of the study area has been selected as point of contact for canvasing the questionnaire and interviews. The CBO is chosen based on its familiarity and interest on the research topic. The CBO is actively monitoring the condition of the river for the past 10 years. They have also published small reports in local newspapers about the river several times. They are reliable and competent in doing surveys also. Three persons are identified to do the survey.

The researcher sent the online survey questionnaire to the above-mentioned persons and explained them about the same. He also trained them about asking questions, research ethics, transparency, proper use of language etc. The research assistants then canvased the predetermined areas. The researcher monitored progress of each day via online (see Annex 5). In case of discrepancy, the researcher contacted them and update the process. A pilot study was done first to test the efficiency of the questionnaire and the competency of the research assistants. After making necessary changes, the final survey was conducted. The researcher also monitored the possible biasness of the research assistants. To avoid this, the researcher verbally informed them and shuffle the questions. The researcher also employed a survey supervisor to monitor the progress.

To avoid biasness in purposive sampling, research assistants are trained to avoid asking leading questions. They are also asked to restraint themselves from making any generalised assumptions beforehand. To avoid homogeneity of respondents (for snowball sampling), all possible types of users are identified before. Then they are contacted. Altogether 8 types of users are identified with various socio-economic backgrounds to avoid homogeneity. Then they are interviewed.

3.6.2 Quantitative data collection

The following describes the method for quantitative data collection.

3.6.2.1 Questionnaire

An online questionnaire was formulated based on independent and dependent variables to measure the same (see Annex 3). The questionnaire used operationalization table as the base. The answers were measured on a 5-point Likert scale. Additionally, section on personal information was included to understand demographic characteristics of respondents. It is assumed that the target population speaks primarily in Bengali language. Therefore, the questionnaire was prepared in Bengali language. The questionnaire was peer reviewed before circulation to check coherence and comprehension. The online questionnaire helped to reach out to a larger population base, which in turn enhanced external validity of the research (Van Thiel, 2014). It also helped in real time monitoring of the data collection. Finally, it helped to collect data quickly in these restricted times due to COVID pandemic.

3.6.2.2 Sample design for Questionnaire

The research area in question comprises to 4 villages, 2 Census Towns and 1 municipality. The total population, according to Census data is 63,590. From this number, the required sample size is calculated using the following:

$$n=N/\ (N.e^2+1)$$

where, n is the required sample size, N is the target population size and e is the margin of error. Due to the limitations due to the pandemic, the margin of error is considered to be 10% for the purpose of this calculation. Based on this, the required sample size was calculated as 99.84. It is rounded off to 100.

3.6.2.3 Data collection

In reality, a total number of 140 responses are collected using *random stratified sampling* approach. It is done by first approaching the local administration in the predetermined study areas. For each of the 7 seven study areas, 20 respondents are selected. After taking the local administration's consent to conduct survey, voter list was obtained from them (see Annex 6). Then households were selected via *random stratified sampling* method and random sample table. Finally, the selected households were visited by the research assistants to conduct the survey. Due to the sensitive nature of the topic, some user groups it is assumed might be reluctant to divulge information. To prevent this, assurance will be given about beneficence, privacy, and confidentiality to protect their identity. However, the researcher cannot guarantee that biasness was avoided. The data collected was then analysed using SPSS.

3.6.3 Qualitative data collection

After quantitative data collection was done, research assistants proceeded to collect data for qualitative data. It is done to compare the quantitative data. The following describes the method for quantitative data collection. The data collection was done via group discussion and personal interviews.

3.6.3.1 Questionnaire

An online questionnaire was formulated based on independent and dependent variables to measure the same. The questionnaire used operationalization table as the base. The questionnaire follows same pattern of quantitative data questionnaire to justify mixed method. The interviews were done in a semi-structured way to allow wide range of topics to be discussed. This further helped in triangulating the data. This also helped in deepening the understanding of the outcomes from the quantitative data analysis. (See Annex 4).

3.6.3.2 Sample design for Group discussions and interviews

As there is no strict formula for selecting the minimum number of respondents for qualitative data, a minimum number of 12 is assumed according to literature (Creswell & Creswell, 2018). 8 target groups are identified based on preliminary survey for discussions and interviews. These groups are Local Farmers, Local Fishermen, Local Residents, Local Pisciculture owners, Local Politicians, Local Administration, Local CBOs, and Academicians. The academicians are chosen based on their expertise on anthropogeomorphology of *Anjana* river. The NGOs are chosen according to their contribution towards the awareness and intervention at local level. The government officials are also chosen as they represent local level (*gram sabha*) to regional level (*block* level) to understand the various perceptions at different levels. Similarly for group discussion, 3 groups are identified. They are women's group, local fishermen's group, and urban resident's group. These groups are chosen to represent the unique perspective of the groups regarding the river.

3.6.3.3 Data collection

Overall, *purposive sampling* method is used for the qualitative data collection. Additionally, *snowball sampling* is employed to gain maximum reach. The researcher initially used books, reports, govt. websites and tacit knowledge to identify the respondents. He used emails, telephone, and local network to communicate with the respondents. The research assistants also helped to identify the appropriate respondents. The researcher emailed several members of academia and NGOs to seek interviews. The research assistants, after obtaining permissions from local administration and community leaders, approached the local residents for group discussions and personal interviews. They first recorded the audio on mobile phone. Later, they sent the audio to researcher via WhatsApp. The audio was then properly transcribed and coded into Atlas Ti. The research assistants were asked to focus on the sub-variables to expand the topics. The interviews were conducted in Bengali. It was checked that each interview lasts to a minimum of 20 minutes and a maximum of 40 minutes. Finally, 14 respondents are chosen for the current study (Table 6).

3.6.4 Secondary Data

The data collected through questionnaires and interviews was complemented with data collected from secondary sources such as Census data, National Sample Survey data, published government reports, policy papers, peer reviewed journals, newspaper articles etc. to improve the validity of the research.

3.7 Ethics, Validity and Reliability

The research employs case study as main research strategy. The inherent problem of case study is low external validity. The following will be done to improve it. For detailed information, see Annex 7.

Table 6: List of respondents for qualitative study (*Source: Author*)

Sl. No.	Category	Interviewee	Designation	Realtion with current research
1	Farmer	Interviewee 1	Agriclutural labour	Agricultural labour for 30 years. Have seen the change in river. Also knows a lot about the previous land-use chnages.
2	Fisherman	Interviewee 2	Fisherman	Fisherman for 30 years. Have seen the change in river. Also knows a lot about the previous land-use chnages.
3	Fisherman	Interviewee 3	Fishmonger	Fishesman turned into Fishmonger. Have changed profession due to changes in river. Also knows a lot about land-use chnages.
4	Resident	Interviewee 4	Resident of urban area	Have culural association with the river. Knows a lot about encroachment.
5	Pisciculture owners	Interviewee 5	Head of fish cooperative	Doing pisciculture since 1973. Very knowledgable about river course, fish and livelihood
6	Politician	Interviewee 6	Local politician	Have seen the change in river. Also knows a lot about the previous land-use chnages.
7	Politician	Interviewee 7	Local politician	Knows a lot about land-use chnages. Wants to protect the livelihoods surrounding the river.
8	Local Administration	Interviewee 8	Member of Village administration	Concious about livelihood changes surrounding the river. Want to change the situation. Very passionate about fishermen.
9	Local Administration	Interviewee 9	Block Development Officer, Local administration	Knows about the process of river governance in West Bengal, govt. schemes, current efforts etc.
10	Local Administration	Interviewee 10	Head of Village administration	Concious about livelihood changes surrounding the river. Want to change the situation. Very passionate about fishermen.
11	Local CBOs	Interviewee 11	Head of a. local CBO	Have seen the change in river. Does awareness campaignes. Take active participation in stopping encroachment.
12	Local CBOs	Interviewee 12	Head of a. local CBO	Have seen the change in river. Does awareness campaignes.
13	Academicians	Interviewee 14	Head of the department of Govt. college, river expert	River expert. Have written multiple articles on Anjana river.
14	Academicians	Interviewee 15	Member of river committee, Govt. of West Bengal, river expert	Has extensive knowledge about river system of Bengal. Want to create river board.

3.8 Data Analysis

The collected data is analysed in two parts. Firstly, quantitative data is checked for normality, noise, linearity, collinearity, and scale. After the frequency distribution, corelation and regression is done in SPSS. For further understanding, residual analysis and variance analysis is done. Secondly, the qualitative data is transcribed. The data is analysed by Atlas Ti. Both deductive and inductive coding is done to understand the inherent pattern. The final coding reflects the operationalization table. Furthermore, various relationship between independent variable and dependent variable is analysed using both graphical method and “and/if/or” relationship. Proper precautions will be taken against incongruency by using Memos (see Chapter 4).

3.9 Analytical limitations

While conducting research, several analytical limitations are identified which could produce underestimates of ECG and its effect on EG. In several instances, and depending on the study design, the effect on the EG estimate cannot be known *a priori*. Several assumptions are likely

to underestimate the effect on the EG estimate in both cross-sectional and longitudinal design. These analytical limitations are discussed below.

Regarding independent variable, it is found that most research is concentrated on monitoring and social capital. However, increased EG as a result of *frequency of monitoring, mode of monitoring and easiness of monitoring* is not assumed to take place, primarily because in most cases, the data used is often published data. However, same cannot be true for cases like *Anjana* where tacit monitoring is done. Increased *frequency of monitoring, mode of monitoring and easiness of monitoring* is likely to affect *information, public participation, and conflict resolution*, which, if ignored, might lead to an underestimation of EG.

It is found that, variable *rate of change* for all three resources i.e., land, water and fish are not assumed to take place, as it is often thought waterbodies as a singular resource. Also, the biophysical condition is assumed to be homogenous. In reality, any waterbody is comprised of land, water, and aquatic biomass and their conditions vary as per time, place, geography, and anthropogenic activities. It is expected that, by including the three aspects will help in estimating the correct effect of *rate of change* on EG. It is also found that *% of change in area, % of change in waterflow, % of change in width of river, % of change in depth of river* is widely used in tidal river management but are not used in river governance. These factors are important for estimating condition of water in river. Thus, it is assumed that increased *% of change in area, % of change in waterflow, % of change in width of river, % of change in depth of river* will affect *infrastructure, adaptability* which in turn might affect EG.

It is found that, variable *presence of outsiders* is not well discussed in literature. Increased EG as a result of *% of change in level of technical support, % of change in level of financial support and % of change in level of technical support* is not assumed to take place, primarily because in most cases, role of outsiders is considered more important than quantifying the effect of it. In reality, increased *% of change in level of technical support, % of change in level of financial support and % of change in level of technical support* is likely to affect *public participation, rule compliance, conflict resolution*, which, if ignored, can lead to an underestimation of EG.

Regarding dependent variable, it is found that variable *infrastructure,* is not well discussed in prominent literature. This is primarily because the previous research focused on other variables and the restoration of biophysical conditions are not considered. However, in case of *Anjana* river, available infrastructure to clean the river is very important for better EG. It is expected that increased *physical infrastructure, research infrastructure, resilience infrastructure and communication infrastructure* might result in increased EG which, if ignored, can lead to an underestimation of EG.

It is found that although much discussion about *adaptability* or lack of it is discussed in literature on resilience, but same cannot be said about commons governance. This is because previous research focused on other variables. However, it is found that *preparedness for change* is important for the current research. It is expected that increased *preparedness for change* might result in increased EG which, if ignored, can lead to an underestimation of EG.

After data collection, it is realised that studies on quantification of EG in developing countries suffers from non-inclusion of *caste, education, occupation, politicisation*, *political will, past association with resource, cultural association* as control variables. Better inclusion of these variables may result in better assessment of EG. Intensive use of *caste, education and occupation* is likely to influence *monitoring, social capital, public participation, and adaptability*. *Politicisation* is likely to have negatively affect EG and *political will, past*

association with resource and cultural association is likely to have positive affect EG. These are not included for the current study, but future research might benefit from these inclusions.

Finally, it is found that the theoretical construct for human-land-water nexus in delta countries of Southeast Asia have their own typical features. Here, the binary division of *terra* and *aqua* does not exists, rather *terra* here is perceived as degrees of wetness. Akin to this, human-land-water nexus is also not static, rather it is a flux between "remembered past" and "observed present". These two theoretical constructs, if ignored, is likely to underestimate the complex nature of ECG and its effect on EG in Southeast Asia.

3.10 Challenges and Limitations

The primary challenge assumed for the current research was the sensitive nature of the topic and impact of COVID on logistics and human psyche. In addition, it is found that the case study area has limited internet connection. Also, hot summer conditions, monsoon and working hours of respondents proved to be challenging. First, it was quite surprising that people welcomed the research topic when properly approached. It is found that some people have genuine concern about the river. To avoid impact of COVID and poor internet, one survey supervisor and three survey assistants are employed to do the survey on behalf of the researcher. They were trained before doing the survey. To avoid hot summer and to respect working hours of respondents, data was collected in early morning and at noon. To avoid any kind of bias, multiple stakeholders are taken in account, and they are interviewed properly. Finally, to maintain correct response, all surveys and interviews are conducted in local language—Bengali.

Apart from challenges, the research faced some limitations. The non-response from the government officials of higher officers is very prominent. Additionally, some respondents gave answers in a socially desirable way which affected reliability of the study. Also, sometimes research assistants showed biasness, which affected reliability. Moreover, despite the researcher's best intentions, some words are not recorded or transcribed properly. The current research is not complete. Further development is needed to properly investigate variables.

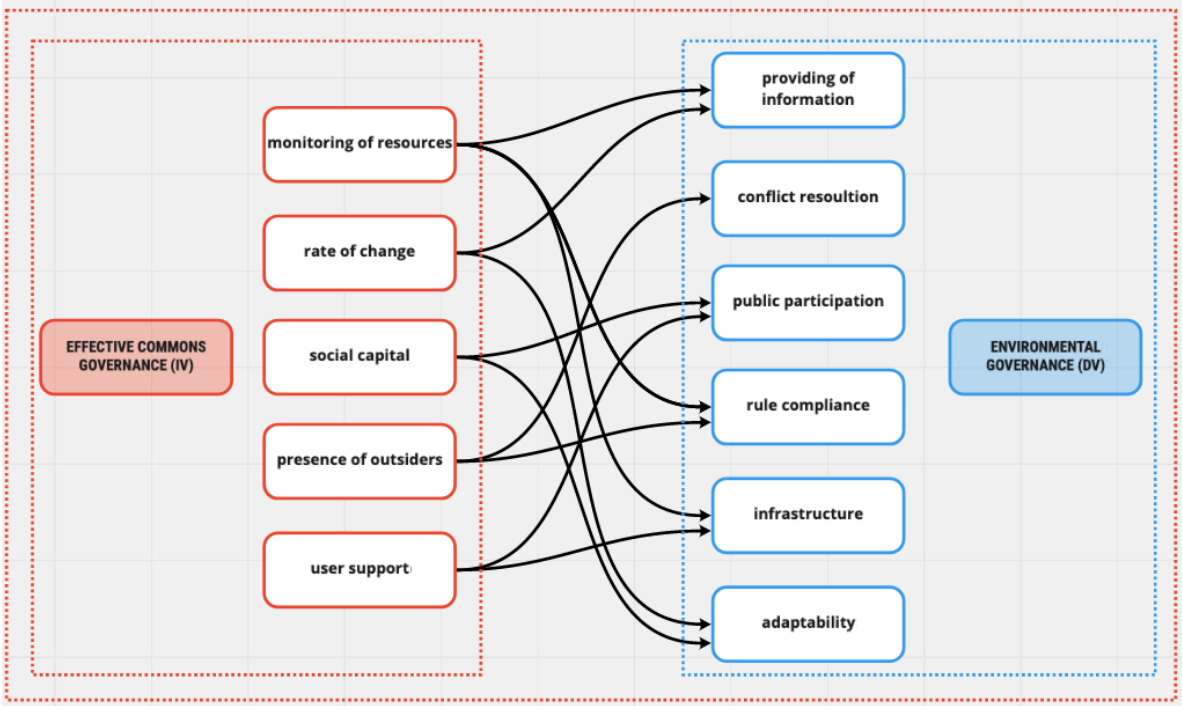


Figure 9: Expanded conceptual framework of present research (*Source: Author*)

Additional concepts like historical overview of environmental governance, past influences on user behaviour, alternative approaches to environmental governance etc. should be studied further contextualise the problem. Finally, during data collection, new variables like caste, education, politicisation etc. are found which could not be properly incorporated in the current research. In future research, they should be incorporated with due diligence.

3.11 Summary

In summary, to find answers to research questions asked in Chapter 1, literature review is done in Chapter 2. Based on the literature review, a conceptual framework is done. Also, null hypothesis is formed — $H_0 : y_1 = y_2 = y_3 \ldots\ldots\ldots = y_k$ (Section 2.9). In Chapter 3, contextualisation is done on the conceptual framework and indicators are formed. In this way, the conceptual framework is expanded by predicting future relationships between variables (Fig 9). The revised conceptual framework still maintains the basic framework but now expresses the detailed relationship between all variables. The revised conceptual framework primarily corresponds to Dietz, Ostrom & Stern's framework (2003). However, the relationships are customised for the current study based on other literature (Agrawal, 2014) (Sarkar et al., 2021) (Cinner et al., 2012) (Nagendra, 2002) (Lauria, 2020) (Wang et al., 2019) (Cookey et al., 2016) and preliminary field survey. In the next chapter, assumption made with null hypothesis is tested against the results found based on analysis of collected data.

Chapter 4: Presentation of data and analysis

After crossing the hills into plains, the length of Teesta River is only few miles.
Even that is divided into territories of India and Bangladesh.
But within these few miles there are divisions of land, forest, shoals, shrubs, meetings, marches, barrages etc.
In reality, these are also markers.
The river flows through the story through these markers.
-Debesh Roy, Teesta Parer Brittanto, pp. 495

4.1 Introduction

In the previous chapters, a question is raised whether effective commons governance can be satisfied for environmental governance for *Anjana* river. The question is further broken down to see to what extent a. monitoring of resources, b. rate of changes, c. social capital, d. absence of outsiders and e. user support influences environmental governance (Chapter 1). To answer these questions, literature review is done, and a theoretical framework is developed (Chapter 2). Based on the literature review, theoretical framework is expanded into various dimensions and indicators. To conduct the empirical research, quantitative and qualitative data is collected. The data is then analysed using various software (Chapter 3). This chapter focuses on the processes and results of the same.

The chapter is comprised of three parts. First, processes and results of the quantitative analysis are described. A socio-economic profile is formed based on descriptive statistics. This is done to understand how various socio-economic aspects are interrelated and how they affect the level of EG. Then correlation between independent and dependent variables (dimension level) is done to understand the most influential variables and the strength of their influence. After that, multiple regression is done to understand the level of influence of each independent variable on dependent variable (dimension level). This is done to answer the research question and sub questions. It is found that some important factors remained insignificant during quantitative analysis. Therefore, qualitative analysis is done to investigate further how independent factors affect dependent factors. The qualitative analysis reveals some unexpected findings which underestimates the effect of ECG on EG. These unexpected findings, along with all results from quantitative and qualitative analysis are corroborated to form the final results. Finally, the null hypothesis (Section 2.9) is tested using the final result. Throughout the analysis, secondary data is used as required to validate the results.

4.2 Quantitative analysis

In order to start the quantitative analysis, collected data from Google Form is converted into a two-way table with respondents in rows and attributes in columns. This table serves as the master data. Data is then cleaned and checked for normality, noise, linearity, collinearity, and scale. It is found that data is not normal and has outliers as expected in Likert scale data. Therefore, median value is used for transforming variables instead on mean. After converting ordinal data to scale data using median, normality was checked. It was found normal. Also, it is found that data has some amount of collinearity but not high as 0.8; so, no Principal Component Analysis is needed. Finally, data has no problem of scale (Annex 9). This modified normal dataset is used for further analysis.

The modified dataset is first used to describe the socio-economic profile of the respondents to understand the socio-economic condition of the respondents. Then it is used to answer the main questions raised in chapter 1. Finally, it is used to justify the answers obtained in the previous section.

4.2.1 Socio-economic profile of respondents

As described in Section 3.2, the river flows through area 16 administrative areas. Out of these, seven representative areas are selected. These areas are Krishnanagar, Dogachhi, Dharmadaha, Patuli, Badkulla, Chandandaha and Vyaspur. A total number of 140 respondents are selected from these areas as described in section 3.6.2.3. Primary survey is conducted among these respondents. Total ninety-one questions are canvassed. After data is collected and analysed, preliminary analysis is done to understand the socio-economic character of respondents. This analysis is done to understand under what circumstances the respondents are living and what might influence their answers. The results are discussed in the following sections.

4.2.1.1 Discussion on respondents

Results show that among the respondents; 70.7% are rural, 14.3% are from peri-urban and 15% are urban (Chart 1). This is because the river flows mainly through the rural area. Further analysis on *age, sex, caste, income, present occupation, past occupation, and time of changing occupation* is done. The results are shown below.

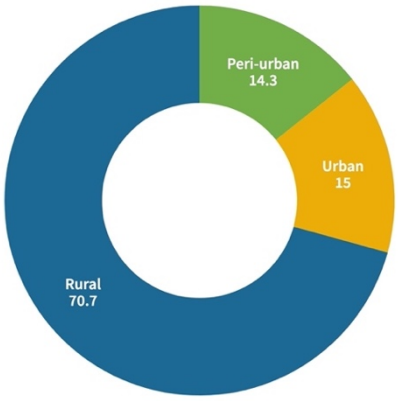


Chart 1: Area wise distribution of respondents (*Source: Author*)

Age: It is found that among the respondents, 53.6% are more than 50 years old, 24.3% are aged between 40 to 50 years, 18.6% are between 30 to 40 years and 3.6% are between 20 to 30 years (Chart 2).

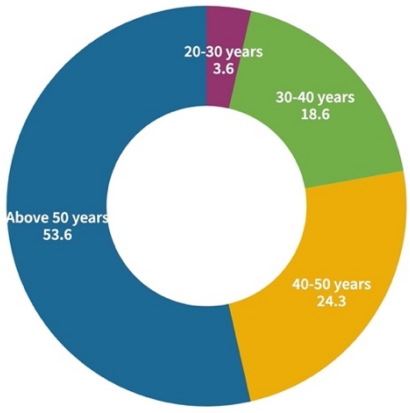


Chart 2: Age distribution of respondents (*Source: Author*)

Sex: It is found that among the respondents, 88.6% are male and 11.4% are female (Chart 3).

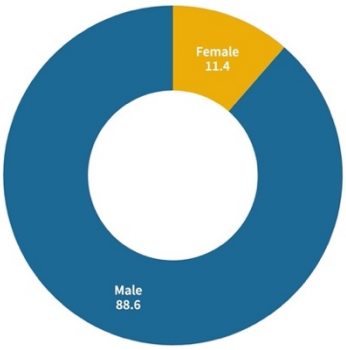


Chart 3: Distribution of sex among respondents (*Source: Author*)

Caste[6]: It is found that among the respondents, 47.1% are of General caste (upper echelon of social strata), 10% are of Other Backward Class (inferior to General caste) and 42.9% are of Scheduled Caste (lowest echelon of social strata) (Chart 4). For details on caste, see Annex 8.

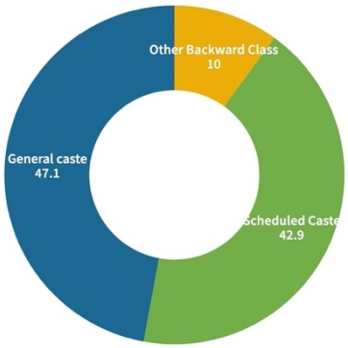


Chart 4: Distribution of sex among respondents (*Source: Author*)

Income: It is found that 82.9% respondents have monthly income up to Rs.5000 per month (57.41 euros/ month) and 15% have monthly income between Rs.5000 to Rs.10000 per month (57.41- 114.83 euros/ month). This reflects the overall poor economic condition of the respondents (Chart 5).

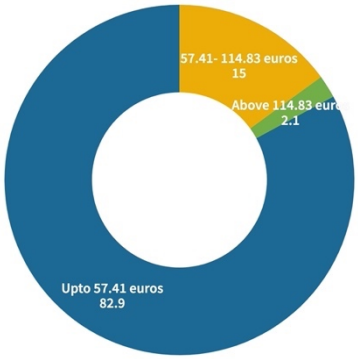


Chart 5: Distribution of income among respondents (*Source: Author*)

[6] Caste is the prevalent social hierarchy practiced in India based on polyethnic segregation and discrimination (Madan, 1971) (Gabriella Eichinger Ferro-Luzzi, 1986). Currently there are four castes according to Constitution of India: General caste (upper echelon of social strata), Other Backward Class (inferior to General caste), Scheduled Caste and Scheduled Tribe (lowest echelon of social strata)

Relation between Caste and occupation: Chart 6 describes the area wise distribution of caste and occupation. It shows that fishing is a dominant trade in the rural area. According to chart, all respondents residing in Patuli, and Patuli-West are fishermen. In Patuli, 50% of them are of Schedule Caste. The number grows to 66.66% in Patuli-West. The other major concentration of fisherman is found in Vyaspur (15%). Both places are adjacent to the river and the water quality is better than other parts of the river. As fishing is considered as socially degrading occupation in India, people of lower caste are associated with such trade, and they tend to live near natural resources i.e., river. Apart from the fisherman, agricultural labour is dominant in the rural area. Like fishing, agricultural labour; which is also considered as socially degrading occupation; — is also dominated by Schedule Caste (50%). Conversely, farmers who own land are from General caste/ upper caste (80%). At the same time, agricultural labours are concentrated in Ballavpur, Dharmadaha, Chandandaha, Dogachhi and Mugrail and farmers who own land are found in Ballavpur. Among these areas, the river is dead at Dharmadaha and Dogachhi. This infers that, absence of water has influenced the choice of occupation. On the other hand, fishing is not found in the peri urban and urban area. Very little (8%) traces of agricultural labour are found in peri urban area. These areas are dominated by small businesses, daily labours, weavers etc.

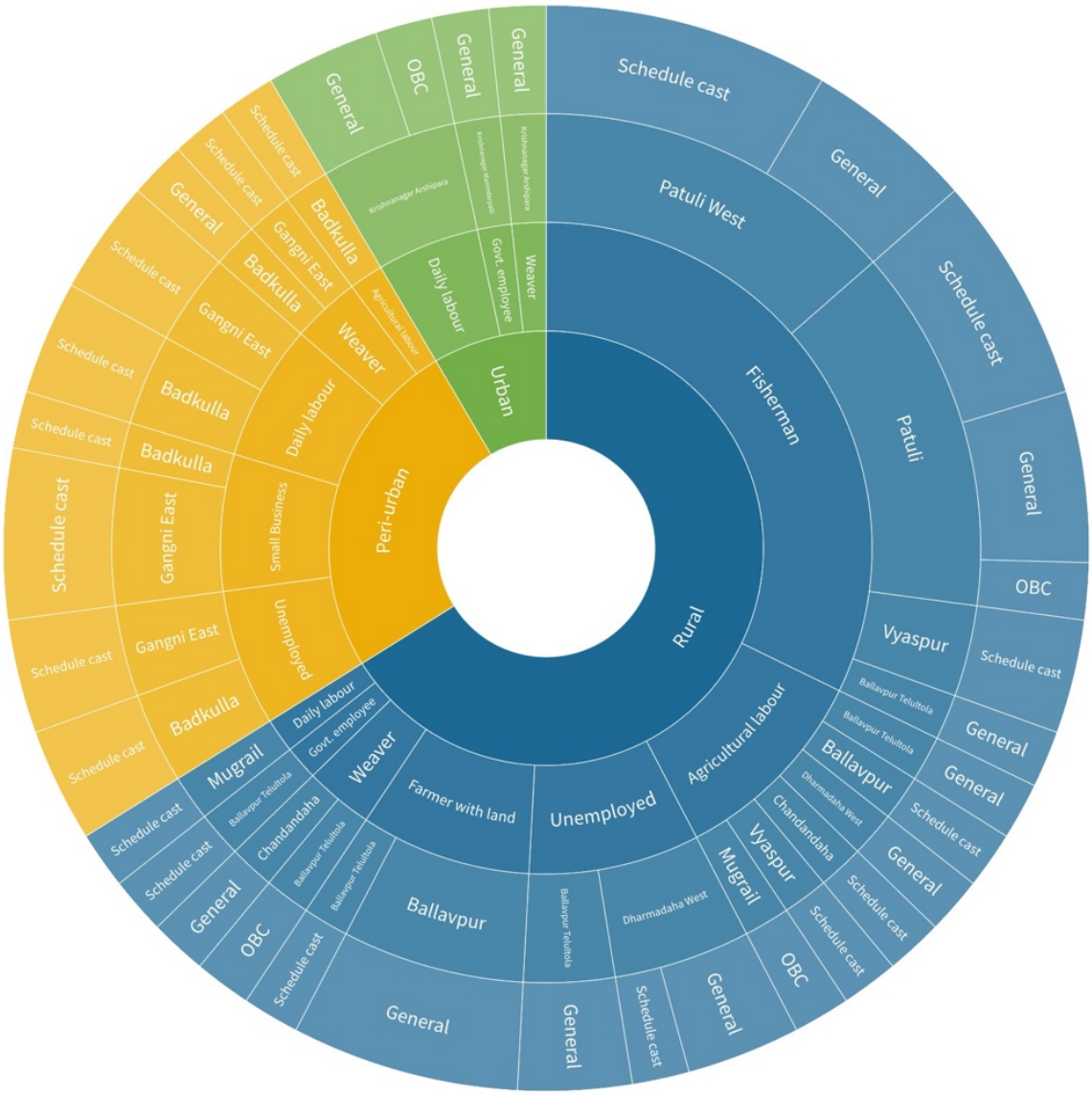


Chart 6: Relationship between Caste and Occupation (*Source: Author*)

Past occupation: It is found that 20 years ago, there were 8 types of occupation. Among them, 17.1% respondents were fisherman, 23.6% were agricultural labour, 13.6% were owner of small business, and 11.4% were daily labour. Also, 18.6% people were unemployed (Chart 7).

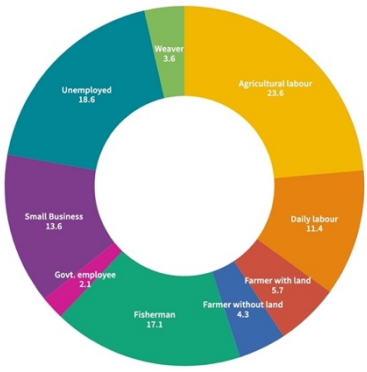


Chart 7: Past occupation among respondents (*Source: Author*)

Present occupation: It is found that presently, there were 12 types of occupation. Among them, 3.6% respondents are fisherman, 24.3% are agricultural labour, 23.6% are owner of small business, and 10% are daily labour. Also, 8.6% people are unemployed. four new occupations have emerged. They are fishmonger, private tutor, student and retired (Chart 8).

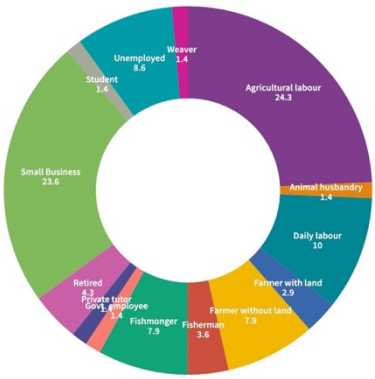
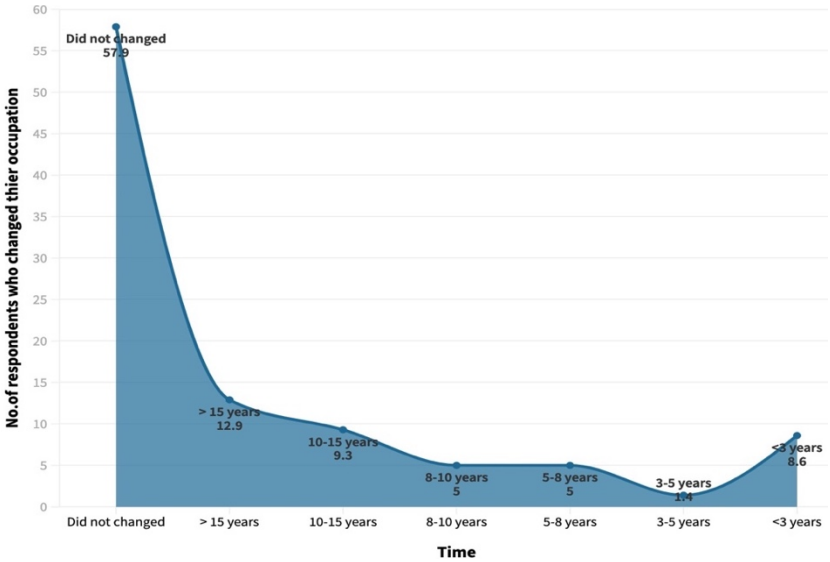


Chart 8: Present occupation among respondents (*Source: Author*)

Time of changing occupation: It is found that 57.9% respondents did not change their occupation in the last 20 years. 12.9% respondents did change their occupation between 15-20 years. 9.3% respondents changed their occupation between 10-15 years. This rate decreased



Graph 3: Time period of switching occupation (*Source: Author*)

for the next few years and then it has increased. In the last 3 years, again 8.6% respondents changed their occupation (Graph 3).

Dynamics of change of occupation: Chart 9 depicts the dynamics of changing from *Past occupation* to *Present occupation*. The results show that, for many trades, people have changed their previous occupation in the past 20 years (for Timeline of research, see Section 3.3). For example, previously there were 24 fishermen. Presently, only 5 people were able to keep their trade. 9 of them turned into fishmonger (they buy fish from wholesale market and do door-to-door selling). Others have changed their occupation into small business, animal husbandry and daily labour. Few of them have become unemployed. This implies that due to loss of fish and water in river, people are compelled to change their occupation. Moreover, people are experiencing degradation of occupation. Similarly, out of 35 agricultural labours, 24 have remained the same indicating people's condition have not improved in the last 20 years. Same happened for farmers without land. Their number has increased from 5 to 11 in the last 20 years. Likewise, 10 daily labours could not change their occupation in the last 20 years. The only positive impact is the overall number of unemployed has reduced from 28 from 12. At the same time, two new occupations i.e., students and private tutors implies that education level has increased in the last 20 years.

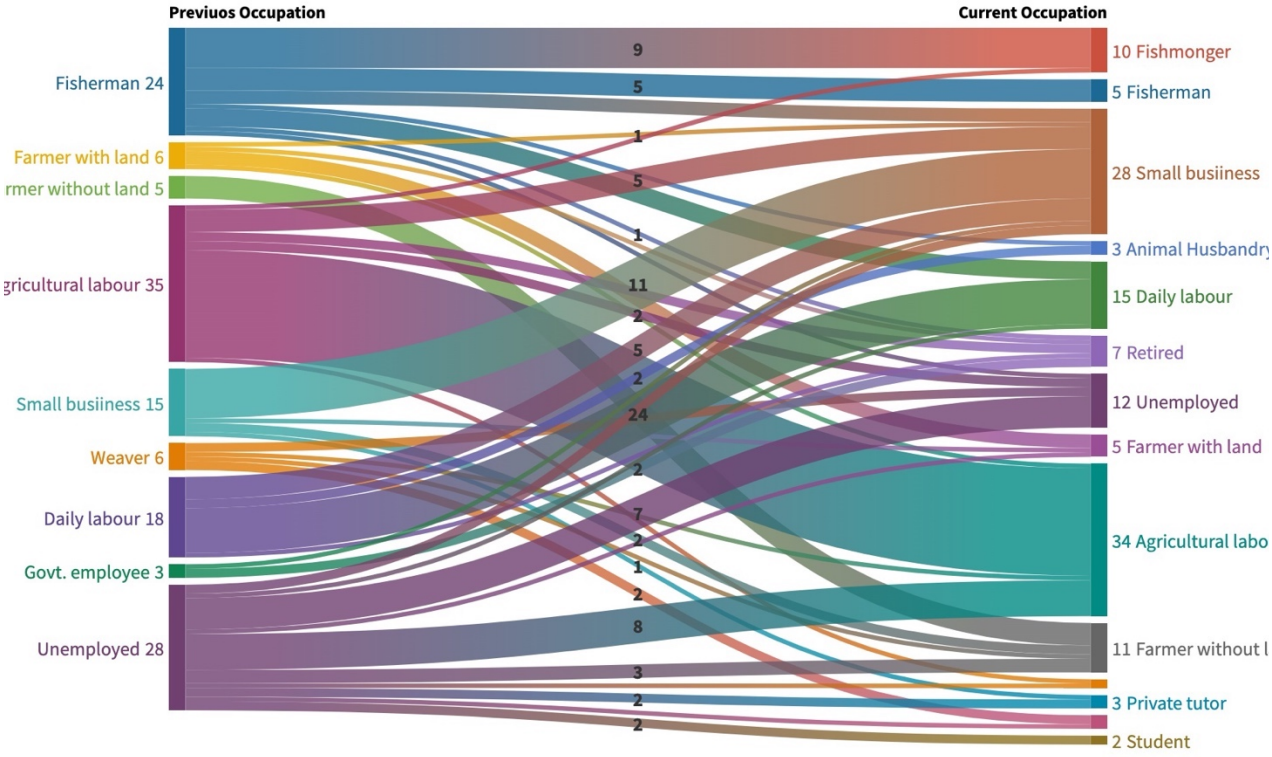


Chart 9: Dynamics of change of occupation. (*Source: Author*)

4.2.1.2 Discussion on dimensions

The quantitative survey has 91 questions to measure 91 indicators. In order to manage them, the answers from these 91 questions are transformed into 16 dimensions according to respective groups. The results of Total scores are shown in Chart 10. Here, dimensions are measured against a 5-point scale (as data is normal).

High scores: The results show that three dimensions regarding *rate of changes* i.e., *change in fish, change in dependency* and *change in water* scored very high (3.07/5 to 4.82/5) indicating high amount of degradation has happened regarding the availability of fish and amount of water in the river over the past 20 years. It also indicates that dependency on river as an economic

resource has decreased severely. Similarly, high score for *rule compliance* (3.59/5) and *adaptation* (3.08/5) indicates that there exist low regards for rules and people are not prepared to adapt for changing conditions of natural resources.

Moderate scores: The dimension *change in land* (2.64/5) and *social capital* (2.05/5) scored moderately indicates that moderate amount of change in land/ encroachment has happened and moderate amount of social awareness and network exists in area. The score of *social capital* compliments with *providing information* (2.01/5) which says that people are informed about natural resource governance. *Monitoring of land* scored low (1.95/5) indicating that there is less awareness regarding land adjacent to river than water in river and fish.

Low scores: Low scores of *infrastructure* (1.9/5) indicates that there is not much infrastructure available for *environmental governance* in the area. This phenomenon is also confirmed by the low scores of *monitoring of water* (1.79/5) and *monitoring of fish* (1.75/5) which reflects overall there is lack of monitoring of resources. Similarly, low score of *user support* (1.71/5) shows that there is low level of user support to govern the environment of the river. This is also reflected in the low score of *public participation* (1.71/5) which shows there is very low public participation among respondents. The low score of *conflict resolution* (1.72/5) also supports this by stating that there are conflicts regarding the *environmental governance* in the area and people are not keen on complying rules. Finally, the very low score of *presence of outsider* (1.5/5) indicates that there is not many "outsiders" or external pressure (foreign businesses, large private entities etc.) on the river. However, it also says that the local and central government is also inactive regarding the *environmental governance* of the river.

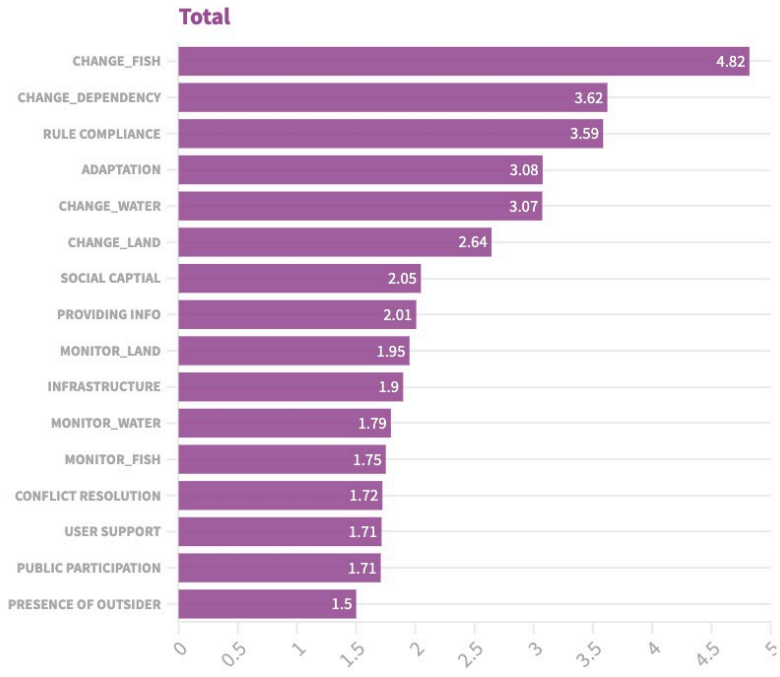


Chart 10: Variation of means of dimensions. (*Source: Author*)

4.2.1.3 Summary of findings regarding socio-economic profile of respondents

It can be said form the above results and discussion that, the area has a good mix of population with varying age. The population is dominated by General caste and Scheduled caste (Annex 8). These castes are interlinked with occupation. People of lower caste are associated with fishing, and they tend to live near natural resources i.e., river. On the other hand, where there is no water in the river, people have opted to agricultural labour. There are no people associated with fishing or agricultural labour in the urban area. This proves that the transition of jobs due

to economic changes happened long ago in the urban area. Thus, the association with river through occupation was lost long ago. Regarding income, it is found that majority of people have monthly income of 57.41 euros. Finally, regarding occupation, it can be said that people in the area whose trades are directly linked with the resources from river are compelled to change occupation due to loss of water and fish in the water. At the same time, people whose trades are based on agriculture also did not fare well also. This also shows up in the discussion of dimensions. However, reduction of unemployed people and increment of education level is showing some positive signs. This contributes to the moderate level of *social capital*. Overall, high to moderate scores of independent variables indicates that there exists some form of *effective commons governance*. However, low scores of all dependent variables implies that there are insignificant amount of *environmental governance* and people are suffering for that.

4.2.2 Discussion on relationship between dimensions

In the previous section, the socio-economic profile of respondents has been discussed. It also tries to find causal relationships between different dimensions. In this section, the extent of this relationship and the causality is discussed further. This is done in two parts. Firstly, correlation between independent and dependent variables (at dimension level) will be discussed via correlation matrix. This will also identify the significant dimensions. This will help to understand the nature of relationship between various variables. Secondly, to determine the exact amount of effect of independent variables on dependent variables, discussion on regression analysis is done. Finally, interpretation of the results is done accordingly.

4.2.2.1 Correlation analysis of independent variables (dimension level)

To predict the strength of relationship between variables, bivariate tables are produced with significance level. After that, significant variables are identified and discussed below. Here significant level is kept at 95%. Chart 11 describes the correlation between ten independent variables (dimension level) i.e., *monitoring of land, monitoring of water, monitoring of fish, change in land, change in water, change in fish, change in dependency, social capital, presence of outsiders and user support*. The following describes the strengths of these relationships.

High Scores: It is found that, there is very strong relationship between *user support* and *social capital* (0.616/sig. 0.000). This indicates that *user support* in the area increases *social capital* in the area which in turn enhances effective commons governance.

Moderate Scores: It is also found that, moderate relationship exists between *monitoring of land* and *monitoring of water* (0.258/sig. 0.002), *monitoring of water,* and *monitoring of fish* (0.295/sig. 0.000), *change in land* and *change in water* (0.328/sig. 0.000), *change in fish,* and *change in dependency* (0.315/sig. 0.000) and *change in fish* and *social capital* (0.27/sig. 0.001). This relationship reflects that all types of *monitoring of resources* are inter-related but there is no extreme corelation. Similarly, all types of *rate of changes* are inter-related but there is no extreme corelation. At the same time, the moderate positive corelation between *change in fish* and *social capital* shows that degradation of availability of fish in the river and the social network between users are inter-related.

Low Scores: The results also show that, there is weak relationship between *monitoring of land* and *social capital* (0.182/sig. 0.031), *monitoring of fish* and *presence of outsiders* (0.225/ sig. 0.008), *monitoring of fish* and *user support* (0.178/ sig. 0.035), and *change in water* and *presence of outsiders* (0.236/ sig. 0.005). These scores show that monitoring of land encroachment of lack of thereof is related to the lack of social networking among users. Similarly, lack of monitoring of degradation of fish in river is associated with inactive local government and weak user support. In the same way, decreasing of water in the river is corelated with inactive local government.

Inverse Scores: Finally, *monitoring of fish* and *change in fish* are inversely related (-0.242/ sig. 0.004) which clearly indicates that if monitoring of fish in river can be increased, then degradation of fish will decrease. In other words, monitoring can increase the *environmental governance* of the area. It is found that, *presence of outsiders* and *change in dependency* are also inversely related (-0.264/ sig. 0.002). This shows that, if local governance is increased, then people dependent on river will not be compelled to change their occupation.

		MONITOR_LAND	MONITOR_WATER	MONITOR_FISH	CHANGE_LAND	CHANGE_WATER	CHANGE_FISH	CHANGE_DEPENDENCY	SOCIAL_CAP	PRESENCE_OF_OUTSIDER
MONITOR_WATER	Correlation Coefficient	0.258								
	Sig. (2-tailed)	0.002								
MONITOR_FISH	Correlation Coefficient	0.088	0.295							
	Sig. (2-tailed)	0.299	0.000							
CHANGE_LAND	Correlation Coefficient	0.027	0.061	0.154						
	Sig. (2-tailed)	0.749	0.473	0.069						
CHANGE_WATER	Correlation Coefficient	0.077	-0.072	0.020	0.328					
	Sig. (2-tailed)	0.366	0.396	0.814	0.000					
CHANGE_FISH	Correlation Coefficient	0.163	-0.113	-0.242	-0.108	0.029				
	Sig. (2-tailed)	0.055	0.182	0.004	0.206	0.735				
CHANGE_DEPENDENCY	Correlation Coefficient	0.145	-0.108	-0.044	0.000	0.072	0.315			
	Sig. (2-tailed)	0.087	0.202	0.604	1.000	0.398	0.000			
SOCIAL_CAP	Correlation Coefficient	0.182	-0.141	0.116	-0.016	0.188	0.27	0.156		
	Sig. (2-tailed)	0.031	0.096	0.173	0.854	0.026	0.001	0.065		
PRESENCE_OF_OUTSIDER	Correlation Coefficient	-0.078	-0.074	0.225	0.148	0.236	-0.212	-0.246	0.097	
	Sig. (2-tailed)	0.358	0.385	0.008	0.080	0.005	0.012	0.003	0.256	
USER_SUPPORT	Correlation Coefficient	0.118	-0.027	0.178	-0.098	0.171	0.189	0.110	0.616	0.212
	Sig. (2-tailed)	0.165	0.752	0.035	0.248	0.043	0.025	0.194	0.000	0.012

Chart 11: Relationship between independent variables (*Source: Author*)

4.2.2.2 Correlation analysis of dependent variables (dimension level)

Chart 12 describes the correlation between six dependent variables (dimension level) i.e., *providing information, conflict resolution, public participation, rule compliance, infrastructure,* and *adaptation.* The following describes the strengths of these relationships.

High Scores: No high score is found.

Moderate Scores: It is found that there is moderate relationship between *infrastructure* and *adaptation* (0.396/sig. 0.000). This indicates that if infrastructure related to monitoring and environmental protection is increased, then adaptive capacity of people will increase with respect to environmental change.

Low Scores: It is also found that *providing information* have weak positive relationship with *conflict resolution* (0.235/sig. 0.005) and *rule compliance* (0.262/sig. 0.002). This indicates with if people have more access to information regarding *environmental governance*, more number of conflicts regarding the river can be reduced and more people will follow rules regarding the same. Similarly, *conflict resolution* has weak positive relationship with *public*

		PROVIDING_INFORMATION	CONFLICT_RESOLUTION	PUBLIC_PARTICIPATION	RULE_COMPLIANCE	INFRASTRUCTURE
CONFLICT_RESOLUTION	Correlation Coefficient	0.235				
	Sig. (2-tailed)	0.005				
PUBLIC_PARTICIPATION	Correlation Coefficient	0.175	0.243			
	Sig. (2-tailed)	0.039	0.004			
RULE_COMPLIANCE	Correlation Coefficient	0.262	0.224	-0.079		
	Sig. (2-tailed)	0.002	0.008	0.353		
INFRASTRUCTURE	Correlation Coefficient	0.152	0.161	0.252	0.162	
	Sig. (2-tailed)	0.072	0.058	0.003	0.055	
ADAPTATION	Correlation Coefficient	0.071	0.056	0.209	0.156	0.396
	Sig. (2-tailed)	0.404	0.510	0.013	0.066	0.000

Chart 12: Relationship between dependent variables (*Source: Author*)

participation (0.243/sig. 0.004) and *rule compliance* (0.224/sig. 0.008). This indicates if more people participate actively regarding *environmental governance*, a greater number of conflicts regarding the river can be reduced and more people will follow rules regarding the same. Finally, *public participation* has weak positive relationship with *infrastructure* (0.252/sig. 0.003) and *adaptation* (0.209/sig. 0.013). This indicates that if more people participate actively regarding *environmental governance*; physical, financial, technical infrastructure regarding the river can be increased and more people will be capable to adapt with the changing environment.

4.2.2.3 Overall relationship among all variables

It is found that among sixteen variables (dimension level), fourteen are significant. Relationship among these fourteen variables is shown in Chart 13.

High Scores: No high score is found.

Moderate Scores: *Social capital* emerged as the most important variable. It has weak/moderately positive relationship with *presence of outsiders* (0.176/sig. 0.037)*, user support* (0.442/sig. 0.000)*, providing information* (0.224/sig. 0.004)*, conflict resolution* (0.331/sig. 0.000)*, public participation* (0.205/sig. 0.015)*, rule compliance* (0.237/sig. 0.005)*, infrastructure* (0.403/sig. 0.000) *and adaptation* (0.184/sig. 0.029). Thus, it can be said, *social capital* is very essential for *environmental governance*. Among these, *social capital* and *user support* have strongest relationship. This is also confirmed in section 4.3.2.1.1. However, the initial value of 0.616 dropped to 0.442 indicating that other variables have some negative influence on *social capital.*

Low to Moderate Scores: Similar to *social capital*, *user support* also emerged as key variable as it has weak/moderately positive relationship with all dependent variables i.e., *providing information* (0.338/sig. 0.000)*, conflict resolution* (0.211/sig. 0.012)*, public participation* (0.189/sig. 0.025)*, rule compliance* (0.268/sig. 0.001)*, infrastructure* (0.34/sig. 0.000) *and adaptation* (0.292/sig. 0.000). This proves that along with *social capital*, *user support* is also very important for *environmental governance*. The third important variable is *monitoring of fish*. it has weak/moderately positive relationship with all *presence of outsiders* (0.274/sig. 0.001)*, public participation* (0.471/sig. 0.000)*, infrastructure* (0.213/sig. 0.011) *and adaptation* (0.219/sig. 0.009). It also has weak negative relationship with *change in fish* (-0.203/sig. 0.016). This proves that i) if monitoring of fish in the water is increased, then public participation will automatically increase, ii) it will also affect the infrastructure by increasing physical infrastructure iii) it will help in preparing people for adaption due to environmental change and iv) if monitoring of fish is increased, then degradation of fish in water can be resisted.

Low Scores: Other important variables emerged are *change in land, change in water,* and *change in fish*. Here, *change in land* has weak corelation with *change in water*, *change in fish*, *presence in outsiders* and *conflict resolution.* Among these, *change in land* and *conflict resolution* have moderate positive relation (0.322/sig. 0.000). This reflects that if there is less amount of land encroachment, it will help in reducing the conflict regarding *environmental governance*. *Change in water* also has moderate positive relation with *conflict resolution* (0.337/sig. 0.000) which also indicates that if water in river can be increased, then it will also help in reducing the conflict regarding *environmental governance*.

Inverse Scores: For *change in fish*, it is found that it has weak negative relationship with *presence of outsiders* (-0.288/sig. 0.001) and *public participation* (-0.371/sig. 0.000). This degradation of fish in water can be arrested by introducing good governance and by a smaller number of foreign businesses entering in the area. At the same time, if degradation of fish in water is arrested then public participation will increase.

Overall, there are relationships among independent variables and dependent variables which proves that independent variables influence dependent variables. However, weak to moderate relationships among variables suggests that there is no multicollinearity among them. To further investigate the specific amount of effect independent variables, have on dependent variables; multiple regression analysis is done. The results of the same is discussed in the next section.

		MONITOR_LAND	MONITOR_WATER	MONITOR_FISH	CHANGE_LAND	CHANGE_WATER	CHANGE_FISH	CHANGE_DEPENDENCY	SOCIAL_CAPITAL	PRESENCE_OF_OUTSIDER	USER_SUPPORT	PROVIDING_INFORMATION	CONFLICT_RESOLUTION	PUBLIC_PARTICIPATION	RULE_COMPLIANCE	INFRASTRUCTURE	ADAPTATION
MONITOR_LAND	Pearson Correlation																
	Sig. (2-tailed)																
MONITOR_WATER	Pearson Correlation	0.106															
	Sig. (2-tailed)	0.212															
MONITOR_FISH	Pearson Correlation	-0.075	0.348														
	Sig. (2-tailed)	0.376	0.000														
CHANGE_LAND	Pearson Correlation	-0.037	0.099	0.213													
	Sig. (2-tailed)	0.661	0.243	0.012													
CHANGE_WATER	Pearson Correlation	-0.022	-0.070	0.101	.363**												
	Sig. (2-tailed)	0.792	0.413	0.236	0.000												
CHANGE_FISH	Pearson Correlation	0.055	0.037	-.203*	-.180*	-0.034											
	Sig. (2-tailed)	0.518	0.668	0.016	0.034	0.690											
CHANGE_DEPENDENCY	Pearson Correlation	0.030	-0.055	-0.039	-0.077	0.064	.201*										
	Sig. (2-tailed)	0.721	0.521	0.649	0.365	0.453	0.017										
SOCIAL_CAPITAL	Pearson Correlation	0.103	-0.041	0.091	-0.001	.194*	-0.033	0.099									
	Sig. (2-tailed)	0.227	0.631	0.283	0.989	0.021	0.700	0.245									
PRESENCE_OF_OUTSIDER	Pearson Correlation	0.029	-0.077	.274**	.283**	.353**	-.288**	-0.134	.176*								
	Sig. (2-tailed)	0.738	0.368	0.001	0.001	0.000	0.001	0.115	0.037								
USER_SUPPORT	Pearson Correlation	0.098	-0.031	0.110	-0.065	0.059	0.103	0.098	.442**	.172*							
	Sig. (2-tailed)	0.249	0.714	0.196	0.444	0.492	0.227	0.247	0.000	0.042							
PROVIDING_INFORMATION	Pearson Correlation	0.002	-0.029	-0.015	0.016	0.163	0.149	0.085	.244**	-0.025	.338**						
	Sig. (2-tailed)	0.981	0.732	0.858	0.848	0.054	0.079	0.319	0.004	0.768	0.000						
CONFLICT_RESOLUTION	Pearson Correlation	0.001	-0.031	0.067	.322**	.337**	0.022	.181*	.331**	0.028	.211*	.243**					
	Sig. (2-tailed)	0.994	0.716	0.431	0.000	0.000	0.798	0.032	0.000	0.743	0.012	0.004					
PUBLIC_PARTICIPATION	Pearson Correlation	0.016	.238**	.471**	0.078	-0.091	-.371**	0.071	.205*	0.098	.189*	0.082	.206*				
	Sig. (2-tailed)	0.853	0.005	0.000	0.360	0.283	0.000	0.406	0.015	0.252	0.025	0.335	0.014				
RULE_COMPLIANCE	Pearson Correlation	0.081	-0.092	-0.136	-0.028	.173*	.493**	.229**	.237**	-0.002	.268**	.226**	.193*	-.240**			
	Sig. (2-tailed)	0.340	0.281	0.108	0.747	0.041	0.000	0.007	0.005	0.982	0.001	0.007	0.022	0.004			
INFRASTRUCTURE	Pearson Correlation	0.179	0.057	.213*	0.077	.180*	-0.122	-0.113	.403**	.218*	.340**	.194*	.179*	.196*	0.138		
	Sig. (2-tailed)	0.034	0.504	0.011	0.363	0.033	0.151	0.186	0.000	0.010	0.000	0.022	0.034	0.020	0.104		
ADAPTATION	Pearson Correlation	0.074	0.053	.219**	-0.015	-0.031	-0.084	-0.101	.184*	.204*	.292**	0.021	0.053	.224**	0.091	.415**	
	Sig. (2-tailed)	0.386	0.537	0.009	0.864	0.712	0.325	0.236	0.029	0.016	0.000	0.803	0.536	0.008	0.287	0.000	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Chart 13: Relationship between all variables (*Source: Author*)

4.2.2.4 Regression analysis (dimension level)

In order to predict the effect of independent variables on dependent variables, Multiple Linear Regression is done. A total number of 6 equations are formed and significance levels are checked. The equations are as follows:

$y_1 = 0.389 + 0.03x_1 - 0.154\,x_2 + 0.102\,x_3 - 0.172\,x_4{}^{*} + 0.230\,x_5{}^{**} - 0.58\,x_6 + 0.08\,x_7{}^{*} + 0.309\,x_8{}^{**} + 0.102\,x_9{}^{*} + 0.355\,x_{10}{}^{**}$

$y_2 = 0.812 + 0.11x_1 - 0.121\,x_2 + 0.136\,x_3 - 0.082x_4 + 0.136\,x_5{}^{*} - 0.104\,x_6 + 0.089\,x_7{}^{*} + 0.478\,x_8{}^{**} + 0.027\,x_9 + 0.162\,x_{10}$

$y_3 = 1.034 - 0.047x_1 - 0.162\,x_2 + 0.440\,x_3{}^{**} - 0.071\,x_4 - 0.036\,x_5 - 0.123\,x_6 + 0.005\,x_7 + 0.063\,x_8 + 0.06\,x_9 + 0.435\,x_{10}{}^{**}$

$y_4 = 0.533 - 0.052x_1 - 0.209\,x_2 + 0.440\,x_3 - 0.165\,x_4 - 0.098\,x_5 - 0.410\,x_6 + 0.143\,x_7 + 0.028\,x_8 + 0.074\,x_9 + 0.321\,x_{10}$

$y_5 = -0.315 - 0.23x_1{}^{*} - 0.061\,x_2 + 0.235\,x_3{}^{*} - 0.05\,x_4 - 0.266\,x_5{}^{**} - 0.174\,x_6 + 0.089\,x_7{}^{*} + 0.143\,x_8 + 0.130\,x_9{}^{*} + 0.344\,x_{10}{}^{*}$

$y_6 = 1.672 - 0.076x_1 - 0.151\,x_2{}^{*} + 0.283\,x_3{}^{*} - 0.183\,x_4 - 0.022\,x_5 - 0.022\,x_6 + 0.053\,x_7 + 0.038\,x_8 + 0.08\,x_9 + 0.438\,x_{10}{}^{*}$

*** Significant at 95%*

** Significant at 90%*

where, y_1= *providing information,* y_2= *conflict resolution,* y_3= *public participation,* y_4= *rule compliance,* y_5= *infrastructure,* y_6= *adaptation,* x_1= *monitoring of land,* x_2= *monitoring of water,* x_2= *monitoring of fish,* x_4= *change in land,* x_5= *change in water,* x_6= *change in fish,* x_7= *change in dependency,* x_8= *social capital,* x_9= *presence of outsider and* x_{10}= *user support.* The variables with significant coefficient are put together to form a relationship chart (Chart 14[7]). The results are discussed below.

[7] Chart 14 describes how each significant independent variable affects each significant dependent variable. For example, independent variable *Change in water* (in light green) is affecting *providing information* (in purple),

Moderate Scores: *User support* has emerged as the most influential variable. It influences four dependent variables i.e., *providing information* (Coeff. 0.35), *public participation* (Coeff. 0.43), *infrastructure* (Coeff. 0.34) and *adaptation* (Coeff. 0.44). This indicates that for one unit change in *user support*, *providing information* will increase by 0.35, *public participation* will increase by 0.43, *infrastructure* will increase by 0.34 and *adaptation* will increase by 0.44 unit, holding other factors constant. This also means that *user support* has very high influence on *environmental governance*.

The second most important variable that emerged is *social capital*. It influences two dependent variables i.e., *providing information* (Coeff. 0.31) and *conflict resolution* (Coeff. 0.48). This indicates that for one unit change in *social capital*, *providing information* will increase by 0.31 and *conflict resolution* will increase by 0.48 unit, holding other factors constant. This also means that *social capital* has high influence on *environmental governance*.

Low to Moderate Scores: The third important variable that emerged are *monitoring of fish* and *monitoring of fish*. Together they form *monitoring of resources*. These variables influence *public participation* (Coeff. 0.44), *infrastructure* (Coeff. 0.56) and *adaptation* (Coeff. 0.28). This indicates that for one unit change in *monitoring of resources*, *public participation* will increase by 0.44, *infrastructure* will increase by 0.56 and *adaptation* will increase by 0.28 unit, holding other factors constant. This also means that *monitoring of resources* has moderate influence on *environmental governance*.

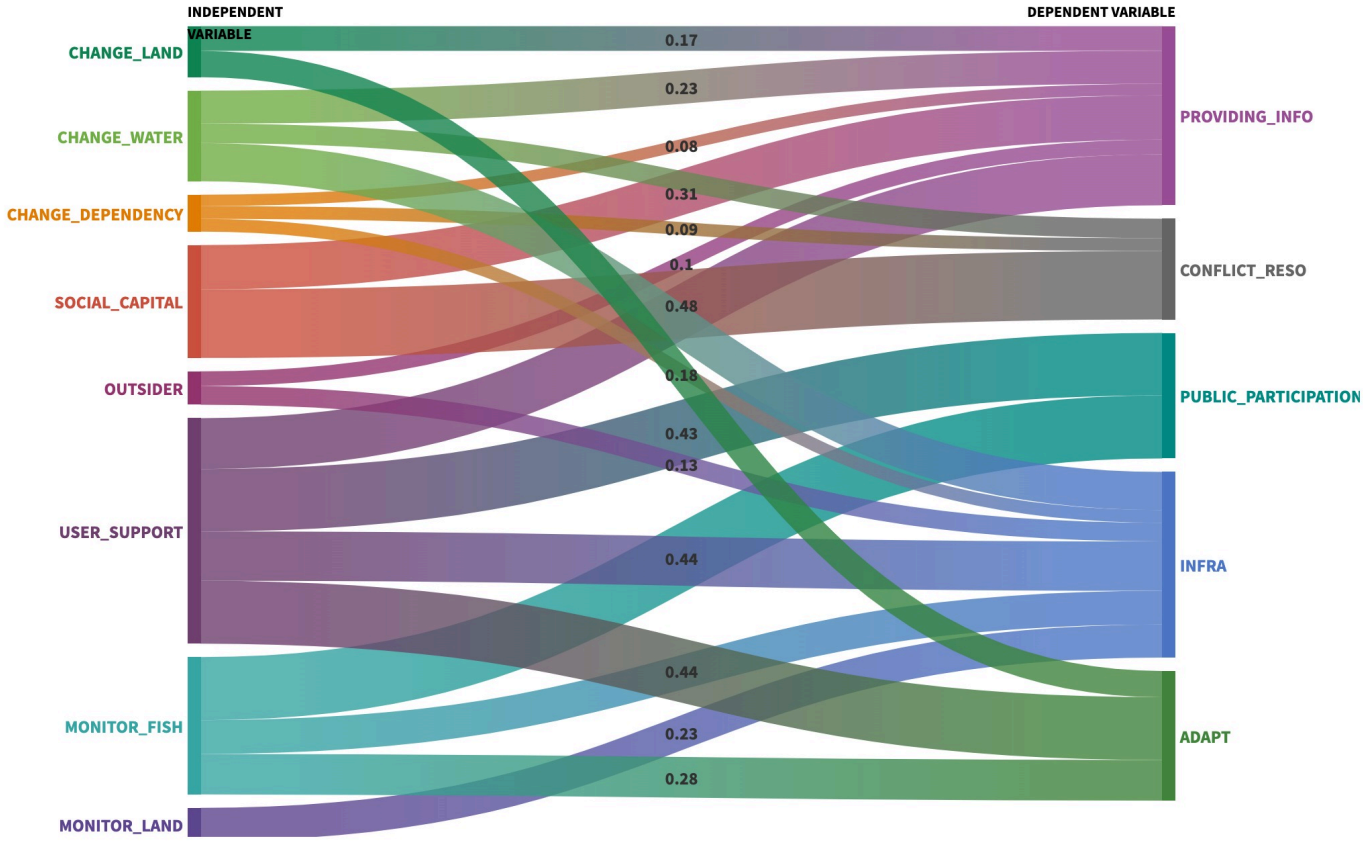


Chart 14: Result of regression analysis. (*Source: Author*)

conflicting resolution (in grey) *and infrastructure* (in blue). The amount of influence is shown via the width of the connecting lines.

The next influential variable is called *rate of changes* which is comprised of *change in water* and *change in dependency*. These two variables also influence *providing information* (Coeff. 0.31), *conflict resolution* (Coeff. 0.23) and *public participation* (Coeff. 0.36). This indicates that for one unit change in *rate of changes, providing information* will increase by 0.31, *conflict resolution* will increase by 0.23 and *public participation* will increase by 0.36 unit, holding other factors constant. This also means that *rate of changes* has weak influence on *environmental governance*.

Low Scores: *Presence of outsider* has very limited influence on *providing information* (Coeff. 0.03) and *infrastructure* (Coeff. 0.13). This indicates that for one unit change in *presence of outsiders*, *providing information* will increase by 0.03 and *infrastructure* will increase by 0.13 unit, holding other factors constant. This also means that *presence of outsider* has negligible influence on *environmental governance*. These findings are corroborated/ triangulated with the help of qualitative data analysis and secondary data in section 4.3.

4.2.2.5 Summary of findings regarding relationship between dimensions

It can be said from the above discussion that regarding *effective commons governance*; — *monitoring of resources* has moderate influence on *environmental governance*, *rate of changes* has weak influence on *environmental governance*, *social capital* has high influence on *environmental governance*, *user support* has very high influence on *environmental governance* and *presence of outsider* has negligible influence on *environmental governance* (Section 1.6.1).

The possible explanation of the results are as follows. First, the river flows through 16 different areas which have urban, peri-urban, and rural characters (Section 4.2.1). Each areas have multitude of people having different levels of association with the river (Section 4.2.1.1). Thus, the river and the user both are heterogenous (Das et al., 2020). This *biophysical condition of resource* and *heterogeneity of resources* makes *monitoring of resources* very hard. Similarly, there are various levels of change occurs at different areas adjacent to the river at different time period. Thus, *rate of changes* is uneven and fail to influence *environmental governance* properly. On the other hand, rising education level and environmental awareness has contributed to the *social capital* (Section 4.2.1.3). Thus, rising number of educated people, CBOs, students etc. are successfully contributing to the *environmental governance* via increased *social capital*. Same goes for *user support*. People are actively cleaning river, providing information about encroachment, and questioning local administration. Finally, the area has not experienced any foreign investment etc. Thus, there is no *presence of outsider*. However, this also implies that the local government and upper government is particularly inactive as the area is governed by several municipalities and panchayats (village administrations).

4.2.3 Analysis of variance

As discussed in Section 3.2 and 4.2.2.5, value of dimensions varies in urban, peri-urban, and rural area. In order to compare and study this variance, one-way ANOVA is done. Significance level is kept at 95%. The observed means are then plotted to get a chart. The result is shown in Chart 9. The same is discussed below.

4.2.3.1 Study of variation in means

Discussion on Rural/ Peri-urban/ Urban score of dimensions: The result shows that for each dimension, there exists variation in the scores of rural, peri-urban, and urban areas. This proves that different dimensions are at different levels in rural, peri-urban, and urban areas.

High Scores: For dimension *change in fish*, score in urban area (4.48/5) is lower than rural area (4.91/5). This shows that degradation of fish in river in rural area is more evident than urban area for last 20 years. However, for *change in water*, score in urban area (3.76/5) is higher than

rural area indicates that the condition of river has worsened more in urban area in last 20 years. Similar thing is observed for *change in land* where scores are higher in urban area (3.71/5) than peri-urban (2.6/5) and rural area (2.42/5). This reflects that more encroachment has happened in urban areas in last 20 years.

This also reflects in *rule compliance*, where lower score in urban area (3.24/5) to rural area (3.7/5) indicates that people comply to rules more in rural area rather than urban area. This compliance has led to less encroachment.

Moderate Scores: Results indicate that people are less prepared in rural (3.05/5) and peri-urban area (3.08/5) regarding *adaptation* to the change as compared urban areas (3.19/5). One of the reasons for this unpreparedness to adapt and severe degradation of river in places can be pointed towards lack of effective commons governance via moderate *social capital* and low *user support*.

Results show that *social capital* is really low in urban area (1.62/5) as compared to rural (2.04/5) and peri-urban areas (2.55/5). This indicates that in urban areas people are very less concerned with the *environmental governance* of the river. This corresponds with the low rule compliance, high encroachment of land and severe degradation of river in urban areas.

As for *user support*, surprisingly scores in peri-urban areas are higher (2.13/5) than urban (1.62/5) and rural areas (1.65/5). Similarly, for *conflict resolution*, scores in peri-urban areas are higher (1.85/5) than urban (1.29/5) and rural areas (1.79/5).

In the same way, for *providing information* for *environmental governance*, scores in peri-urban areas are higher (2.15/5) than urban (1.71/5) and rural areas (2.04/5). This has to do with the rising education level and rising *environmental governance* in peri-urban areas.

Low Scores: For *monitoring of land, water* and *fish*, urban areas score higher than peri-urban and rural areas. This happens due to the presence of high number of monitoring bodies like CBOs and CBIs in the urban areas. However, urban areas have very less *social capital* (1.62/5) which leads to severe degradation of environment of river as evident from high value of *change in land, water,* and *fish* in urban areas (3.71/5, 3.76/5 and 4.48 respectively).

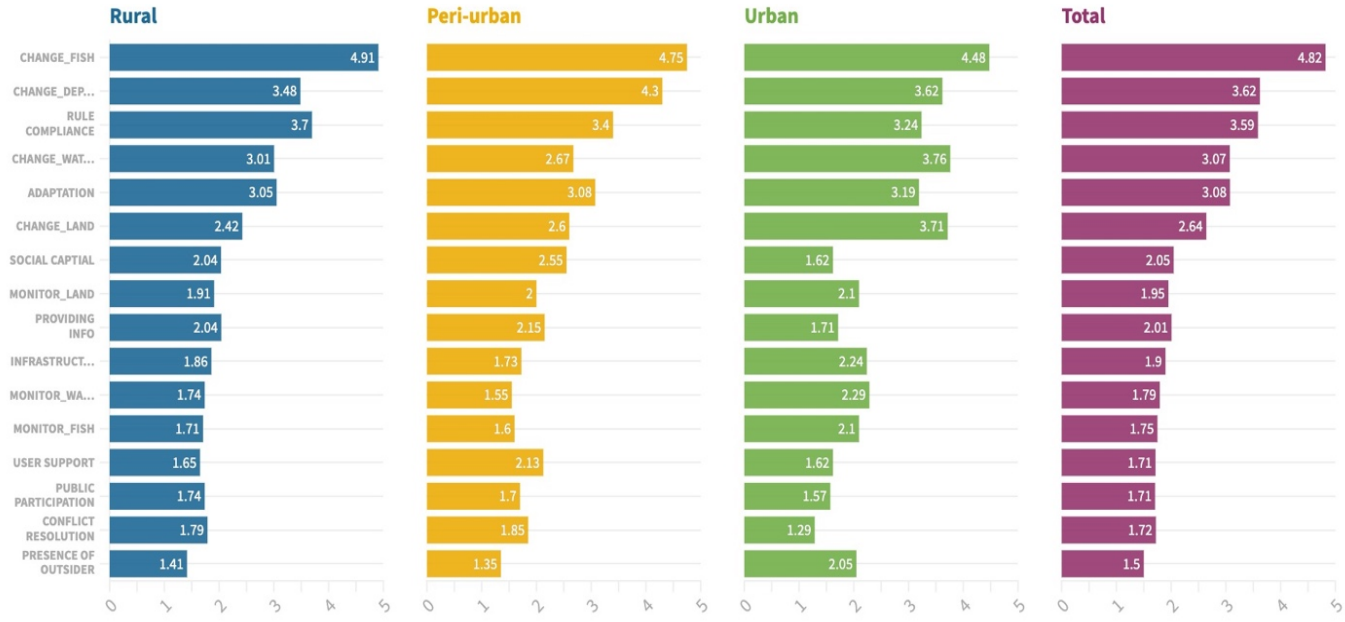


Chart 15: Analysis of variance (*Source: Author*)

Finally, for *presence of outsiders*, urban areas score higher (2.05/5) than peri-urban (1.35/5) and rural areas (1.41/5) which indicates that there is very less of a presence of outsiders like foreign businesses, private entities in the area in the peri-urban and rural areas. The score is little higher in urban areas due to the limited involvement of local government.

4.2.3.2 Summary of findings regarding quantitative analysis

It can be seen from the above discussion that *monitoring of resources* varies in different areas and the river is severely degraded in urban area, but not so in peri-urban or rural areas. Similarly, the *rate of changes* also varies in different areas. Degradation of fish in river in rural area is more evident than urban area for last 20 years, whereas the condition of river has worsened more in urban area in last 20 years. This contradictory phenomenon happens because the urban area has lost fish before 20 years. Therefore, it did not register in the current research. Thus, *time of change* is important for studying. Regarding *social capital*, it is found that, people in rural area have higher social capital compared to other areas. This is because in other areas, people have lost their association with river via occupation long ago (Section 4.2.1.3). Surprisingly, *user support* is high in peri-urban areas. This has to do with the rising education level and environmental awareness in those areas. Finally, for *presence of outsiders*, urban areas score high indicating that there is more involvement of local government in urban areas (Photo 5,6,7). These factors contribute to the *environmental governance* in various intensity. While doing the qualitative analysis, it is found that some variables needed more explanation. In order to do this, qualitative analysis is done. The results are discussed below.

Photograph 10: Anjana river in urban areas showing neglect towards it (*Source: Google*)

Photograph 9: Anjana river in rural areas showing illegal road over river with river flowing through pipes (*Source: Author*)

Photograph 8: Map showing the choked origin of the Anjana river by brick kiln owners. (*Source: Google maps*)

4.3 Qualitative analysis

In order to start the qualitative analysis, data is collected in the form of group discussions and personal interviews. These interviews are then translated from Bengali to English for coding. Then the documents are coded against same indicators used for quantitative analysis to justify the mixed method (Section 3.3). Sometimes new codes are introduced as 'in-vivo' codes. The results are discussed below according to dimensions. This is done in two parts. Firstly, discussion is done on how independent variable influences dependent variables via networks. Secondly, the 'in-vivo codes' are discussed as new factors.

4.3.1 Analysis of networks

To understand the how independent variable affects dependent variables, networks are created. The results are follows: —

Monitoring of resources: Results show that (Fig. 10) the *monitoring of resources* is mainly done by CBOs and CBIs. The method is mainly oral. They *provide information* to each other via mobile phones via which they communicate in real-time over helpline numbers, document information informally and sometimes publishes in newspaper. Students, educated people, CBOs as well as fishermen of rural areas share more information than urban areas raising *social capital* (Section 4.2.3.2). It is also found that although there is strong hierarchy of local government in all areas, in reality they do little monitoring. Horizontal governance is also absent along with vertical governance. It is surprising that despite strong vertical governance, financial assistance from local or upper government is absent and very little *physical or financial infrastructure* is available. The role of local government proves that *presence of outsiders* is not excludable as the jurisdiction of the river is under several municipalities and panchayats (Section 4.3.2.3). Also, the river is the property of central government according to

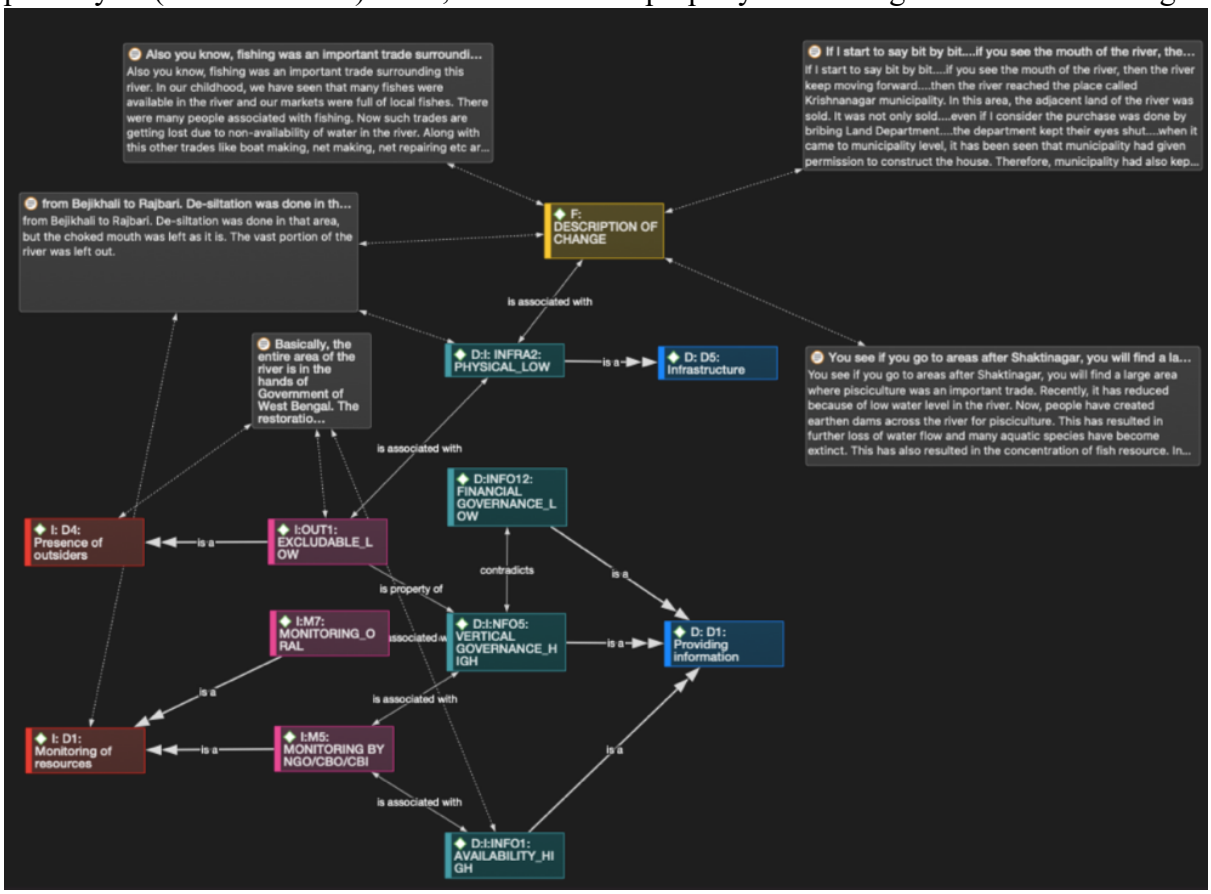


Figure 10: Network of Monitoring of resources (*Source: Author*)

Indian laws. There is *heterogeneity* via multi-layer governance, multiple user groups with different level of association (Section 4.3.3.2) with river and the different biophysical state of the river combined with very little formal monitoring and financial assistance begs the question to rethink the role *monitoring of resources* and infrastructure regarding *environmental governance*.

Rate of changes: Results show that (Fig. 11) instead of moderate change, all respondents stated that the river has gone through extreme changes in the past 20 years. The amount of change is uneven (Section 4.3.2.2). It is also found that in some urban and rural areas major change has occurred long before 20 years. Among all different kinds of changes took place, *change in fish* has emerged as most severe one. The degradation of availability of fish in river has severely affected the *change in livelihood* associated with the fishing trade. It is found that *extreme change* is caused by a combination of multiple factors i.e., low amount of *providing information* (via low *institutional governance* and low *horizontal governance*), low *rule* compliance and low *conflict resolution* (via presence of high legal disputes). At the same time, *extreme change* is also caused by low *social capital* (via past trend of *decreasing public engagement*). However, currently *social capital* is increasing in peri-urban and rural areas (Section 4.2.1.3, 4.2.3.2) due to rising education level and environmental awareness. This fragmented condition of the resources and their uneven changes over time compels one to rethink the impact of time *period and amount of change* on *environmental governance*. It is also found that, *overpoliticisation* is the root cause of all the problems. This is discussed in the next section.

Social capital: Results show that (Fig. 12) among the various aspects of *social capital*, it is found that *trust* has decreased in last 20 years. At the same time, *capacity for social mobilisation, public engagement* and *environmental awareness* has increased. Among these

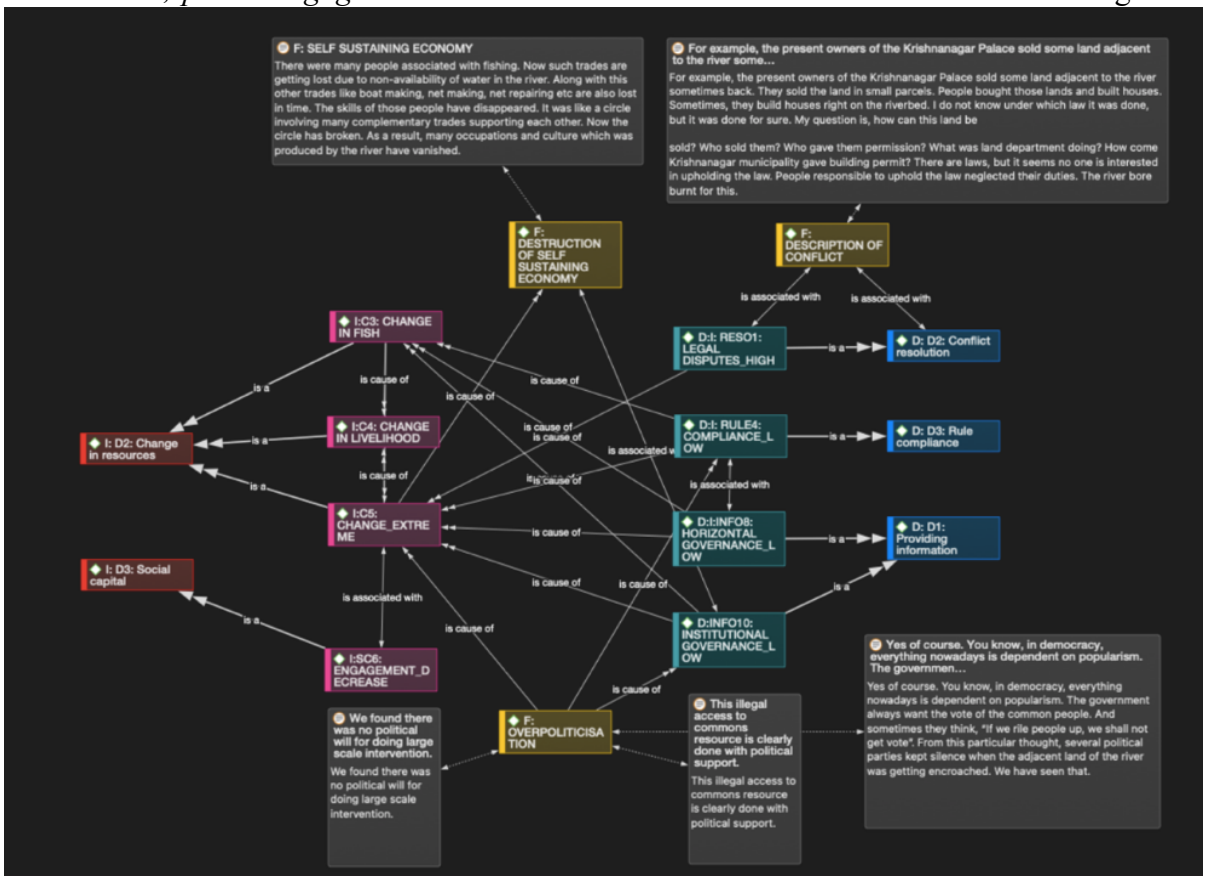


Figure 11: Network of Rate of changes. (*Source: Author*)

factors, *public engagement* has increased the most due to increasing *environmental awareness* (Table 7) It must be pointed out that the idea of *environmental awareness* proved to be limited among interviewees. The question of legal awareness and constitutional awareness have always remained vague. People in the area do know about the day-to-day change of the river, but they are almost unaware of the constitutional rights, environmental laws, judiciary process for breaking such laws that exist in India. They are also unaware of the governance mechanism exists for the river governance in India. Many of them are afraid of judiciary process.

In case of Anjana river, the peri-urban areas have experiencing rapid growth in education. These areas have also experienced the degradation of river in the last 10 years. People are forced to change their occupation in these areas due to degradation of river. To address the problem, the local government in these areas (Badkulla) have become active in river protection. These four factors i.e., good education, observing the degradation of river, past

	●I: D3: Social capital Gr=4
●I:SC1: TRUST_INCREASE Gr=1	0
●I:SC2: TRUST_DECREASE Gr=2	1
●I:SC3: CAPACITY_INCREASE Gr=3	3
●I:SC4: CAPACITY_DECREASE Gr=0	0
●I:SC5: ENGAGEMENT_INCREASE Gr=8	7
●I:SC6: ENGAGEMENT_DECREASE Gr=1	1
●I:SC7: AWARENESS_INCREASE Gr=3	2
●I:SC8: AWARENESS_DECREASE Gr=3	0

Table 7: Co-occurrence table of Social capital. (*Source: Author*)

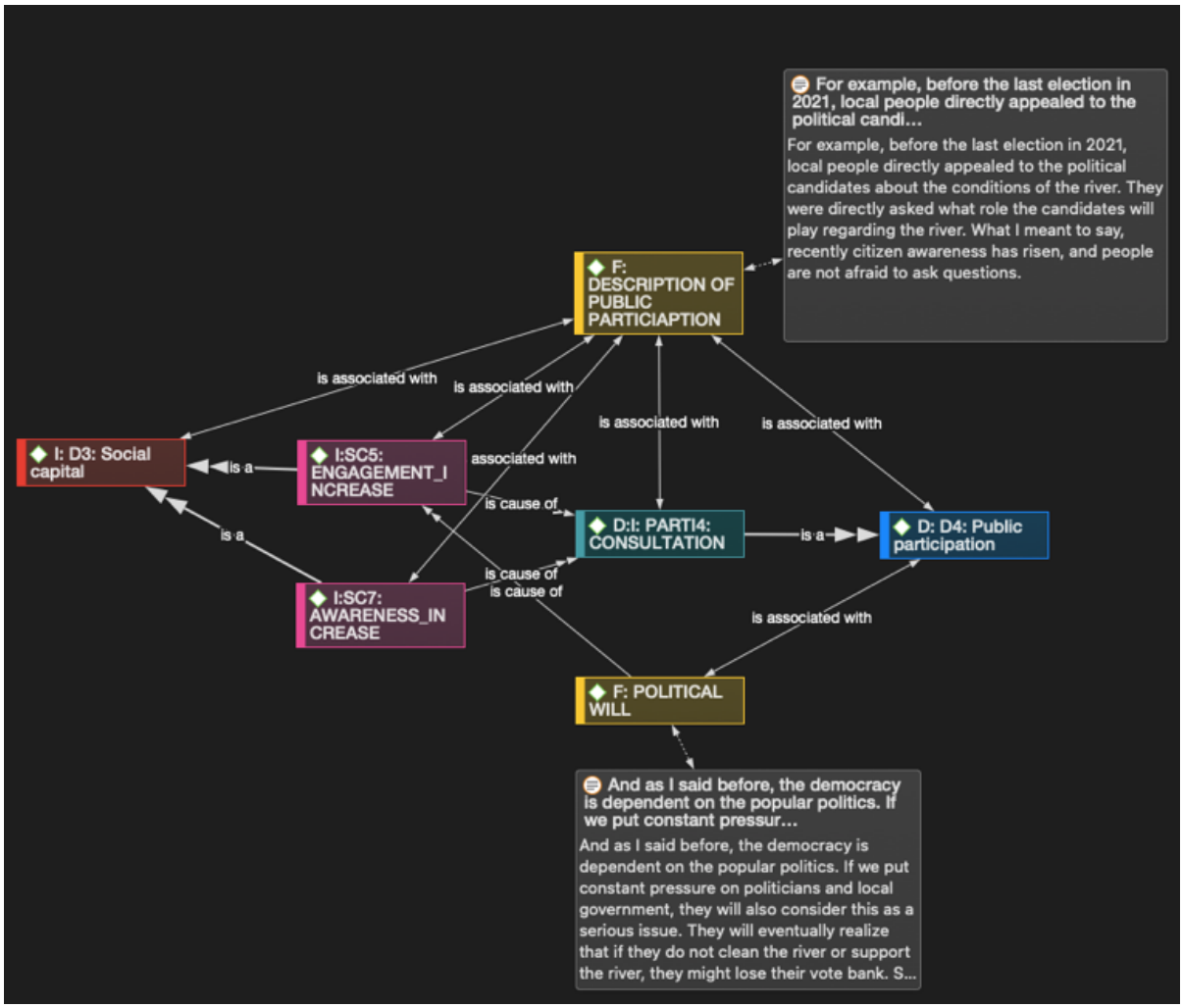


Figure 12: Network of Social capital. (*Source: Author*)

association with the river and support from local government have contributed towards increased *public engagement* and *social capital* in these areas. This is also affecting the amount of *public participation* (via *consultation*). On the contrary, people in urban area have lost the association with river long ago. Thus, *social capital* regarding *environmental governance* is very low in urban area (Section 4.2.3.1). This varied level of *social capital* in different areas forces one to seek the role of *social capital* regarding *environmental governance* in a new way. The study also finds that *political will* and *age wise association* have emerged as the root cause of increasing *social capital* and *public participation*. This phenomenon will be discussed in the next section.

Presence of outsiders: It is evident from results that the river is subject to multiple ownership. Thus, *outsiders* are omnipresent (considering local, provincial, and central government does not fall under user group) (Fig 14). The action of such *outsiders* further complicates the *environmental governance*. For example, the lack of *positive engagement* by local government leads to low *vertical governance,* low *financial governance*, low *institutional governance*, low *public participation* (via *therapy* or keeping people shut with doing some token work like cleaning a very small portion of the river) and low *physical infrastructure*. It also found that, introduction of railway in 1905, upgradation of roadways, in-migration of refugees during 1947, 1968 and 1971 have altered the land-use long ago (Fig. 13). Thus, *presence of outsiders* definitely effects on *environmental governance* via *providing information, public participation,* and *infrastructure* although they might not happen in the timeline of the research. This aspect is undermined in the quantitative analysis where presence of outsider has emerged as a weakly influential variable, but qualitative analysis shows that it is important.

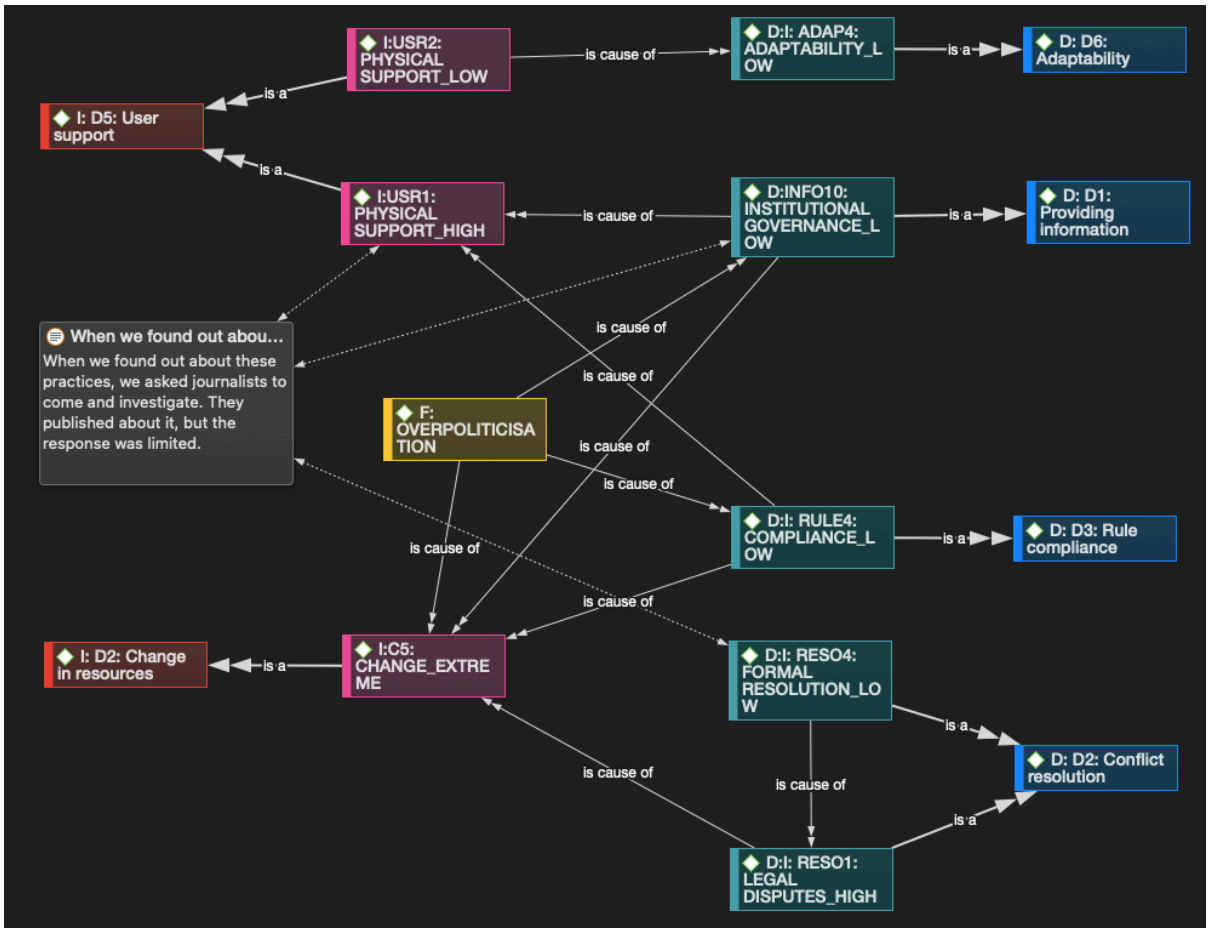


Figure 13: Network of Presence of outsiders. (*Source: Author*)

1:17 p 1 in Interview 1.pdf

Codes:

- D:I:INFO1: AVAILABILITY_HIGH
- I: D4: Presence of outsiders
- I:OUT1: EXCLUDABLE_LOW

Content:

Basically, the entire area of the river is in the hands of Government of West Bengal. The restoration of the river is taken care by Central Government. I what meant to say is, Central Government allots the fund. The money comes through the State Government. Then restoration work takes place. Sometimes, panchayats observe the restoration work. This is the overview of the ownership and restoration work of the river.

Figure 14: Quotation on Presence of outsiders. (*Source: Author*)

User support: Results show that (Fig. 15) both *high physical support* and *low physical support* exists. This is because there exists both phenomena. For example, fishermen who are affected by degradation of river clean their part of the river by themselves. Also, people are planting trees along the riverbank. Also, CBOs are trying to stop the encroachment and illegal construction. In some areas, local government are also trying to de-silt the water using rural employment program (MGNREGA). All these factors contribute to *high physical support* and ultimately to *providing information*. On the other hand, until 5 years ago, there were not much consolidation of people regarding *environmental governance*. Moreover, several interviewees have asserted that in the last 20 years, the area has not experienced much in-migration. Rather, people who are living around the river for generations have slowly encroached and destroyed the river (Fig 16). Interviewees also asserted that new generations in rural areas have little attachment to the river due to change of occupation (Photo 8). For them, the river is an

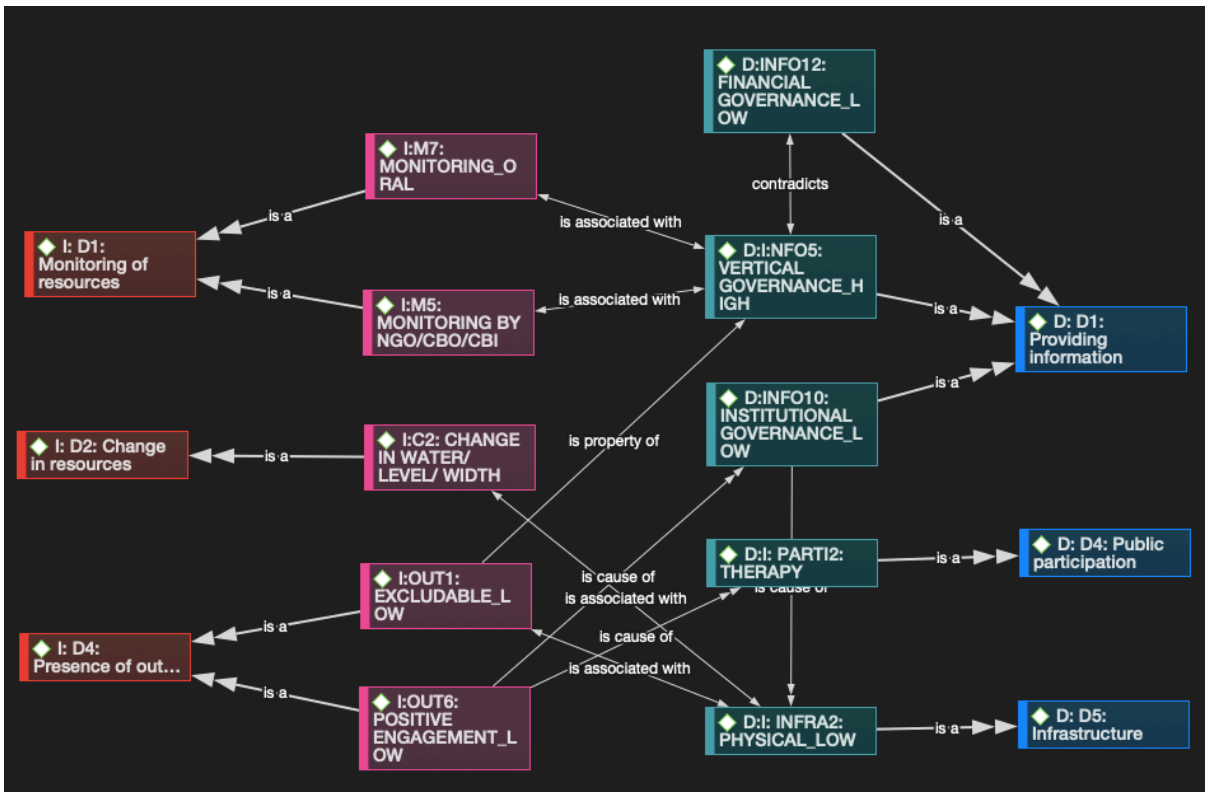


Figure 15: Network of User support. (*Source: Author*)

opportunity to grab land. In urban areas, people have lost the association with river long ago. People in urban area, including doctors, churches, mosques even provincial government started grabbing land long ago. Another important point emerged as the rigidity of the hierarchical structure of governance. Democratic decentralization in India happened in 1993 amid much fanfare. However, in reality, the lowest tier of village governance i.e., Gram Sansad has to cross three tiers to reach to Jilla Parishad to for any kind of administrative and financial approval (Pratheep, 2015). This rigidity restricts the local government to do any kind good intervention regarding the *environmental governance*. Also, the CBOs are politically divided (Fig 17). This *political polarisation* has caused non-unified *user support*, which in turn have affected EG.

Photograph 11: Facebook post on the encroachment of Anjana river. (*Source: Author*)

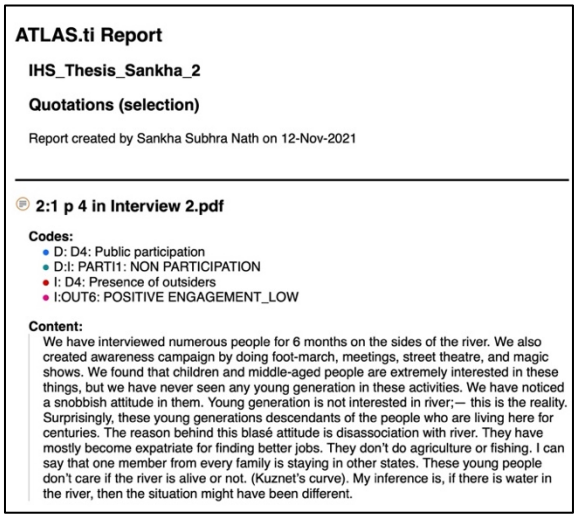


Figure 16: Quotation regarding User support. (*Source: Author*)

ATLAS.ti Report
IHS_Thesis_Sankha_2
Quotations (selection)
Report created by Sankha Subhra Nath on 12-Nov-2021

2:2 pp 7 – 8 in Interview 2.pdf

Content: You see, there are several organizations who are working on the river restoration or global governance at the state level. However, each of those organization is politically inclined. For example, there is one organization which was formed long ago by the extreme leftist Naxalite people. There is a second organisation, which was formed a little bit later by the SUCI, the student wing of leftist party. The third organization is governed by the Left Front party. The fourth organization was once independent, but now it has mainly become an associated to Trinamool Congress. Now the government has created these districts Advisory Committee for Rivers to govern the rivers and it has a provision to select someone from these organizations or CBOs. due to the political condition, everywhere, the people who are nominated are coming from organizations associated with Trinamool Congress. This over politicization of the situation has led to many problems. Although everybody wants the same thing that the rivers should be well restored, still everybody is object. If is very different. Everyone sees river governance from a wide range of perspectives. For example, The CBOs associated with Naxalite people tells the stories about land rights of tribal people residing in forest and water, But the CBOs associated with CPIM are strictly against these people. They want all people to be removed from forest and water for the protection of the environment. Thus a dichotomy exists. Most importantly, some influential CEOs have become silent about governments actions against environment as well as rivers. For organisations like ours who are not associated with any kind of political organisations. We are very confused. We do not know whom should we address to for our own problems. It appears that if you do not have political backing you cannot even approach the government properly.

Figure 17: Quotation on polarisation of CBOs (*Source: Author*)

4.3.2 Analysis of new factors

While doing qualitative analysis, several new "in-vivo" codes emerged. These codes are clubbed together as new factors. These factors are discussed below.

Overpoliticisation: Bengalis are known for their affinity towards *overpoliticisation* (Haque, 1980) (Nath, S., 2017). *Overpoliticisation* means involving politics in every aspect of life including substitution of political criteria rather than merit-based criteria in recruitment of public service leading to systematic corruption (Peters & Pierre, 2004). It causes the emergence of populist politics, lack of co-operation among public and paves way for corruption in micro-economic activities (Törnquist, 1998). It also promotes bipolar political activities with extremely volatile political atmosphere (S. Seal et al., 2020). In the case of West Bengal, *overpoliticisation* can be attributed to the Left regime, who ingrained political party into every aspect of society. They turned people into 'party society' (Bhattacharyya, Dwaipayan, 2009). The effect still continues. For Anjana river, overpoliticisation has patronised encroachment of river over several political regimes (Photo 9). The government has not played any role towards *environmental governance* in fear of losing vote-bank. Even when local government is put under pressure, they responded limitedly by de-silting a very small portion of river (*therapy*) (Photo 10). Sometimes, the government officials and the political representatives themselves are directly involved in the encroachment of the river (Dreze & Sen, 1999) or they are found patronising businessmen encroaching the river. This political-financial nexus has produced a fearful social atmosphere. Although there is general *environmental awareness* among people, people are afraid of doing something positive about the river. Thus, *overpoliticisation* hampers *monitoring of resources* via blinding monitoring agencies or dragging them into corruption, exaggerates *rate of changes* by involving several agencies into encroachment, hinders *social capital* and *user support* due to volatile political atmosphere. In this way, *overpoliticisation* affects *environmental governance*.

জমি লুটেরাদের কবলে রবীন্দ্রনাথের স্মৃতিধন্য অঞ্জনা নদী মৃত্যুর প্রহর গুনছে

অসীম বিশ্বাস

বিশ্বকবিকে কবি রবীন্দ্রনাথের স্মৃতিধন্য অঞ্জনা নদী ইতিহাসের পাতা থেকে উধাও। নদীর বদলে এখন সরকারি খাতায় অঞ্জনা খাল। বর্তমানে কবির প্রিয় নদী বিলুপ্ত। প্রতি বছর ৫ জুন ঘটা করে বিশ্ব পরিবেশ দিবস মর্যাদা সহকারে পালন করা হয়। ৪০ বছর ধরে মহাসমারোহে গঙ্গা উৎসব, নদী উৎসব হয়েছে প্রতিটি জেলায় জেলায়, বাস্তবে কি সফল হয়েছে। কিন্তু নদীর সংস্কার না হয়ে অপমৃত্যু হয়েছে অঞ্জনা নদীর। নদিয়াবাসীর পক্ষ থেকে প্রশ্ন তুলেছেন অঞ্জনা নদী বুজি করা। ঈশ্বদিন যাবৎ সরকারের নদীর ওপর দিয়ে কোন নিয়ন্ত্রণ ছিল না। তবে ১০০ দিনের কাজের মাধ্যমে কিছুটা সংস্কার হয়েছে নদীর ধারে। নদীর মাঝখানে কচুরিপানায় ভর্তি হয়েছে নদী। লুট হয়েছে অঞ্জনা নদী। অঞ্জনা নদীর জমি যে যার মতো দখল করে নিয়েছে। মাটি যথেচ্ছভাবে লুট হয়ে গেছে। আইনকে বুড়ো আঙুল দেখিয়ে নদীর ওপর বেআইনি অট্টালিকা। কৃষ্ণনগর ৫ কিমি অফিক গতিপথে একটু ফালিও নদী নেই। অবশেষে আছে বিষাক্ত নালা। কৃষ্ণনগরের বেহেলাখালি, বাধাডাঙ্গা চার্চরোডের নদীর কোন অবলবই চোখে পড়বে না। সবই উধাও। অঞ্জনা নদী শুকিয়ে যাচ্ছে ভোগাবাদীর দখলে। যাতে এর ঐতিহ্য বজায় রেখে নদীকে দিয়ে ভালো ইট তৈরি হয়। অঞ্জনাকে মুক্তে ফেলার জন্য নদীর ইতিউতি ইটভাটা মাথের ডেড়ি গড়ে উঠেছে। নদীকে ঘিরে সাধারণ মানুষের আবেগ বহু পুরনো দিনের। এলাকার মানুষ চায় প্রিয় অঞ্জনা নদী ফিরে যাক তাঁর স্বাভাবিক গতিতে। মাঝি মাল্লাদের গলায় আবার ফিরে যাক সেই অঞ্জনা নদীর গান। বিপরে প্রকৃতিতেই। পরিবেশবিদদের কথায় বহু হোক নদী হত্যা। নদী কারোর পৈতৃক সম্পত্তি হতে পারে না। দাবি উঠেছে নদিয়া জেলার মানুষের নদীর বুকে দখলকারী সমস্ত অবৈধ নির্মাণকারীদের বিরুদ্ধে। রবীন্দ্রনাথের লেখনীতে চিরভাস্বর হয়ে যায় অঞ্জনা নদীর চন্দনী গাঁ। সময়ের সঙ্গে সঙ্গে অঞ্জনা নদীর সবের দিন হারিয়ে গিয়েছে।

Photograph 13: Newspaper report describing the impact of land mafia on Anjana river (Source: *Rajat Das*)

Photograph 12: Token cleaning of river in urban area, 2021 (*Source: Rajat Das*)

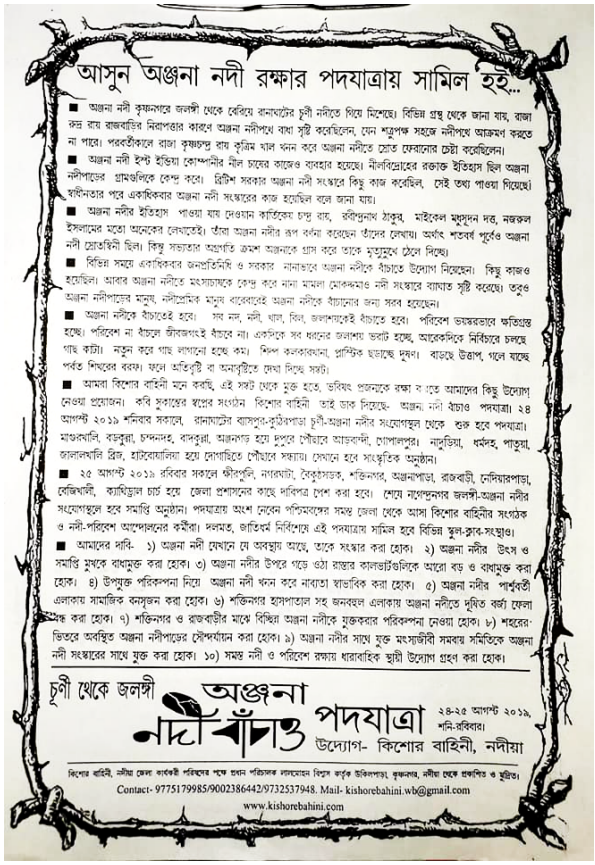
Over-dependency on government: It is found that people are over-dependent on government. This happened due to systematic *overpoliticisation* over decades and populist politics. In general, the interviewees assigned the job of *environmental governance* to the local government. They openly criticise inaction of government, yet they want government to take care of the river. Even the CBOs have reduced their roles as awareness generating agencies. They do see themselves as implementing agencies. They hesitate to take legal action against environmental offenders and corrupt politicians. This phenomenon has contributed to weak institutional capacity of CBOs and have hampered *social capital* and *public participation*.

Political polarisation: West Bengal is known for its highly polarised politics (Kanungo, 2015). The moribund economy of West Bengal has fuelled an intricate self-interested actor-institution nexus in the economy of the state (Nath, S. & Chakrabarti, 2011). This has caused two-fold problem. On one hand, this has propagated the corrupt practices with the help of *overpoliticisation*. On the other hand, this has created a fearful and opportunist atmosphere. The situation is so adverse that even CBOs and NGOs have political support. They act according to their political hierarchy. This has hindered the *social capital* and *environmental governance* in a big way.

Political will: Results show that *political will* emerged as a countermeasure to the above-mentioned issues. Interviewees with higher education level says that recently there is increasing *political will* among new generations regarding *environmental governance*. This is evident by more young people are concerned about *Anjana* river. They also are taking active roles by cleaning garbage, planting trees, doing awareness campaigns etc (Photo 11,12,13).

Photograph 14: Awareness campaign school children (*Source: Facebook*)

Photograph 15: Awareness campaign by CBOs (Source: *Facebook*)



Photograph 16: Poster for Foot-marching to save Anjana river (*Source: Facebook*)

4.3.3 Summary of findings regarding qualitative analysis

It can be seen from the above discussion that regarding *monitoring of resources*, the river is the property of State. However, both horizontal and vertical governance is missing. Thus, institutional monitoring is almost absent. The void is fulfilled by informal monitoring by CBOs and common people. They monitor day-to-day changes of the river, but they are unaware of the various institutional and legal changes regarding *environmental* governance. Also, the river runs through several administrative boundaries. It is found that the biophysical condition of the river is varying in these areas. As a result, multiple levels of dependency and association with the river is found in these areas. These factors point towards the fact *heterogeneity* is associated

with natural resources due to their large size and multiple user groups. Thus, *monitoring of resources* is inherently problematic.

Regarding *rate of changes*, it is found that the river has gone through extreme changes in the past 20 years. This is more evident in the rural areas. As for urban areas, the same changes happened long ago, and the river has reduced to a drainage channel long ago. Lack of horizontal and vertical governance played a big part here. As discussed in Section 4.4.2, *overpoliticisation* and *political polarisation* both have played a major part in the systematic and institutional degradation of the river. *Overpoliticisation* has also played a significant role in non-participation of people (*public participation)*.

Unlike the previous two factors affecting *environmental governance*, it is found that *social capital* is increasing, especially in the peri-urban area. The research points out that this is happening due to four factors. They are good education, observing the degradation of river, past association with the river and support from local government. This proves that all these factors contribute towards the *effective commons governance* which in turn affects *environmental governance*. However, this also points that people are still have *over-dependency on government*. *Political polarisation* also affects *social capital* adversely by fragmenting it.

As for *presence of outsiders*, it is found that the river has multiple ownership including State. Therefore, their action or inaction plays a huge role (Photo 14, 15) in the *environmental governance* of the river. The research points that the lowest level of governance is restrained (administratively and financially) by the rigid hierarchy of the bureaucracy. This restraint adversely affects *environmental governance*. A generalised statement can be made from this; — today all commons resources are under some form of institutional governance and proper functioning of these institutions are essential for *commons governance*. Additionally, the research shows that, the study area has negligible in-migration confirming that there is no addition of stakeholders/outsiders. Ideally this should increase the *environmental governance*. Instead, it is found that newer generations are contributing to the environmental degradation due to their lack of association with the river. A vicious economy based on self-interested actor-institution nexus has developed due to *overpoliticisation* which is fuelling environmental degradation of the river (Photo 16,17).

Photograph 17: Illegal bridge made by local people showing inaction of government (*Source: Papai Sikdar*)

Photograph 18: Legal bridge made by local administration showing lack of environmental concern of government (*Source: Papai Sikdar*)

Finally, similar to *social capital, user support* in the area has significantly increased. This is due to rising education level, awareness campaign and general concern for the river. People are communicating with each other; they sometimes are taking active participation (*consultation*) in the *environmental governance,* and they have started demanding their environmental rights. The last one was unthinkable 20 years ago. However, cross-current exists. People are facing political and bureaucratic restraints. They are afraid to confront the offenders as they often find lack of support from judiciary. They are also facing financial struggles due to their *over-dependency on government*. Despite these obstacles, few people are found determined to do betterment of the river. They have *political will,* and their number is increasing.

Photograph 20: New encroachment, Ghoshpukur, urban area (*Source: Rajat Ray*)

Photograph 19: Old encroachment, Ghoshpukur, urban area (*Source: Rajat Ray*)

4.4 Summary

It can be concluded from the above discussion that the five factors of *effective commons governance* i.e., *monitoring of resources, rate of changes, social capital, presence of outsiders* and *user support* does have some effect on *environmental governance* but not with equal intensity. Also, the factors themselves have nuances. For example, for *monitoring of resources*, it is done by mainly fishing community and CBOs. However, the effort is limited due to i) very poor condition of river in some parts leading to disassociation of people and ii) people have left trade associated with water due to lack of water. These two factors have adversely affected the *monitoring of resources*. In addition, the large size of the river and heterogeneous nature has made *monitoring* very difficult. For *rate of changes*, it is found that no significant encroachment happened in the past 20 years. In some places encroachment is reversed (Gangni). Thus, it appears that the *rate of changes* has not happened, and good *environmental governance* has been achieved. In reality, encroachment happened during 1950s to 1990s and it is rendered the river dead in urban areas. Regarding *social capital*, it is found that *social capital* has increased significantly in last 20 years due to rising education and environmental awareness. However, the intensity varies due to multiple factors i.e., level of education, level of association with river, level of environmental awareness and level of support from local government. As for *presence of outsiders*, it is found that the i) the river has institutional ownership with a complicated vertical and horizontal governance system and ii) there is no in-migration. The role of local and upper government plays a huge role in *environmental governance*. This also happens due to *overpoliticisation* and *over-dependency on government* (Photo 18, 19). Finally, like *social capital*, *user support* in the area has significantly increased. People are actively participating in *environmental governance* of *Anjana* river. However, they are facing political and bureaucratic restraints. Despite these obstacles, few people with *political will* are found determined to do betterment of the river (Photo 20). It can be said from

this discussion that, *rise in ECG does increase some amount of EG for river* (Section 2.9). In other words,

H_0 is rejected.

Symbolically, $H_0 : y_1 \neq y_2 \neq y_3 \ldots\ldots\ldots \neq y_k$

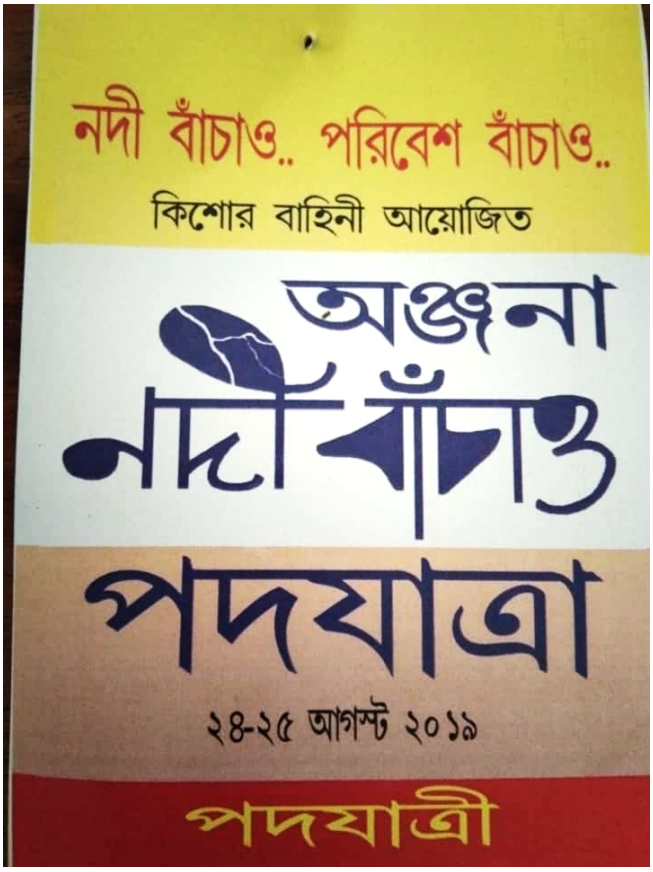
Therefore, H_1: The independent variable has some effect.

Symbolically, $H_1 : y_1 < y_2$ or $y_1 > y_k$.

Based on this answer, research questions are answered in the next chapter.

Photograph 23: Cleaners of river clashed with encroachers, Dec 2020 showing self-interest (*Source: NFN Network*)

Photograph 22: Cleaning of Anjana via MGNREGA, Dec 2020 showing over-dependence on government (Source: *Mintu Biswas*)



Photograph 21: Poster for Foot-marching to save Anjana river (*Source: Facebook*)

Chapter 5: Conclusions

No room, no room, the boat is too small.
Loaded with my gold paddy, the boat is full.
Across the rain-sky clouds heave to and fro,
On the bare riverbank, I remain alone –
What had has gone: the golden boat took all.
– Sonar Tori, Rabindranath Tagore, 1894
(Translated by William Radice)

5.1 Introduction

As per chapter 1, the main research question is to what extent the five prerequisite conditions of *effective commons governance*; *— monitoring of resources, rate of changes, social capital, absence of outsiders and user support*; are satisfied for *environmental governance* for *Anjana* river. To answer this question, extensive literature review is done, and a theoretical framework is developed in Chapter 2. To conduct the research, quantitative and qualitative data is analysed using various software as described in Chapter 3. In Chapter 4 the obtained results are discussed, and interim conclusions are drawn, and null hypothesis is rejected. Based on these conclusions, this final chapter finally proceeds to answer the research question raised in Chapter 1.

The chapter is divided into three sections. First, an attempt has been made to explain to what extent the five prerequisite conditions of *effective commons governance* are satisfied for *environmental governance* for *Anjana* river. Secondly, a critique is attempted with respect to Ostrom's theory and how current research makes a departure from that. Finally, some suggestions are given based on the departure on how to strengthen theory of *commons governance*.

5.2 Answering research questions

In Chapter 1, one research question and five research sub-questions is formed. Here, the five sub-questions are addressed followed by research question.

5.2.1 Sub-question 1: Monitoring of resources

Regarding the question to what extent the use of the resources can be monitored easily for better *environmental governance* of *Anjana* river; it is found that:

1. Almost no monitoring is done by central and provincial government. There are six important departments who are responsible for Anjana river on paper. They are, land records department, irrigation department, water resource department, fisheries department, district development committee and district advisory committee for river. Despite this presence of strong horizontal and vertical governance, out of all these departments, only irrigation department did some survey on encroachments and land titles in 2009. Since then, the records are not updated. Water quality or flow is not checked since 2009. Same can be said for the fish. Despite the varied bio-physical conditions of the river, it is argued by the government officials that monitoring of Anjana is supposedly easy due to advancement in monitoring technology and the relatively short length (29 km) of the river. However, it is not done due to lack of funding and organisational restrictions. According to some interviewees, central government only allocate funds for restoration of Ganga River. These funds cannot be

diverted to other projects. The lack of infrastructure and fragmented nature of governance negatively effects of monitoring of EG for Anjana river.

2. The local governments at village level does tacit monitoring on the river. It is found that, some village level officials are very interested in proper EG for the river. However, they act only in their jurisdiction due to organisational restrictions. Also, they do not coordinate with other villages. Thus, there is a lack of horizontal and vertical governance. Also, they cannot formulate any monitoring or fiscal policy for EG of the river due to organisational rigidity. This lack of adaptive horizontal and vertical governance is the main reason for lack of monitoring of EG for Anjana river.
3. Due to absence of institutional monitoring, CBOs monitor the river. They have established good networks with residents residing by the river for monitoring day-to-day changes in the river. They use WhatsApp, Facebook, and phone to gather information and monitor the river in a tacit way. During survey, no proper logbook is found at the CBOs regarding documentation of changes despite their earnest monitoring of the river. It is also found that CBOs are politically fragmented. Due to unorganised efforts of CBOs and their political fragmentation the desired effect on EG remains underestimated.
4. Apart from irrigation department and CBOs, common people, especially whose livelihood are dependent on the river, also monitor the day-to-day changes on the river. They inform the CBOs for actions regarding the protection of the river. They have huge distrust on government and judiciary for these actions. Monitoring by CBOs and people says that there exists social capital. However, politicisation and lack of trust reduces the desired amount of public participation. The rigid social traits and colonial past in the rural areas also hinder the amount of public participation.
5. The level of monitoring is not equal across urban-peri-urban-rural areas. This is because people have different level of association with the river. It is seen that where the biophysical condition of the river is better, people are keener on monitoring. In other areas; where river is dead; —people have very little association with the river. Also, people whose livelihood are dependent on river or people who are educated are more inclined towards better EG for the river. However, over dependence on government, lack of education/ skill/ entrepreneurship and poverty has severely hindered local adaptation strategy for EG. Most of the young people migrated to other provinces for jobs as adaptive measures. This has triggered a socio-economic-environmental change in the study area via loss of association with river and subsequent loss of EG for the river.

Thus, varying biophysical condition of river, heterogeneity of the resource, past association with resource, level of trust, politicisation and availability of horizontal and vertical governance makes monitoring difficult (Vogt et al., 2015) (Epstein et al., 2013). It can be said that for current research, *monitoring of resources* is partially satisfied.

5.2.2 Sub-question 2: Rate of Changes

Regarding the question about the rate of changes occurring around *Anjana* river that affect the *environmental governance* of the river, it is found that:

1. Rate of changes comprises of two things: quantity/ level of changes and time period of change. Research asserts that no significant changes have occurred in the past 20 years (2001-2020) in the study area. In fact, in some places the adverse changes have been reversed by the action of local government in 2019. This is very positive aspect regarding the EG of the river. This proves that there is some level of institutional localised governance in the study area.

2. However, upon further research it is found that extreme changes in land use and water flow have occurred outside the timeline of research. These types of changes are occurring from 1675 AD (blocking of river by king) to 2000 AD (severe flood and waterlogging). Thus, the initial assumptions about changes proved wrong and current condition of Anjana river is found as the result of extreme changes in the past.
3. The quantity/ level of changes varies in different places. This is because Anjana river runs through varying geographical conditions, and it is subjected to varying degrees of anthropogenic interventions in different areas. For example, the changes in urban areas are more severe than the rural areas and they are occurring since 1675 AD. On the contrary, the changes in rural areas a relatively much less and they are happening since 2010. The peri-urban areas are experiencing changes in waterflow since 1095, when the rail line was built over the river. Thus, different areas have experienced different levels of changes.
6. The quantity/ level of changes varies also varies with the level of association with the river. People whose livelihood are directly dependent on river tries to resist the adverse changes as much they can. In rural areas, fishermen clean the river with hands to protect their livelihood while others try to encroach the floodplain and sell it for agriculture, fisheries or construction. In urban areas, the water channel was encroached and was converted into fisheries around 1935. Now the origin of the river is totally blocked. Since there is no flowing water in urban areas, the floodplain of the river is constantly encroached, and buildings are built on it. In many cases, government buildings are also built over the dried riverbed. Many legal disputes exist regarding these. In peri-urban and rural areas most common method of encroachment is building earthen dam along the river or across the river. Bamboo fences are also used for the same purpose. These encroached areas are used for fisheries, agriculture, and construction. It is argued that if there is no water in the river, encroachment is bound to happen. Out of 29 km stretch of over, only 5 km area has fish. These examples proves that the river faced extreme changes. Current research suggests that level of education along with support from local government helps to foster EG. This can be seen in the peri-urban areas. In the urban areas, although education level is high, over-politicisation and negligence of local government has reduced the river into a drain. This lack of institutional governance and intricate self-interested actor-institution nexus in the economy of the state have adversely affected the EG of the river.
4. There is a distinct change in the occupation due to gradual decline in water and fish in the river. Many fishermen have switched their livelihood since 2001. They have turned into fishmongers, agricultural labourers, or shop owners. Same can be said for the agricultural labourers. Overall, sharp mobility is observed from primary sector to tertiary sector and current research does not show any upward economic mobility in the study area. It is also found that many people have migrated to other provinces in search of jobs. It is suggested that one person from every family lives in other provinces today.

Thus, lack of institutional governance, lack of transparency and institutional monitoring, lack of conflict resolution, lack of infrastructure to protect the resource have adversely affected the EG of the river. Much of this has to do with the *overpoliticisation*. Therefore, *signal and noise of change* and *politicisation* does affect the *rate of change* adversely (Clement, 2010). Overall, it can be said that for current research, *rate of changes* is partially satisfied.

5.2.3 Sub-question 3: Social capital

Regarding the question about how the *social network* among stakeholders affects *environmental governance* it is found that:

1. there is significant level of *social capital* exists (via *social mobilisation* and *public engagement*) among the stakeholders. Social capital exists among the common people, CBOs, academicians, various economic and social groups, but the level of social capital varies in different areas. The common people in rural areas have deep trust in some CBOs. Together they form alliance to increase the EG of the river. However the common people do not trust the local government or provincial government at all. in fact they fear the local government due to over-politicising practices and fearful actor-institution nexus. to some extent the fear of judiciary and mistrust on government have bonded the common people and CBOs in a better way.
2. In urban areas, the social capital exists due to higher level of education, rural areas it exists because people are seeing the degradation river every day. It is found that social capital is comparatively high in peri-urban areas as compared to rural and urban areas due good education, observation of degradation of river, past association with the river, realisation of the problem and support from local government.
3. Research suggests that, despite moderate level of social capital in rural areas, it is more effective in conflict resolution. This is because in rural areas people still have association with the river and informal conflict resolutions are very much common. Also there is less number of conflicts in the rural area as compared to urban areas regarding the EG of the river.
4. It is observed that since 2010, public engagement has increased significantly. many CBOs have developed to enhance the EG of the river. They have been employing various methods like street plays, awareness campaigns, protests, foot-march etc. to raise the environmental awareness regarding the river. The study also finds that political will and age wise association have emerged as the root cause of increasing social capital and public participation. However, no unified idea of EG is found and the question of legal awareness and constitutional awareness have always remained vague (Das, M. & Pandit, 2016) (Ghosh, Anindya Sundar et al., 2018).

Current study suggests that due to increasing education, observing the degradation of river, *past association with the river* and support from local government help in increasing the social capital in the area. However there are *non-participation* by the common people and *therapy* by the local government. Also the level varies in different areas due to different level of *public engagement* and *trust on government*. it can be said that social capital in the area can be increased further by better institutional governance. Overall, it can be said that for current research, *social capital* is highly satisfied.

5.2.4 Sub-question 4: Presence of outsiders

Regarding the question about to what extent the *presence of outsiders* on the river affects the *environmental governance* of the river, research shows that:

1. The river is under multiple ownership of various levels of State. According to Indian law of water resources, all surface water including rivers belongs to please state. It is found that for the EG of the river, Central government is supposed to allot the funds. the money is supposed to come to state government and thin distributed to the district level for utilization. the district will then divide some portion of the money among the various villages for maintenance of the river. however current practice does not allot money to small rivers. all the money is paint on the primary river which is Ganga. Thus, there is no funding nor governance available for Anjana river. The district authorities does not have any directives or power regarding the maintenance of the river. They also do not have any self-generated funds for this. Same can be said for the village level administration.

2. For the current research it is assumed that government is an outsider and not a direct stakeholder as they do not conform to the research framework. Their action or lack of it definitely affects the environmental governance of the river.
3. For current research, it is found that horizontal and vertical rigidity in governance causes major problem. Regarding vertical governance, village level governments cannot produce any kind of plan for the maintenance of the river without getting approval from the higher level of government. Also they do not have the funds. They also cannot produce any fiscal plans by themselves without getting any approval. it is found that they have cross three levels of governance for the approval. This adversely affects the EG of the river. Same thing can be said about the horizontal governance. There are several departments like irrigation, water resource, fisheries, land records and river advisory committee who are supposed to work together for the environmental governance of the all the rivers in the district. However they only concentrate their efforts on the major river i.e. Ganga. These lack of horizontal and vertical governance hampers the EG of the river.
4. It is also found that there exists an actor-institution nexus in the economy of the area. It is found that the government officials are keen on following the orders rather than investigating the causes on their own and solving them. They also sometimes are directly involved in the encroachment of the river or they are found patronising businesses who are encroaching the river. Most importantly they turn blind eye towards the encroachers or the polluters. recently due to extreme public pressure, they have started doing some token restoration in the river by desilting some portions.
5. It is also found that area does not suffer from external economic pressures, rather its own users are now trying to destroy the river by encroaching more and more portions of it. This has to do with the loss of association with the river and lack of alternative economic opportunities.
6. One significant thing which came out of the research is, although there is no proof of in migration in the area since 2000, tacit knowledge in the area suggests that a large number of people migrated from Bangladesh into the area in 1950s 60's and 80s. these people have definitely altered the land-use of the area.
7. Also, introduction of rail line and subsequent in-migrations in 1905 altered the land-use and flow of water permanently.

Thus, the blasé attitude of the government employees and common people are primary reason for degrading the level of user support. This along with horizontal and vertical rigidity in governance, lack of adaptive, scalable and polycentric governance, lack of proper policies, lack of developmental plans and adversely affect the EG of the river. In addition, the *effect of urbanisation* and *timeline of change* also affects EG (Randeria, 2007). Therefore, action/ inaction of *outsiders* definitely affects *environmental governance*. Overall, it can be said that for current research, *presence of outsiders* is partially satisfied.

5.2.5 Sub-question 5: User support

Regarding the question on how the level of *user support* affects the *environmental governance* research shows that:

1. *User support* has significantly increased since 2000s. As described above, this is due to rising education level, constant awareness campaign and general concern for the well-being of the river. Similar to *social capital*, user support is found to be high in peri-urban areas. People across all segments of society are interested in the EG of the river due to their cultural traits. A little lack of interest is seen in the younger generation who have lost association with the river due to the migratory nature of their jobs.

2. It is found that, user support exists at an informal level among common people and CBOs due to lack of institutional governance. some government officials also are keen on the EG of the river. however they cannot perform because of the organizational rigidity. it is found that user support among local administration is more evident at the lowest level of governance which is village level. this is because how the village administration is more connected with the people whose livelihood are dependent on the river and the problem is occurring at a small scale.
3. CBOs form the main pillar of the user support along with common people. they constantly motor unit the resource and take necessary action when needed. however they only have the manpower. They do not have any kind of technical, financial or infrastructural capacity. Also there is a lacuna regarding the rights and environmental laws of India. these factors affect negatively on the EG of the river.
4. The common people in the rural area are very much interested in the of the river. However, public participation in the area is facing political and bureaucratic restraints. *Overpoliticisation* and *polarisation* also creates major hindrance (Giest & Howlett, 2014). People in the area are ill equipped with the adaptation techniques regarding the edge of the river. Prolonged environmental degradation of the river has forced pauperization and compelled people to switch jobs. Very often they cannot cope with the economic distress and migrate to other provinces for employment opportunities. Despite these obstacles, some people have *political will* to do betterment of the river.

Thus, past association with the river, rising level of education, growing environment awareness, increasing public engagement, and political will are increasing the EG of the river. However, loss of association with the river, organizational rigidity, lack of technical financial capacity, lack of knowledge of rights and environmental laws, and pauperization Are negatively affecting the same. Overall, it can be said that for current research, *user support* is highly satisfied.

5.2.6 Research question: Effective commons governance

Finally, regarding the question to what extent, the five prerequisite conditions of *effective commons governance* are satisfied for *environmental governance* for *Anjana* river, it can be said that *effective commons governance* is partially satisfied as three out of five contributing factors are partially satisfied, thus conforming partially to Ostrom's theory (Harashima, 2000). There are several reasons for this. An attempt is made to elaborate the causes in the next section.

5.3 Critique on effective commons governance

Since Dietz, Ostrom and Stein's (2003) study on effective commons governance/ adaptive governance/commons governance was published list a plethora of research on adaptive governance has been done. Since 2011, discourse on commons governance focuses on the complexity of the issue, its relationship with urbanisation, land development, property rights and global pandemic. the importance of contextualization of this study and the consideration of the human perception about commons governance also become very important. these study focuses on the human perception and its effect on commons governance eat in an extremely contextualised study area. It does so by looking at a local common resource namely Anjana river and tries to see how extremely localised factors of "remembered past" i.e. socio-cultural traits, pre-colonial and colonial past, position in social hierarchy, level of past association with the river and factors of "witnessed present" i.e. pauperization, occupational dynamics, out migration, over politicization, actor-institution nexus and lack of horizontal and vertical governance affects the environmental governance of the river. in this regard, the study is very different from studying global commons, which would require a very different set of

parameters. the findings of the current study offers some new insights which might enrich the discourse of the Commons governance. they are discussed below.

First, the empirical studies of *commons governance* which successfully shows polycentric governance as an alternative to the private or public governance is mostly based on field studies in rural areas of Nepal, India and Africa (Ostrom, 1994). At the time of writing this research in 2021, eighteen years have passed since the path breaking article on adaptive governance, and the world has changed a lot. Global population has increased from 6.3 billion to 7.8 billion people (18.1%). Liberalisation has happened in most of the developing countries. Global trade and necessary infrastructure have increased many folds. These conditions have changed the nature of commons governance (Ostrom, 1999) (Cumming et al., 2020).

Secondly, current trends in commons research points towards the importance of bio-physical conditions of the resource and the spatial consideration (Guerry et al., 2015) (Jiang et al., 2018). Research finds that natural resources are often too big with different biophysical conditions. They are also heterogenous in nature because the intensity of the natural resource is not homogenous everywhere. The spatial relationship between the resource and the population depending upon these natural resources are also important (Bren d'Amour et al., 2017) (Keesstra et al., 2018). Regarding this, two aspects are important in Southeast Asia: density and predictability. Density means the average value of the resource per unit area (sq. km. or sq. mile) and predictability means the inverse of the variance in the value of the resource per unit of time of unit area (with the assumptions that probability distributions are not overly correlated with spatial grouping of land or time).

As river watershed have high density and high predictability, it can be said from theories of resource allocation that here communities' resort to institute more private property rights and tries to remain geographically stable. With time, with the increase in population fragmentation of resources occurs and the increasing competition for resources results in establishment of intricate sets of rules and sanctions (Dasgupta, 2001). Slowly, the rules and sanctions get codified into communities' daily life. These rules, along with proto-scientific religious rules forms the deep structure of these natural resource dependent communities. Soon the role of power, knowledge, control, and conflict over governance of natural resource creates division and hierarchy in the communities (Burns & Stöhr, 2011). The over regulation and lack of resources give rise to underlying hierarchy, antagonisms, factionalisms, mistrusts, and discriminations (Lieten, G. C. M., 2002). The apparently homogenous communities who appears to be regimented under the rules actually becomes a highly contested medieval world.

The situation is often aggravated by colonialism which generally imposes a foreign segregation-based development on these communities. The result forms a mutated developmental model based which is built by superimposing a foreign model of development on the existing rigid rule-based social structure which subsequently exaggerates the existing discriminatory practices (Ghosh, Binoy, 1956). Colonialism also completely disregards the environmental governance and the deep connections between human-land-water. They favour a binary model suitable for better economic exploitation rather than the existing dynamic human-land-water nexus (Mathur & Da Cunha, 2009) (Bhattacharyya, 2018).

Because of these complexities, stupidities and rigidities, presently these communities resist any kind of non- hierarchical equal-opportunity situations presented to them as the existing privilege-holders in the communities often fear of losing their status quo. The deep mistrust due long history of systematic discrimination among the social hierarchy also hinders to create a unified view of development. As a result, any kind of developmental model including better environmental governance often leads to severe resistance. Also, introduction of benefit based developmental model leads to corruption, self-interest, seizure of benefits and

overpoliticisation (Peters & Pierre, 2004). Ultimately, environmental governance remains a highly contested subject in these communities which is fuelled by existing religious rules, existing relationship with natural resources, politicisation, deep mistrust, historically discriminatory practices, high self-interest, and actor-institution nexus (Pattanaik, 2003)(Gadgil & Guha, 1993). All these factors contribute to the "remembered past" and forge different levels of association between the user group and natural resource (Eggertsson, 2011).

For the current study, it is found that the river has different biophysical conditions in urban, peri-urban and rural areas. The fertile region is inhabited by people for at least 700 years. The fertility of the land and regulated yearly inundation produced high density and predictability which in turn boosted stability and reduced mortality. The growth of population resulted in fragmentation of land parcels which created more competition over control of the river. At the same time, religious sanctions and counter corruptions became practice. These have given rise to the strict social hierarchy and practices. They also produced deep mistrusts and contests among the communities. Later, British administrators imposed the 'permanent settlement' land distribution system. They superimposed a static land distribution and tax regime on a dynamic landscape always in flux between land and water. They also systematically destroyed the river based self-sustained economy to favour indigo production and introduce England made fabrics. These superimpositions permanently mutated the economic production based on the river and altered the human association with the river. After independence in 1947, the local government tried to create development opportunity by creating fisheries. However, the opportunity was ceased by politically connected people, and they created put up earthen dams across the river. Thus, the flow of the river completely stopped in many sections of the river. The dried floodplain of the river soon started to get encroached. In the end, extreme path dependence created via varying biophysical condition of river, heterogeneity of the resource, past association with other groups, level of trust, politicisation and the quantity and quality of horizontal and vertical governance have created layers of perceptions among the user groups negatively affects the EG while past association with resource, proto-scientific religious rules and deep structure positively affects the EG of the river.

Thirdly, current trends in commons research points towards the importance of scalable context based adaptive governance (Carter et al., 2015). The superimposition of colonial foreign laws like eminent domain on existing discriminatory social systems and colonial imposition of foreign laws and complete disregard of existing grassroot level environmental governance has caused systematic and recurring inequalities in the communities of Southeast Asia which were under the colonial rule (Randeria, 2007). The systematic over-exploitation of natural resource and the systematic destruction of existing natural resource-based economy both by colonisers and local landlords have led to perpetual pauperization (Lieten, G. K., 1992) (Bose & Sugata, 1993). The tension between customary community based resource exploitation laws and the individual eminent domain law always produced huge protests and struggles between communities and State (Shiva, 1986) (Gadgil & Guha, 1993). In very few cases, the communities managed to retain their control over natural resources. Most of the time, they have succumbed to the more organised and financial strong actor-institution nexus (Ramachandran, 1995) (Nath & Chakrabarti, 2011).

When communities could not cope with the economic pressure they often start migrating to other areas which offers more economic benefits or better social conditions (Lusome & Bhagat, 2006) (MAURYA & KUMAR,). Those who cannot migrate remain in their places living under the myth of historic association with natural resource. They try to find new ways to over-exploit the resource which leads to an intricate web of occupational shifts, opportunistic behaviours, upward as well as downward economic mobility, pauperization, politicisation, and finally 'party society' (Bhattacharyya, 2009) (Nath, 2017). This also fuels the blasé attitude of local

government and produces actor-institution nexus and political polarisation (Dreze & Sen, 1999) (Nath & Chakrabarti, 2011). The fearful actor-institution nexus often hinders any non-hierarchical equal-opportunity developmental models including environmental governance as that would challenge their status quo of rentier class. They also resist any kind of synergy in horizontal and vertical governance for the same reason. The underlying non-ergodic nature of the communities and blasé attitude also impedes any kind of innovation.

As discussed before, introduction of any kind of development only fuels opportunistic behaviour, inequality, pauperization and politicisation. Here, Liberalisation has added another layer of complexity. Post liberalisation and post decentralisation has created huge opportunities of local decentralised governance. However, it has also produced new types of governance described as a "new medievalism" (Anderson, 1996) which has been accused of "hollowing out" of the state i.e., the functions of the central authorities are gradually moved towards international and transnational organisations/institutions while cities and villages are resorted to increasing self-governance with the help of non-state actors (Jessop, 2002).

Access to opportunity in otherwise moribund economy also generates unequal power structure between various stakeholders which include governmental hierarchies, bureaucrats, politicians and policy stakeholders, lobbyists, non-profits and media houses. They seek to influence development via manipulative persuasion, bribe, coercion, and sanction. Here level of education and empowerment plays an important role. It is found that absence of education and empowerment (including women) in the beneficiary groups often gives rise to discretion via ignorance, feigned arrogance, non-decision-making, false compliance and tokenistic behaviour among the state actors. The values and perceptions of these actors become more critical in delivery of the development project rather than design properties of the original governance mechanism (Morrison et al., 2019). The network of institutional conditions and attitude of state actors, plurality of interests among stakeholders including non-profits, aspirations of beneficiaries, and strategies taken by various actors and agencies to gain maximum manifests as an "ecology of games" (Lubell et al., 2017). All these factors of "witnessed present" i.e., non-ergodicity, pauperization, occupational dynamics, out migration, maintain status quo, over politicization, and exercise of designed power-pragmatic power-framing power, community aspirations or lack of it, actor-institution nexus and lack of adaptive horizontal and vertical governance affects the environmental governance of the natural resource.

For the current study, until 18th century, the area was once known for its artisan fabrics and cash crops. It created a self-sustainable circular economy-based society. The British colonisers and the fiefs working under them systematically dismantled this self-sustainable circular economy and relegated it into a moribund economy. Despite the presence of fertile land, the area has suffered from several famines from 1770 to 1943 due to over-exploitation of natural resources by then government (Garrett, 1910) (Sen, 1983). The 1943 famine disrupted the traditional human-land-water nexus. This coupled with partition of Bengal in 1947 triggered huge in-migration from neighbouring Bangladesh. The migratory population encroached several areas and permanently altered the land-use of the area. Post-independence efforts of economic development in the area via fisheries created more encroachments in river near urban areas. The rise of leftist party in 1970s redistributed agricultural lands to boost economy. However, they also produced "party society" which patronised unchecked encroachments. Several local administrators went to court against this actor-institution nexus. However, much-discussed red-tape system in Indian judiciary blocked all environmental justice.

Decentralisation in 1993 introduced huge change political and governance. Originally, it is used as an instrument for people's empowerment and self-governance. It radically broke the existing hierarchy of central oriented governance structure. In reality, the vast spatiality of the

area introduced new type of hierarchy in the system. In the new system, although there exists much freedom to exercise self-governance, power to exercise environmental governance is still absent. After liberalisation happened in 2000s, new education and economic opportunities emerged. This started the out migration of the existing population. Occupational shifts due to new economic opportunities also led to further disassociation of people with the river. Several CBOs came out as an alternative 'watch dog' to provide environmental justice. However, they also are politically fragmented. The relentless environmental campaign by the CBOs have elevated the environmental awareness in the area. The common people in the area are also joining in public engagement. At the same time, growing education and support from local government are helping towards incremental environmental governance in the area. However, politicisation and lack of adaptive/ scalable horizontal and vertical governance is underestimating the potential of the EG.

It is found that environmental governance in the study area suffers from three tier problem. First, at the individual level, people are not aware of their constitutional rights regarding environment. They also do not possess knowledge on environmental rights. They have deep mistrust towards government and fearful of the judiciary. Secondly, at the collective level, CBOs are politically inclined. They also do not possess knowledge on environmental rights. They do not have research, technology and fiscal strength; hence they resort to only advocacy. Thus, they often hesitate to take necessary action and sometimes perform manipulative persuasion. Thirdly, the executive and the legislative arms of government have blasé attitude and they often form actor-institution nexus. Finally, the judiciary is plagued with red-tape and very often judiciary does not work in conjunction with executive arm. As a countermeasure to this, National Green Tribunal is formed in 2006 to provide a single window, fast track court. Orders from this apex court has very recently made the executive and judiciary as the liable stakeholder in environmental governance in 2020. This incremental and strategic approach is slowly but effectively transforming the environmental governance. In the end, non-ergodicity, moribund economy, lack of innovation, actor-institution nexus, migration, polarisation and occupational dynamics negatively affects EG while education, support from local government and judiciary, understanding of importance of the river and involvement of academia positively affects EG of the river.

It can be said from the above discussion that:

1. According to Dietz, Ostrom & Stern (2003) easy monitoring of resources enhances the environmental governance. However, current research finds that natural resources are often too big with different biophysical conditions. These varying conditions forge different levels of association with the user groups. Also, the occupation of the user group plays significant role on the association with the natural resource. Thus, *biophysical conditions of resource* and *heterogeneity of users* makes commons governance quite challenging.

2. It is argued that moderate changes in resources enhances the environmental governance. Current research finds that natural resources are exploited systematically over a long time, but the effect was not significant due to fewer users. Since 2000, with sudden population explosion, the effect has suddenly become prominent. Thus, *signal and noise of change* contributes to the commons governance.

3. It is said that high social network among stakeholders enhances the environmental governance. Current research also supports this. However, current research also finds that there is no unified idea of commons governance. *Level of education* and *past*

association with resource plays a major role. Moreover, overpoliticisation of CBOs have adversely affected the network. Also, legal awareness is nil among users.

4. It is mentioned that absence of outsiders among stakeholders enhances the environmental governance. Current research finds that today, every common property is under some form of institutional governance. Therefore, the *role of institutional governance* plays a critical role in commons governance. Here, *overpoliticisation* and *polarisation* plays an important role. Also, natural resources are becoming scarce, they are exploited more than before, and they are constantly facing *pressure due to urbanisation*. This is also affecting commons governance which are not seen before.

5. It is stated that high user support among stakeholders enhances the environmental governance. Current research also supports this. However, current research also finds that user support is highly dependent on *occupation, social strata (caste)* and *past association with resource*. At the same time, *overpoliticisation* and *polarisation* plays an important role in determining the level of user support.

Thus, can be said from the above discussion that the discourse on effective commons governance has come a long way. The theory should be updated and contextualised according to the post-liberalised world. In view of this, some suggestions are given in the next section.

5.4 Current limitations and suggestions to future research

In order to update and contextualise the theory of effective commons governance to the delta countries of Southeast Asia, current limitations are stated followed by suggestions to the future research. The current limitations can be categorised into three parts i.e., theoretical, methodological, and analytical. They are discussed below.

For the theoretical construct, it is found that the theoretical construct for human-land-water nexus in delta countries of Asian countries have their own unique characteristics. The binary division of *terra* and *aqua* cannot be applied here, rather *terra* here should be observed as a degree of wetness. Akin to this, human-land-water interaction is also not binary, rather the interaction is a flux between association and disassociation with the nature. Due to the irrelevance of the binary worldview of western approach towards EG for the current study, an alternative theoretical construct derived from ephemeral worldview of "wet theory" consisting of "remembered past" and "witnessed present" is developed for the current study. However, the result of the study reveals a more complex situation. It is found that perceptions of property rights play a huge role in EG. Current trends also suggest nature-based solutions, land value capture mechanisms, incremental and local governance for successful implementation of EG. The role of power on EG also emerged as an important theme. These concepts should be explored in the future research in association with the current framework. Finally, as discussed above, how the complex conditions of non-ergodicity, lack of innovation, path dependence and open network further mutates the already weak structure made by layers of superimposed foreign constructs over a medieval rigid discrimination-based system should be studied further.

For the methodological construct, the current tried to incorporate as many aspects (indicators) as possible to understand the effect of ECG on EG. It tried to contextualise the issue as per suggestions given by literature. Analytical limitations from previous studies are explored and new indicators are introduced along with existing indicators given by Ostrom's framework. However, during data collection and data analysis, it is revealed that several new indicators were ignored and underestimated. These are discussed below.

First, *monitoring of resources* should be studied along with *biophysical conditions of resource* and *heterogeneity of users* to understand how different biophysical conditions and varying user groups affect the monitoring. Secondly, while studying *rate of changes*, the *signal and noise of change* and the *timeline* should be chosen carefully. Thirdly, *social capital* should be studied along *level of education* and *past association with resource* as these two factors critically affect social capital. Fourthly, in case of *presence of outsiders*, some form of institutional governance is omnipresent. Hence, *role of institutional governance* and *pressure of urbanisation* should be studied. Also, the role of *overpoliticisation* and *polarisation* should be investigated as these two factors often influence the *role of institutional governance*. Finally, *user support* should be studied in association with *occupation, social strata (caste)* and *past association with resource* as these factors influence the level of *user support*. These indicators should be incorporated in the future research.

For the analytical construct, multiple regression is done with a normalised dataset. Current research suggests that this process might underestimate the desired outcome. Therefore, a more robust approach via neural network using non-normalised data and other advanced method is suggested for future research for obtaining better results. Also, to maintain congruency in data and access remote areas in the case study area research assistants are employed. This might have produced some biasness and type II error. Also, the transcribed data from Bengali to English might have produced some errors. Future research should take precautions against these errors as they might affect the results.

5.5 Concluding remarks

The study of commons governance is becoming perplexing everyday due to pressure of population, rapid urbanisation, scarcity of natural resources and volatile global economic conditions. This study has tried to understand how commons governance is performing in this complex situation. It does so by testing Ostrom's theory of effective commons governance for a specific condition. While conducting the research, it is found that the adopted framework is semi sufficient for testing. The framework should be expanded by studying how environmental governance can be achieved when dynamic and open ended complex systems meets the rigid semi-medieval semi-modern structure found in society. The current framework helped to gain deeper insights about individual perceptions about environmental governance. However, a need of larger dataset is felt to justify the width and breadth of the subject. Also, the need of advanced statistical techniques like neural network is felt. However, these could not be achieved due to time constraint. At the same time, it is felt that several context specific issues like caste, property rights, politicisation etc. should be investigated. Initially these issues are not considered, and they are noticed during the data analysis. These issues should be investigated in future research to deepen the understanding on intricate processes of commons governance. Finally, current research is restricted only to a specific place. Similar studies should be conducted in other areas with varying biophysical conditions of resource combined with varying socio-economic conditions. Such studies will help to understand the process of commons governance more accurately in this everchanging world.

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How closely attuned the minds of all these [rural] people were— how devoid of individuality and originality they were and how alike they all thought. They had identical feelings, identical notions of humour and identical sets of fears and superstitions and they all measured up to identical standards of meanness and generosity.

— Manik Bandopahyay, The Puppet's Tale. (1968)

Rivers ran in our heads; and tides were in our veins.

— Amitava Ghosh, The Hungry Tide. (2004, pp 165).

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Annex 1: Details of study area

The course of *Anjana* river can be divided into three distinct parts- urban, peri-urban and rural. Therefore, the current study is focused on these three areas to understand the various conditions of human-land-water nexus existing in these three areas and conduct a comparative analysis. It is understood from a preliminary visual survey that the river has fallen to heavy encroachment in the urban areas, it has become a collection of isolated stagnant waterbodies peri-urban area, and the river has retained its former glory in the rural area. The following is the condition of the river found after the preliminary survey.

1.1 Introduction

The origin of Anjana river is at Lat 23°25′11.46′′N and Long 88°28′57.92′′E. The river originates from Jalangi river, an important river in the Bengal delta. The origin of the river lies in the 52 no. Ruipukur mouja of Krishnanagar. Among the eight distributary rivers emerged from Jalangi, Anjana was the most prominent one. From its source point the river first flows towards north. Then it flows towards east. Then the river passes through the Krishnagar Municipality and rural areas such as Dogachhi (census town), Khirpuli, Hatboalia, Jalalkahali, Dharmmadaha, Patuli, Ballabpur, Badkula (census town), Gangni, Anjangarh, Chandandaha, Mugrail, Gagakhali, and Byaspur. After flowing 29 km it meets River Churni at Vyaspur village in Khisna gram panchayat, Ranaghat Block I.; Lat 23°16′56.25′′N, 88°35′01.51′′E. Thus, the river is both distributary river as well as a connecting river as it distributes the excess water of Jalangi and it is also connects Jalangi and Churni. Today, Anjana has turned into a connecting rivulet full of water hyacinth and stagnant water.

Discussion on the entire 29 km stretch spanning from Krishnanagar in North-West to Vyaspur in South-East of Anjana is absent from the existing literature. Thus, this study focuses to bridge this gap. The study comprises of two parts. First, the systematic changes are chronologically described. Then, the current condition of the seven representative areas is discussed.

1.2 Chronology of changes

The change of Anjana started in 17th Century when Bengal basin started tilting towards eastern side. Due to this tilting, Bhagirathi/ Hoogly river is slowing getting converted into a degraded river. As all other rivers are interconnected with Bhagirathi/ Hoogly river, all other rivers are getting affected. The result is loss of water in the river. This is one of the main causes of degradation of Anjana. Secondly, at origin, the riverbed of Anjana is 1m higher than Jalangi which has triggered alluvial deposition at the origin. Also, this has prevented the water from entering into Anjana. These two natural causes affect the water flow in Anjana.

It is found that there are systematic anthropogenic changes happened in the river. In 1674, the then ruler of Krishnanagar kingdom Raja Rudra Roy encountered some problem with the Muslim kings of Murshidabad. As a result, he put up an earthen dam at the origin of the river in 1675. The king did this to protect the kingdom from muslim invaders. He also narrowed the 2 km channel from Ruipukur to King's palace which was on the banks of the river. These acts stopped water from Jalangi to enter Anjana. This anthropogenic effect was the starting point of Anjana's demise. The second human intervention was done by Raja Krishnachandra Roy between 1728-1782. He created a moat around the King's palace to protect himself from the Maratha invaders.

Later in the early 1800s, the British indigo planters created an aqueduct necessary for irrigating indigo fields. The aqueduct is known today as 'Heler khal'. They also created earthen dam across the river between Hazaripota and Joypur. They did this to prevent the river transport of the local resistance against indigo plantation (needs reference on indigo revolt). These factors

further reduced the flow of water in the river. On 17th March 1860, four Italian missionaries of Sisters of Charity from St. Bartolomea Capitanio and Vicenza Gerosa came to Krishanagar. Soon they set up a church on the floodplain of the river. The church still exists today. This marked the first recorded instance of encroachment of the floodplain.

Commercial use of river by turning the river into fisheries by encircling portions of it started before 1947. The process gained traction in 1960s. In 1935, the local landlords put earthen dams across the river to start commercial fishery. From 1945-46, government started collecting water tax in exchange of leasing the river for fishery. In 1961-62, West Bengal Government promoted commercial fishery in Anjana under the Bengal Tank Improvement Act. The result can be still seen in Dogachi. As a result of putting up earthen dam across the river for commercial fishing, today Anjana has turned into large 10 waterbodies; — but no river exists there. In May 1985, MP Sadhon Chottopadhyay and Sukumar Mondol obtained permission to dredge the whole river. The project was named 'Anjana river flow project', but ultimately the project was never executed. The encroachment of the river in the urban areas became evident in 1990s due to pressure of urbanisation. In many cases, the local government legally pursued against the offenders, but to no avail. The lingering judiciary system and red-tape system delayed all justice.

In 2000, a severe flood devasted the urban area and many rural areas. In many areas the waterlogging took 2 years to recede. In 2010, a token attempt was made by the local government to clean the river. However, only 2 km stretch was cleaned. The rest was left as it is. Since then, the river has turned into open sewage in urban areas. The municipality tries to clean the river from time to time, but garbage dumping in the river exceeds the effort.

In rural areas, the river was functional till 2010s. After that the river lost its navigability in rural areas. Many areas are now filled with water hyacinth. The loss of water has triggered encroaching of the riverbed. It is now used for agriculture, fisheries, buildings etc. In many areas, the loss of water has resulted in constructing illegal bridges to maintain communication as boats are no longer an option. In other areas, people have deliberately shortened the river channel by constructing parallel dams along the river channel. Today, 89% of the river is encroached in the urban area. Similarly, only 8 km stretch from Badkulla to Vyaspur is navigable. This precarious condition of the river is also forcing the relationship between the river and its surrounding people to mutate.

Study of human-land-water nexus is not new. However, Brisbane Declaration (2018) tries to look the matter in a new light. This is a new direction in the study of climate change and river. Here, the river is not an isolated geological object of study, rather it is a result of human-land-water nexus. In the next section, the current study area is looked through this lens.

1.3 State of river in representative areas

The river is almost 29 km long. Out of this, 7 km lies in the urban area and rest is in rural area. Among this, there are two peri-urban area. It is found that people have different levels of association with the river in different areas according to their caste, occupation, education, and past level of association with the river. These features are elaborated below for the seven representative areas chosen for study.

1.3.1 Krishnanagar

Krishnagar city is a very old settlement. The city was named after Raja Krishna Chandra Roy. The city was established in approximately 1550s. The city was the capital of the Krishnanagar Kingdom. It was originally very important handicrafts and agricultural trading town. Today the town is the district headquarters of Nadia district. It has a railway junction. The river is divided into two parts in the urban area. One part has width of 24 feet only while the other is about 150

feet wide. According to the municipal record, least 89% of the riverbed has been encroached. The origin of the river which lies in the Ruipukur area has turned into 31 inches wide drain. The rest is filled up with earth by a brick kiln. The River channel is completely blocked here. This situation stretches for the next two kilometres. After that, the river becomes a little bit wide, but full of garbage. The river becomes a little bit wide and prettier in the Kings Palace area. Here, there is water in the river but the river has converted into a stagnant pool of water. After the Kings palace in the Christianpara, Ghoshpara area, the river has converted into a series of ponds named Ghosh Pukur, Biwas Pukur, etc. These ponds are used for fisheries. The rest of the river in the urban area has been turned into an open drain and sewerage. There are several instances where the flood plain has been encroached. Also, there is abundant amount of garbage in the river. Overall, the condition of the river in the urban area is very bad. There are several civil society organisations in the area which are actively participating in the restoration of the river. Very recently, the local government has also taken some feeble initiatives to stop the encroachments. This is very less compared to the earlier efforts by local

Figure 20: Origin of the river- blocked (*Source: Author*)

Figure 19: Condition of river in urban area. (*Source: Author*)

Figure 18: River expert explaining the condition og the river (*Source: Author*)

Figure 21: Encroachment using earthen dam (*Source: Author*)

MLAs, epecially in the Congress regime. The condition of the river has resulted in recording instances of water logging, dengue, malaria and other health hazards.

1.3.2 Dogachhi

Dogachhi is a very old settlement. The area lies just outside of Krishnagar. Today it is considered as a census town or peri-urban area. The area is known for its fisheries. Here in 1961-62 commercial fishery was promote it by the state government. The state government under the Bengal Tank Improvement Act, formed some fishing cooperatives and leased out the river. The cooperatives built earthen dams across the river channel for fishery. As a result, the river has turned into a series of rectangular pounds. It is found that there is a long history of court cases and litigations regarding the ownership of this fisheries. Again, Dogachhi proves that although the river is under the ownership of the state government and central government, local people claim the river as their own due to conflicting property rights. Construction of fisheries have stopped the natural flow of water through the river. The next portion of the river does not get any water from the upstream due to this.

Figure 23: Earthen dam along the river (*Source: Author*)

Figure 22: Encroachment of river for fisheries (*Source: Author*)

1.3.3 Dharmadaha

Dharmadaha lies in the rural area. It is a very old settlement. Current population is approximately 5500. Originally the area was inhabited by the priests (Brahmins) who worked under the king. There is an old temple established in 1850 as a testament to this settlement. The river has vanished here. The course of the river passes beneath the railway culvert which chokes

Figure 25: Bridge over river restricting waterflow (*Source: Author*)

Figure 24: Agriculture on riverbed (*Source: Author*)

the river. It runs from north to south in this section. The river was earlier fed excess water by

two nearby oxbow lakes. These lakes are now converted into agricultural fields. As a result, the river does not get enough water. Additionally, when central government created new road along the river, they encroached the riverbed. The actual river channel is now only 10 ft wide. Rest of the area has been converted into agricultural field. It is found that one particular family is controlling all agricultural fields. They also resi st any kind of dredging. Thus, waterlogging is a common feature.

Figure 26: Temple on floodplain (*Source: Author*)

Figure 27: Railway bridge over river (*Source: Author*)

1.3.4 Patuli

Patuli is relatively newer than Dharmadaha. It lies in the rural area. Population is around 5500. Here, river runs from south to north for a short distance. The river is full of water hyacinth. However, water is deep. There are fishing nets called 'vasal' all over the water. The dry floodplain is used as playing fields. There is a temple in the floodplain. The river is fed by monsoon runoff water. Due to blockage at Dharmadaha bridge, no water comes from the upstream. There are several people associated with fishing lives here. According to them, till 30 years ago, there was flowing water in the river with a variety of fish. Now, the river is drying up. As a result, people are changing their occupation. The existing fishermen themselves clean the river for fishing.

Figure 29: Village head (*Source: Author*)

Figure 28: Dried riverbed (*Source: Author*)

1.3.5 Badkulla

Badkulla is a per-urban area (census town). It has a railway station. The population is around 14000. The river flows from west to east here. The town is fast growing. Here, the river channel is quite deep, but water is very less. There is some water hyacinth in the river. The river is used for jute fermenting (pat jaak). The water is not used for any other purpose. It is found that, although most of the riverbank is empty, some areas have buildings. There are signs of old

fisheries. Local municipality has broken the earthen dams necessary for the fishery. Still, due to lack of river, the river has turned into a series of stagnant waterbodies. According to the local residents, earlier, small fish was found in this part. Now no fish exists. According to the locals, recently the local government tried to de-silt the river via MGNREGA works. However, it was not done properly.

Figure 30: Illegal construction on river (*Source: Author*)

Figure 31: Illegal construction on river (*Source: Author*)

1.3.6 Chandandaha

Chandandaha is very old settlement which lies in the rural area. It was mentioned in Tagore's poem. The river is quite wide here, but water channel is shallow and there is some hyacinth in the river. Jute fermenting is done in this area also. Also, fishing nets (vasal) are found. Here, local government has created an earthen dam across the river for transport. The river flows through a small pipe beneath this dam. The river has reduced to only 10 ft because of this. Additionally, people have created earthen dams along the river channel for fishing or agriculture. These factors also contributed to the narrowing of the river by 40 ft. This feature is evident for 3.5 km stretch.

Figure 32: Jute processing on floodplain (*Source: Author*)

Figure 33: Road built by local govt (*Source: Author*)

1.3.7 Vyaspur

Vyaspur is relatively old settlement which lies in the rural area. The area was first inhabited by the indigo planters. At that time, the area was known for producing indigo dye. The river flows from North to South. The river meets the Churni river here. The colour of the river at confluence in black coloured and there is no flow. On the contrary, the colour of Churni river at confluence in muddy coloured and there is good flow. Water hyacinth and fishing nets are ttwo distinctive features of the river here. The river channel is quite deep, but the amount of water is very less. There is banana plantation on the riverbed. Earlier, there were people associated with fishing trade, but due to lack of water they have turned to agricultural labour. There was a proposal for sluice gate at the confluence by the irrigation department, but it was never implemented.

Figure 37: Encroachment of flood plain (*Source: Author*)

Figure 36: Bottleneck of river (*Source: Author*)

Figure 34: Bridge built by community (*Source: Author*)

Figure 35: Fishing nets or *vasals* (*Source: Author*)

Annex 2: Details of research strategy & methods

The research focuses on how much of the preconditions of effective commons governance can be applied for ecological governance of *Anjana* river. In order to do so, an in-depth analysis of spatial, social, economic and environmental conditions over time is done. This analysis involves asking a representative sample of respondents from the area about the changes occurred in the area. The analysis also covers various aspects regarding the changes over 20 years (from 2000 and onwards). Therefore, the research strategy is a single case study which will allow to work with small units and large variables (Van Thiel, 2014). Also, the research is primarily focus on questionnaire, interview and content analysis, matching it to be a case study (Van Thiel, 2014).

Since the current research uses both primary data and secondary data, as opposed to only secondary data, the research is not a desk research. At the same time, no experiment is being performed with any simulation or gaming. Therefore, the research is not experimental. Finally, the aim is to achieve in-depth analysis of the problem with primary data collection. Hence, the research is not a survey type, as it includes large number of units and large number of variables (Van Thiel, 2014).

The research tries to do process tracing to understand what series of events are responsible for the current state of the river. To conform with case study research, the research will focus on last 20 years (time) and it will confine to the 26 kilometre stretch of the river (space) (Van Thiel, 2014). Since the river has gone through drastic changes in the last 20 years it seems apt to choose that time (Section 3.2). The specific areas for doing surveys are chosen after doing preliminary field survey. It is found that 7 areas can represent the current research (urban-peri-urban-rural), so the research is concentrated in that area.

It has been argued that subjective attributes such as perceptions cannot be adequately studied via quantities (Doyle et al., 2009). Quantitative studies often have limited depth over subject matters. They also have the issue of reliability due to limited scope data triangulation. Therefore, to improve reliability, the research will employ both quantitative and qualitative approaches for better understanding of the complex system (Van Thiel, 2014). Thus, mixed methods approach will be adopted in the form of a testing research design.

As the primary step of the research, data is collected from primary and secondary sources. The research identifies various stakeholders/ users of the common property for data collection. Data is collected through stratified random sampling and purposive sampling (Van Theil, 2014 p.46).

As per case study protocols, pilot study is conducted. The results from the pilot are send for feedback to independent experts help to standardize the questionnaire for final results. Furthermore, quantitative data collection is done first. The data is analysed to find results conforming the objective of research. Then, qualitative data collection is done to compare previous findings. Finally, the results are combined to create final results. Finally, secondary data is used to substantiate the findings. In this way, the inherent problem of low external validity is addressed (Van Thiel, 2014).

Annex 3: Questionnaire for quantitative data collection

অঞ্জনা নদীর উপর সার্ভে- ১

নমস্কার, আমার নাম শঙ্খ শুভ্র নাথ। আমি রটারড্যাম ভিত্তিক হাউজিং এবং আরবান ডেভেলপমেন্ট স্টাডিজ ইনস্টিটিউটের একজন ছাত্র। আমার রোল নং 590219। আমি বর্তমানে অঞ্জনা নদীর তীরে বসবাসকারী মানুষের সাথে অঞ্জনা নদীর সম্পর্ক নিয়ে গবেষণা করছি।

নিম্নের সার্ভের প্রশ্নগুলির উত্তর দেওয়ার মাধ্যমে আমার গবেষণা প্রকল্পে আপনার অবদান রাখার জন্য আমি প্রথমেই আপনাকে ধন্যবাদ জানাতে চাই। আপনার উত্তর আমাকে অঞ্জনা নদীর তীরে বসবাসকারী মানুষের সাথে অঞ্জনা নদীর সম্পর্ক বিষয়ে আরো গভীরভাবে বুঝতে সাহায্য করবে।

পরবর্তী প্রশ্নগুলির উত্তর দিতে আপনার আন্দাজ আধঘন্টা লাগবে। আপনার উত্তর সম্পূর্ণরূপে গোপন রাখা হবে এবং আপনার নাম সম্পূর্ণরূপে উহ্য রাখা হবে। গবেষণা শেষে আপনার উত্তরগুলি ডিলিট করে দেওয়া হবে যাতে অন্য কেউ আপনার উত্তরগুলি জানতে না পারে। এই কারণে আমি আপনাকে অনুরোধ করবো যাতে আপনি নির্ভয়ে এবং আন্তরিকভাবে আপনার ব্যক্তিগত মতামত দেবেন। যদি কোনো প্রশ্ন আপনার কাছে আপত্তিকর মনে হয় বা কোন কারণে আপনার উত্তর দিতে অসুবিধা বোধ হয় আপনি স্বচ্ছন্দ্যে না বলতে পারেন।

সার্ভে শেষ করার পরে যদি কোনো বিষয়ে আপনার মতামত পাল্টাতে হয় বা সার্ভে থেকে নিজের নাম সরিয়ে যাওয়ার প্রয়োজন বোধ করেন বা সার্ভে সংক্রান্ত কোনো বিষয়ে আলোচনা করতে ইচ্ছে করে তবে আমাকে 590219sn@eur.nl এই ঠিকানাতে যোগাযোগ করতে পারেন।

সর্বশেষে, আপনি এই সার্ভে ফর্ম ফিল-আপ করার মাধ্যমে আমার গবেষণা প্রকল্পে আপনার অবদান রাখার অনুমতি দিলেন।

আপনার মূল্যবান সময় আমাকে দেওয়ার জন্য পুনরায় ধন্যবাদ।

*Required

ব্যক্তিগত তথ্য

আপনার ব্যক্তিগত তথ্য দিন ।

1. নাম *

2. ঠিকানা *

3. বয়স *

Mark only one oval.

- 0-20
- 20-30
- 30-40
- 40-50
- 50 এবং উপরে

4. লিঙ্গ *

Mark only one oval.

- পুরুষ
- মহিলা
- অন্যান্য

5. কাস্ট *

Mark only one oval.

- জেনারেল
- ও. বি . সি
- এস. সি
- এস. টি

6. মাসিক আয় *

Mark only one oval.

- 0-5000
- 5001-10000
- 10001-20000
- 20001-30000
- 30001- 50000
- 50000 এবং উপরে

7. বর্তমান পেশা *

_____

8. পূর্ববর্তী পেশা (যদি থাকে)

_____

9. পূর্ববর্তী পেশা পরিবর্তনের কারণ (যদি প্রযোয্য হয়)

_____

10. কত বছর আগে পেশা পরিবর্তন করেছেন? (যদি প্রযোয্য হয়)

_____

নজরদারি- নদীর লাগোয়া জমি

নদীর লাগোয়া জমি/ দুপাশের অঞ্চলে পরিবেশরক্ষা বিষয়ে নজরদারি সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

11. আপনার অভিজ্ঞতা থেকে বলুন, বিগত ২০ বছরে নদীর দুপাশের অঞ্চলে কোনো পরিবর্তন হয়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- হয়েছে
- হয়নি

12. আপনার অভিজ্ঞতা অনুযায়ী, নদীর দুপাশের অঞ্চল কে/কারা নিরীক্ষণ করে বলে আপনার মনে হয়? *

Mark only one oval.

- State গভর্নমেন্ট
- Local গভর্নমেন্ট
- ব্যবসায় সমবায়
- NGO
- পরিবেশবিদ
- অন্যান্য
- হয় না

13. আপনার অভিজ্ঞতা অনুযায়ী, নদীর দুপাশের অঞ্চল কতবার নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

14. আপনার অভিজ্ঞতা অনুযায়ী, কীভাবে নদীর দুপাশের অঞ্চল নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ লিখিত (কেউ বা করা বিষয়টা রেকর্ড করে)
- ◯ মৌখিক (শুধু লোকের মুখে মুখে বিষয়টা ঘোরে, কিন্তু কোনো রেকর্ড হয় না)
- ◯ প্রযোজ্য নয়/ জানি না

15. আপনার অভিজ্ঞতা অনুযায়ী নদীর দুপাশের অঞ্চল নিরীক্ষণ করা কতটা সহজ বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ সহজ নয়
- ◯ অল্প সহজ
- ◯ সহজ
- ◯ বেশি সহজ
- ◯ খুব বেশি সহজ

16. আপনার অভিজ্ঞতা অনুযায়ী নদীর দুপাশের অঞ্চলে নিরীক্ষণ করা কতটা খরচ সাপেক্ষ বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

17. আপনার অভিজ্ঞতা অনুযায়ী নদীর দুপাশের অঞ্চল কতটা পরিমাণে নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

নজরদারি- নদীর জল

নদীর জলের পরিবেশরক্ষা বিষয়ে নজরদারি সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

18. আপনার অভিজ্ঞতা অনুযায়ী, বিগত ২০ বছরে নদীতে জলের প্রবাহের (স্রোত) পরিবর্তন হয়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- হয়েছে
- হয়নি

19. আপনার অভিজ্ঞতা অনুযায়ী, নদীর জলের প্রবাহ (স্রোত) কে/কারা নিরীক্ষণ করে? *

Mark only one oval.

- State গভর্নমেন্ট
- Local গভর্নমেন্ট
- ব্যবসায় সমবায়
- NGO
- পরিবেশবিদ
- অন্যান্য
- হয় না

20. আপনার অভিজ্ঞতা অনুযায়ী, বছরে কতবার নদীর জলের প্রবাহ (স্রোত) নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

21. আপনার অভিজ্ঞতা অনুযায়ী, কীভাবে নদীর জলের প্রবাহ (স্রোত) নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ লিখিত (কেউ বা করা বিষয়টা রেকর্ড করে)
- ◯ অলিখিত (শুধু লোকের মুখে মুখে বিষয়টা ঘোরে, কিন্তু কোনো রেকর্ড হয় না)
- ◯ প্রযোজ্য নয়

22. আপনার অভিজ্ঞতা অনুযায়ী, নদীর জলের প্রবাহ নিরীক্ষণ (স্রোত) করা কতটা সহজ বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ সহজ নয়
- ◯ অল্প সহজ
- ◯ সহজ
- ◯ বেশি সহজ
- ◯ খুব বেশি সহজ

23. নদীর জলের প্রবাহ নিরীক্ষণ করা কতটা খরচ সাপেক্ষ বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

24. আপনার অভিজ্ঞতা অনুযায়ী, নদীর জলের প্রবাহ কতটা পরিমাণে নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

নজরদারি- নদীতে মাছের পরিমাণ

নদীর জলের মাছের পরিমাণ পরিবেশরক্ষা বিষয়ে নজরদারি সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

25. আপনার অভিজ্ঞতা অনুযায়ী, বিগত ২০ বছরে নদীতে পাওয়া যাওয়া মাছের পরিমাণ কমে গেছে বলে আপনার মনে হয়? *

Mark only one oval.

- হয়েছে
- হয়নি

26. আপনার অভিজ্ঞতা অনুযায়ী, নদীতে মাছের পরিমাণ কে/কারা নিরীক্ষণ করে বলে আপনার মনে হয়? *

Mark only one oval.

- State গভর্নমেন্ট
- Local গভর্নমেন্ট
- ব্যবসায় সমবায়
- NGO
- পরিবেশবিদ
- অন্যান্য
- হয় না

27. আপনার অভিজ্ঞতা অনুযায়ী, বছরে কতবার নদীতে মাছের পরিমাণ নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

28. আপনার অভিজ্ঞতা অনুযায়ী, কীভাবে নদীতে মাছের পরিমাণ নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- লিখিত (কেউ বা করা বিষয়টা রেকর্ড করে)
- অলিখিত (শুধু লোকের মুখে মুখে বিষয়টা ঘোরে, কিন্তু কোনো রেকর্ড হয় না)
- প্রযোজ্য নয়

29. আপনার অভিজ্ঞতা অনুযায়ী, নদীতে মাছের পরিমাণ নিরীক্ষণ করা কতটা সহজ বলে আপনার মনে হয়? *

Mark only one oval.

- সহজ নয়
- অল্প সহজ
- সহজ
- বেশি সহজ
- খুব বেশি সহজ

30. আপনার অভিজ্ঞতা অনুযায়ী, নদীতে মাছের পরিমাণ নিরীক্ষণ করা কতটা খরচ সাপেক্ষ বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

31. সামগ্রিকভাবে নদীতে মাছের পরিমাণ কতটা পরিমাণে নিরীক্ষণ করা হয় বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

পরিবর্তন - নদীর লাগোয়া জমি

নদীর লাগোয়া জমি/ দুপাশের অঞ্চলে পরিবেশরক্ষা বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

32. বিগত ২০ বছরে নদীর দুপাশের অঞ্চলে নদীর লাগোয়া জমিতে কতটা পরিবর্তন হয়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

33. বিগত ২০ বছরে নদীর প্লাবনভূমিতে/ নদীর লাগোয়া জমিতে কতটা জমিদখল হয়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

34. বিগত ২০ বছরে নদীর দুপাশের অঞ্চলে নদীর লাগোয়া জমিতে কতটা ঘরবাড়ি বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

35. বিগত ২০ বছরে নদীর দুপাশের অঞ্চলে নদীর লাগোয়া জমিতে আবর্জনা ফেলা কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

পরিবর্তন - নদীর জল

নদীর জলের ক্ষেত্রে পরিবেশরক্ষা বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

36. বিগত ২০ বছরে নদীর জলের প্রবাহ (স্রোত) কতটা কমেছে হয়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

37. বিগত ২০ বছরে নদীখাতের প্রস্থ (চওড়া) কতটা কমেছে বলে আপনার মনে হয় (নদী আগে চওড়া ছিল, এখন কতটা চওড়া আছে)? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

38. বিগত ২০ বছরে নদীখাতের গভীরতা (depth) কতটা কমেছে বলে আপনার মনে হয় (নদী আগে ডিপ ছিল, এখন কতটা ডিপ আছে)? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

39. বিগত ২০ বছরে নদীর মধ্যে কচুরিপানার পরিমাণ কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

40. বিগত ২০ বছরে নদী খাত কতটা ব্যবসার কাজে ব্যবহৃত হয়েছে (মাছচাষ, ইটভাটা, চাষবাস, মাছের ভেড়ি ইত্যাদি) বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

41. বিগত ২০ বছরে নদীর জল তোলা কতটা বেড়েছে (জলসেচ/ পানীয় জল/ অন্যান্য কাজের জন্য) বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

পরিবর্তন - নদীর মাছের পরিমাণ

নদীর মাছের পরিমাণের ক্ষেত্রে পরিবেশরক্ষা বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

42. বিগত ২০ বছরে নদীর মাছের পরিমাণ কতটা কমেছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

43. বিগত ২০ বছরে নদীর মাছের প্রজাতির পরিমাণ কতটা কমেছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

44. বিগত ২০ বছরে নদীতে মাছ চাষ কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

পরিবর্তন - নদী নির্ভরশীলতা

নদীর উপর নির্ভরশীল মানুষের জীবিকা বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

45. বিগত ২০ বছরে নদীর উপর নির্ভরশীল মানুষের পরিমাণ কতটা কমেছে? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

46. বিগত ২০ বছরে নদীর উপর নির্ভরশীল জীবিকার পরিমাণ কতটা কমেছে? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

47. বিগত ২০ বছরে নদীর জল উত্তোলন প্রযুক্তিতে কতটা পরিবর্তন হয়েছে (নদী থেকে পাম্প করে জল তোলা কতটা বেড়েছে)? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

সামাজিক সম্পদ

নদীর উপর নির্ভরশীল মানুষের জীবিকা বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

48. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে "অন্যদের (প্রতিবেশী/ Local গভর্নমেন্ট/ অন্যান্য) উপর আপনার গোষ্ঠীর ভরসা" কতটা বেড়েছে? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

49. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে "অন্যদের (প্রতিবেশী/ Local গভর্নমেন্ট/ অন্যান্য) সাথে আপনার গোষ্ঠীর পারস্পরিক বোঝাপড়া" কতটা বেড়েছে? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

50. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে "আপনার গোষ্ঠীর ক্ষমতা" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

51. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে "আপনার গোষ্ঠীর তথ্য/জ্ঞান" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

52. বিগত ২০ বছরে আপনার গোষ্ঠী নদী পরিচালনা বিষয়ে কতটা সক্রিয় হয়ে উঠেছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

53. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে অন্যান্য গোষ্ঠীর এর সাথে আপনার গোষ্ঠীর সংযোগ কতটা বেড়েছে? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

54. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে সাধারণ মানুষের মধ্যে সমাজ সচেতনতা কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

55. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে আপনার গোষ্ঠীর নেতৃত্ব কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

নতুন গোষ্ঠী

নদীর উপর নির্ভরশীল নতুন গোষ্ঠী যেমন জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

56. বিগত ২০ বছরে নদীর উপরে নির্ভরশীল গোষ্ঠী কতটা বেড়েছে (নতুন জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি) বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

57. বিগত ২০ বছরে নদীকে কেন্দ্র করে আপনার গোষ্ঠীর রোজগার কতটা বেড়েছে (জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি) বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

58. বিগত ২০ বছরে নদীকে কেন্দ্র করে নতুন গোষ্ঠীর এর রোজগার/ প্রভাব কতটা বেড়েছে (সরকার আপনাদের কথা শুনছে/ সাধারণ মানুষ আপনাদের কথা শুনছে/ রাজনৈতিক ক্ষমতা বেড়েছে) বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

59. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে কোন কোন গোষ্ঠীর প্রভাব বেড়েছে (একাধিক অপসন নির্বাচন করতে পারেন) বলে আপনার মনে হয়? *

Tick all that apply.

- [ ] State গভর্নমেন্ট
- [ ] Local গভর্নমেন্ট
- [ ] ব্যবসায় সমবায়
- [ ] NGO
- [ ] পরিবেশবিদ
- [ ] সাধারণ মানুষ
- [ ] অন্যান্য

সদস্য/ গোষ্ঠী সহযোগিতা

নদীর উপর নির্ভরশীল এমন গোষ্ঠী যেমন জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদির সাথে অন্য গোষ্ঠীর সহযোগিতা বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

60. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে আপনাদের গোষ্ঠী কতটা সহযোগিতা করতে পেরেছে/ যুক্ত থাকতে পেরেছে (জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি) বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

61. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে আপনাদের গোষ্ঠী কতটা কারিগরী (technical) সহযোগিতা করতে পেরেছে (নিজেদের উদ্যোগে যন্ত্র দিয়ে নদী পরিষ্কার করা/ নিজেদের উদ্যোগে পানা পরিষ্কার করা/ নতুন টেকনোলজি আনা ইত্যাদি) বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

62. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে আপনাদের গোষ্ঠী কতটা আর্থিক সহযোগিতা করতে পেরেছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

63. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে আপনাদের গোষ্ঠী সাধারণ মানুষের সাথে কতটা যোগাযোগ গড়ে তুলেছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

তথ্যপ্রদান

নদীর উপর নির্ভরশীল এমন গোষ্ঠী যেমন জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদির কাছে নদীর পরিবেশরক্ষা বিষয়ে তথ্য বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

64. নদী সম্পদ (নদীর লাগোয়া জমি/ নদীর জল/ মাছ) বিষয়ে আপনাদের গোষ্ঠীর কাছে কতটা তথ্য আছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

65. নদী সম্পদ (নদীর লাগোয়া জমি/ নদীর জল/ মাছ) বিষয়ে আপনারা কতটা তথ্য আদানপ্রদান করেন বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

66. নদী সম্পদ (নদীর লাগোয়া জমি/ নদীর জল/ মাছ) বিষয়ে সরকার কতটা তথ্য আদানপ্রদান করে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

67. নদী পরিচালন ব্যবস্থা কতটা স্বচ্ছ/ দুর্নীতিমুক্ত বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

68. নদীকে কেন্দ্র করে পরিবেশ ও মানুষের সম্পর্ক বিষয়ে আপনাদের গোষ্ঠীর কাছে কতটা তথ্য আছে বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

69. নদী সম্পদ বিষয়ে আপনাদের গোষ্ঠীর তথ্য সরকারি তথ্যের সাথে কতটা মেলে বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

বিরোধ নিষ্পত্তি দক্ষতা

নদীর উপর নির্ভরশীল এমন বিভিন্ন গোষ্ঠী যেমন জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদির মধ্যে নদীর পরিবেশরক্ষা বিষয়ে ঘটে যাওয়া বিরোধ বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

70. নদী সম্পদ (নদীর লাগোয়া জমি/ নদীর জল/ মাছ) বিষয়ে কতগুলি আইনি ঝামেলা (জোর করে মাছচাষ, জমিদখল, নদীদখল ইত্যাদি) আছে বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

71. নদী সম্পদ (নদীর লাগোয়া জমি/ নদীর জল/ মাছ) বিষয়ে সরকার ও বিভিন্ন গোষ্ঠীর মধ্যে কতটা যোগাযোগ আছে বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

72. বিগত ২০ বছরে নদী সম্পদ (নদীর লাগোয়া জমি/ নদীর জল/ মাছ) বিষয়ে কতটা বিরোধ নিষ্পত্তি হয়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

নদী পরিচালনা বিষয়ে জনসাধারণের অংশগ্রহণ

নদীর পরিচালনা বিষয়ে জনসাধারণের অংশগ্রহণ বিষয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

73. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে জনসাধারণের "অংশগ্রহণ না করার প্রবণতা" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

74. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে জনসাধারণকে "কিছু বলে চুপ করিয়ে দেওয়ার প্রবণতা" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

75. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে জনসাধারণকে "জানিয়ে কাজ করার প্রবণতা" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

76. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে জনসাধারণের "পরামর্শ নিয়ে করে কাজ করার প্রবণতা" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

77. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে জনসাধারণকে "মিথ্যা আশ্বাস দেওয়ার প্রবণতা" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

78. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে জনসাধারণকে "সাথে নিয়ে কাজ করার প্রবণতা" কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

79. বিগত ২০ বছরে নদী পরিচালনা বিষয়ে জনসাধারণকে "সম্পূর্ণ দায়িত্ব দেওয়ার প্রবণতা" দেওয়া কতটা বেড়েছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

নদী পরিচালনা বিষয়ে নিয়মাবলী

নদী পরিচালনার নিয়মাবলী (যেমন কতটা জল তোলা যাবে, কতটা মাছ ধরা যাবে, কোন জায়গায় মাছ ধরা যাবে, কোন জায়গায় ধানচাষ যাবে, আবর্জনা ফেলা যাবে না, জমিদখল করে যাবে না ইত্যাদি) বিষয়ে জনসাধারণের অংশগ্রহণ করা নিয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

80. নদী পরিচালনা বিষয়ে সরকারি এবং অন্যান্য নিয়মাবলী সম্পর্কে আপনি কতটা জানেন বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

81. নদী পরিচালনা বিষয়ে নতুন ঘরোয়া/ বেসরকারি নিয়মাবলী তৈরী করতে জনসাসারণের কতটা আগ্রহ আছে (আজকে যদি আপনাকে নদী পরিচালনার জন্য কোনো নতুন নিয়ম বানাতে বলা হয়, তবে আপনি/জনসাসারণ তাতে কতটা আগ্রহী হবেন) বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

82. নদী পরিচালনা বিষয়ে নতুন ঘরোয়া/ বেসরকারি নিয়মাবলী প্রণয়ন করতে (নতুন নিয়ম চালু করা)জনসাসারণের কতটা আগ্রহ আছে বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

83. নদী পরিচালনা বিষয়ে কোনো শাস্তি মেনে নিতে জনসাসারণের কতটা আগ্রহ আছে (যদি কেউ নদীতে আবর্জনা ফেলে/ জমিদখল করে, তবে সে স্বেচ্ছায় কতটা শাস্তি মেনে নেবে) বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

84. নদী পরিচালনা বিষয়ে কোনো পুরষ্কার গ্রহণে জনসাসারণের কতটা আগ্রহ আছে (যদি কেউ নদীতে আবর্জনা না ফেলে/ জমিদখল না করে, তবে সে পুরস্কার পেতে কতটা আগ্রহী হবে) বলে আপনার মনে হয়? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

নদী পরিচালনা বিষয়ে পরিকাঠামো

নদী পরিচালনার পরিকাঠামো (যেমন মাটি কাটার যন্ত্র পাওয়া যায় কিনা, জলের গুণগত মান মাপার যন্ত্র পাওয়া যায় কিনা, পানা পরিষ্কার যন্ত্র পাওয়া যায় কিনা, গভর্নমেন্ট ডিপার্টমেন্ট আছে না, গবেষণামূলক পরিকাঠামো আছে না ইত্যাদি) বিষয়ে জনসাধারণের অংশগ্রহণ করা নিয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

85. নদী সম্পদ ব্যবহার করার জন্য কতটা কারিগরি পরিকাঠামো আছে বলে আপনার মনে হয় (মাটি কাটার যন্ত্র/ জলের গুণগত মান মাপার যন্ত্র/ পানা পরিষ্কার যন্ত্র ইত্যাদি)? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

86. নদী পরিচালনা বিষয়ে কতটা প্রাতিষ্ঠানিক পরিকাঠামো আছে বলে আপনার মনে হয় (গভর্নমেন্ট ডিপার্টমেন্ট)? *

Mark only one oval.

- ◯ খুব অল্প
- ◯ অল্প
- ◯ মাঝারি
- ◯ বেশি
- ◯ খুব বেশি

87. নদী পরিচালনা বিষয়ে কতটা গবেষণামূলক পরিকাঠামো আছে বলে আপনার মনে হয়? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

88. নদী পরিচালনা বিষয়ে phone/ internet এর কতটা গুরুত্ব আছে বলে আপনার মনে হয় (আপনি কি মনে করেন, আপনার কাছে ফোন থাকলে নদী বিষয়ে আপনার কথা আপনি তাড়াতাড়ি লোকের কাছে পৌঁছে দিতে পারতেন)? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

নদী পরিচালনা- অভিযোজন ক্ষমতা/ নতুন পরিস্থিতির সাথে মানিয়ে নেওয়ার ক্ষমতা

নদী পরিচালনার ক্ষেত্রে নতুন পরিস্থিতির সাথে মানিয়ে নেওয়ার বিষয়ে জনসাধারণের অংশগ্রহণ করা নিয়ে বিগত ২০ বছরে ঘটে যাওয়া পরিবর্তন সম্পর্কে আপনার অভিজ্ঞতা বলুন।

যদি কোনো ক্ষেত্রে আপনার উত্তর "জানি না" বা "উত্তর দিতে পারছি না" হয় সেক্ষেত্রে আপনি "খুব অল্প" অপসন নির্বাচন করবেন।

এখানে গোষ্ঠী অর্থে গোষ্ঠী অর্থে আপনি যে জীবিকার সাথে যুক্ত সেই জীবিকার সাথে যুক্ত মানুষজন বা জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি বোঝানো হয়েছে। কোনরকম রাজনৈতিক গোষ্ঠী বা দল বোঝানো হয়নি।

89. নদীর বন্যা/ জল কমে যাওয়া/ জমিদখল ইত্যাদি বিষয়ে মানুষের কতটা প্রস্তুতি আছে বলে আপনার মনে হয় (আজকে যদি নদীতে হঠাৎ করে বন্যা/খরা হয় তবে তার জন্য নদীর দুপাশের লোক কতটা প্রস্তুত)? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

90. নতুন গোষ্ঠীদের মেনে নেওয়া ও সেইমতো নিজেদের adjust করা বিষয়ে মানুষের কতটা প্রস্তুতি আছে বলে আপনার মনে হয় (নতুন জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, মাছচাষকারী, কৃষক সম্প্রদায় ইত্যাদিকে আপনারা কতটা মেনে নিতে পেরেছেন)? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

91. নতুন সরকারি/ বেসরকারি নিয়মাবলী মেনে নেওয়া বিষয়ে মানুষের কতটা প্রস্তুতি আছে বলে আপনার মনে হয় (আজকে যদি নদী পরিচালনা বিষয়ে নতুন সরকারী নিয়ম আসে, আপনারা তা মেনে নিতে কতটা প্রস্তুত)? *

Mark only one oval.

- খুব অল্প
- অল্প
- মাঝারি
- বেশি
- খুব বেশি

Annex 4: Questionnaire for qualitative data collection

3. সামাজিক সম্পদ

নদী সংস্কারকে ঘিরে আপনাদের নিজেরদের উদ্যোগ সম্পর্কে আপনার অভিজ্ঞতা বলুন।

সামগ্রিকভাবে জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি নদীর পরিবেশরক্ষার বিষয়ে কতটা অবদান রাখতে পেরেছেন? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

4. অন্যান্য গোষ্ঠী

নদী সংস্কারকে ঘিরে অন্যদের প্রভাব সম্পর্কে আপনার অভিজ্ঞতা বলুন (নতুন জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায়. পঞ্চায়েত, জেলা পরিষদ, স্টেট গভঃ)।

5. সদস্য/গোষ্ঠী সহযোগিতা

নদী সংস্কারকে ঘিরে একে অপরকে সাহায্য করা সম্পর্কে আপনার অভিজ্ঞতা বলুন।

a. বর্তমানে নদী সংস্কারকে ঘিরে আশপাশের জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি একে অপরকে কতটা সাহায্য করেন ?
b. আগে কি ছিল?
c. কতবছর ধরে সাহায্য করছেন?

a. নদী সংস্কারকে ঘিরে আশপাশের পঞ্চায়েতের একে অপরকে কতটা সাহায্য করেন?
b. আগে কি ছিল?
c. কতবছর ধরে সাহায্য করছেন?

সামগ্রিকভাবে জেলে সম্প্রদায়, ব্যবসায়ী সম্প্রদায়, কৃষক সম্প্রদায় ইত্যাদি নদীর পরিবেশরক্ষার বিষয়ে একে অপরকে কতটা সাহায্য করে উঠতে পেরেছেন?এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

পঞ্চায়েত, জেলা পরিষদ, স্টেট গভঃ ইত্যাদি নদীর পরিবেশরক্ষার বিষয়ে একে অপরকে কতটা সাহায্য করে উঠতে পেরেছেন?? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

6. তথ্যপ্রদান

নদী সংস্কারকে ঘিরে বিভিন্ন খবরাখবর করা সম্পর্কে আপনার অভিজ্ঞতা বলুন।
নদী সংস্কারকে ঘিরে আশপাশের পঞ্চায়েতের কাজকর্ম সম্পর্কে আপনার অভিজ্ঞতা বলুন।

সামগ্রিকভাবে নদী সংস্কারকে ঘিরে বিভিন্ন খবরাখবর নদীর পরিবেশরক্ষার উপরে কোনো প্রভাব ফেলছে? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

7. বিরোধ নিষ্পত্তি দক্ষতা

নদী সংস্কারকে ঘিরে বিভিন্ন বিরোধ/ আইনি সমস্যা সম্পর্কে আপনার অভিজ্ঞতা বলুন।
আপনারা বিরোধ নিষ্পত্তির জন্য কিছু করে উঠতে পেরেছেন কি?

সামগ্রিকভাবে নদী সংস্কারকে ঘিরে বিরোধ/ আইনি সমস্যা নদীর পরিবেশরক্ষার উপরে কোনো প্রভাব ফেলছে? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

8. নদী পরিচালনা বিষয়ে জনসাধারণের অংশগ্রহণ

নদী সংস্কারকে ঘিরে জনসাধারণের অংশগ্রহণ করা বা না করা সম্পর্কে আপনার অভিজ্ঞতা বলুন।

নদী সংস্কারকে ঘিরে জনসাধারণের অংশগ্রহণ করা বা না করা নদীর পরিবেশরক্ষার উপরে কোনো প্রভাব ফেলছে? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

9. নদী পরিচালনা বিষয়ে নিয়মাবলী

নদী সংস্কারকে ঘিরে সরকারী ও মৌখিক নিয়ম সম্পর্কে আপনার অভিজ্ঞতা বলুন।

নদী সংস্কারকে ঘিরে নিয়ম থাকা না থাকা নদীর পরিবেশরক্ষার উপরে কোনো প্রভাব ফেলছে কি? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

নদী সংস্কারকে ঘিরে নিয়ম থাকলেও সেটা মানা বা না মানা নদীর পরিবেশরক্ষার উপরে কোনো প্রভাব ফেলছে কি? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

10. নদী পরিচালনা বিষয়ে পরিকাঠামো

নদী সংস্কারকে ঘিরে সরকারি পরিকাঠামো সম্পর্কে আপনার অভিজ্ঞতা বলুন। অন্যান্য পরিকাঠামো সম্পর্কে আপনার অভিজ্ঞতা বলুন।

বর্তমানে সরকারি পরিকাঠামো নদী পরিবেশরক্ষার উপরে কোনো প্রভাব ফেলছে কি? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

11. নতুন পরিস্থিতির সাথে মানিয়ে নেওয়ার ক্ষমতা

নদীর এই নতুন পরিস্থিতির সাথে নিজেরদের মানিয়ে নেওয়ার সম্পর্কে আপনার অভিজ্ঞতা বলুন।

বর্তমানে নদীর সাথে মানুষের সম্পর্ক কেমন? সেটা নদী পরিবেশরক্ষার উপরে কোনো প্রভাব ফেলছে কি? এই সম্পর্কে যদি আপনার অভিজ্ঞতা থাকে তো তা বলুন।

Annex 5: Daily logs of data collection

18/07/21 Formulation of questionnaire.

Today I started the formulation of questionnaire from the Indicator Table. It was easy as I have chosen all my indicators with dummy (yes/ no question) or Likert scale (5 point). The main challenge was to translate from English to bengali. I had to be careful in translating the words without losing correct meaning. And challenge I found that, I have almost 90 questions. I think this will be overwhelming for both research assistants and respondents. However, I have no solution apart from alerting them both. I have to speak to the research assistants about this. I also need to tell them about research ethics and validity.

I prepared the questionnaire on Google Form. I took care of the GDPR compliance by putting the intention of the survey and disclaimers about ethics and validity. I specifically mentioned about the anonymization of the data as there might be political disruptions on the respondents.

The questionnaire was sent to Nirmalendu Nath and Dr. Subhrajit Banerjee for approval. After he went through the questionnaire, we discussed the questionnaire over Google Meet. I changed some areas as per our discussion and finalized the questionnaire. Tomorrow, we are conducting the pilot survey.

Today I also set up the final places for conducting survey in consultation with Nirmalendu Nath. Since the river goes through urban-rural- peri-urban- rural area, we thought of doing four cross sections at each area. We fixed places for rural- peri-urban- rural area, urban is yet to be fixed. The areas are as follows:

Urban: Yet to be fixed, Rural: Patuli- Ballavpur, Peri-urban: Badkulla-Gangni, Rural: Chandandaha-Mugrali/ Vyaspur.

We figured that in order to complete the survey properly, we need to canvas 20 people from each of these above-mentioned areas/ villages/ census towns. Therefore, this week we are sending Pintu and Papai to canvas these areas and talk to village heads to give a understanding of the upcoming survey. We are doing this to prepare people for the upcoming survey and avoid any hostility. Since, Pintu and Papai are already familiar with the area, we think it will not be a problem. They are given this whole week to canvas these areas. After they complete the canvassing we shall start the survey.

As of today, the summary of upcoming survey stands as following:

Place/ Date	22/07	23/07	24/07	25/07	26/07	27/07	29/07	30/07
Badkulla								
Gangni								
Patuli								
Ballavpur								
Chandandaha								
Mugrali								

For each place number of targeted respondents is 20. There will be 4-6 research assistants for each place. Each research assistant will target 4-5 respondents. For each respondent, maximum time limit is 1 hour. (As there are almost 90 questions, one hour will be needed) One place shall be canvassed in one day.

19/07/20 Pilot Survey-Quantitative data

Today Nirmalendu Nath, along with 3 research assistants have gone to do the pilot survey of 3 people at Jelepara and Rajbonshipara near Badkulla railway station. The area lies in the peri-urban region of the river course. They interviewed the following:

1. Asim Biswas- Member, Local village administration
2. Kartick Shikdar- Construction worker, ex-fisherman
3. Ratan Shikdar- Daily wage worker, ex-fisherman

The outcome of the survey was registered properly on Google Form. I observed the results from my laptop. I also talked to the research assistants to see if they are facing problems. Overall, the survey was good. Respondents reacted as predicted. There was no hostility or animosity.

It is found that, there are pressing questions which are not answered through the survey questionnaire. Therefore, focus group discussions and interviews will be conducted in future to get answers to those questions. For example, the degree of encroachment was discussed in survey. However, who is responsible for encroachment, why there is encroachment and what is the outcome of encroachment are not asked explicitly. These questions can be answered via focus group discussions and interviews.

Also, the respondents as well as research assistants have hard time in understanding the questions. Therefore, the questions are needed to be simpler and research assistants are needed to be more trained. There was one case of biasness in one question, but it was avoided. In future, I need to explain the research assistants more from abstaining themselves from doing judgement on their own.

20/07/21 Revision of questionnaire

Today I revised almost my entire questionnaire in consultation with Raja (one of the research assistants). He faced problems yesterday in understanding the questions due to the nature of vocabulary used during the pilot survey. The respondents also had difficulties in understanding the questions. So today, we tried to make the questionnaire simpler and easier to understand. In this way, respondents with little education can answer the questions easily.

After consultation with Raja, I changed many words in the questionnaire which are little difficult to understand with more simpler words, included examples and rephrased some questions. A few questions like former occupation is added for better understanding of the respondent. The final questionnaire is again send to Nirmalendu Nath for approval.

21/07/21 Training of Research Assistants

Today, I talked with the research assistants again. I reminded them of biasness. A new problem has arisen. The local village head is too keen to help. I a fearing this might skew the result of the survey. So I asked the research assistants to let me talk to him tomorrow. I am going to ask him about the personal interview. This will help him to pacify. Also, I am going to ask him not to be involved personally during survey, rather send someone close to him with the research assistants. This will help in maintaining the integrity of the survey.

New situation.

The local village head of Patulipur is keen to help. So, I am sending two research assistants (instead of four) to the village. The village head will supply them the current voter list. The research assistants will identify 5 neighbourhoods of Patulipur village lying adjacent to the

Anjana river. In each neighbourhood, they will identify 5 people from the voter list using random sampling technique. In this way, total 20 people will be identified from that voter list using stratified random sampling technique.

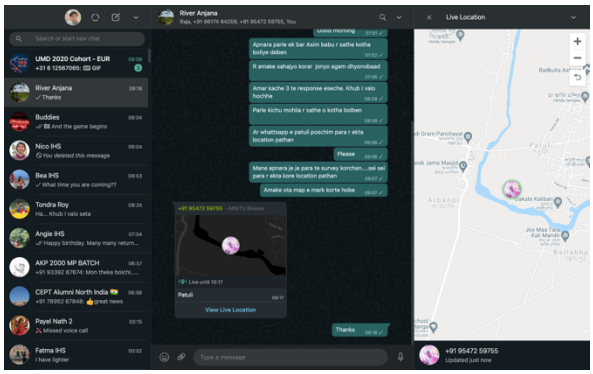
The village head will personally go or send someone with the research assistants to canvas these 20 people. An alternative can be, the village head will summon these 20 people one by one at the local village administration office and the research assistants will interview the respondents. This will be decided tomorrow by the village head.

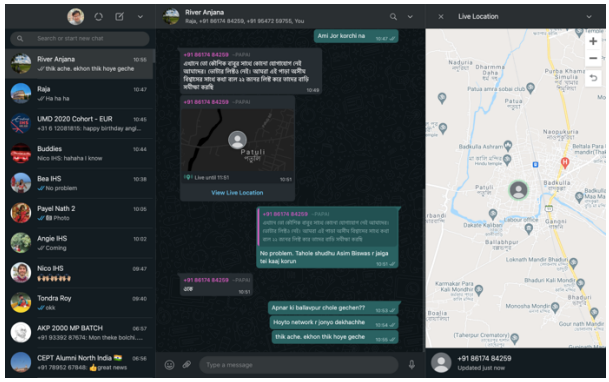
I talked with the research assistants. They again suggested some changes in questionnaire. Also, we talked about the maximum number of people that they can survey in one day. I said about 12 to 15 is fine with me as only two people are going tomorrow.

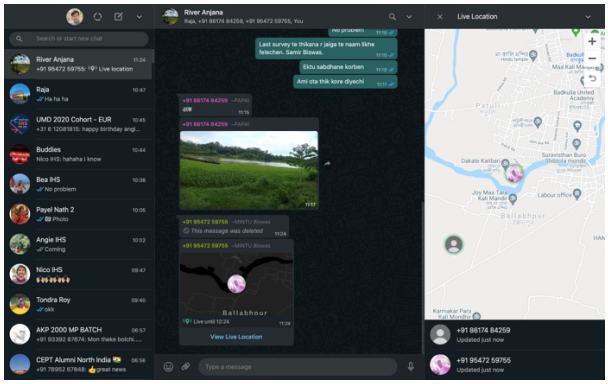
22/07/21 Quantitative data— First day of Survey

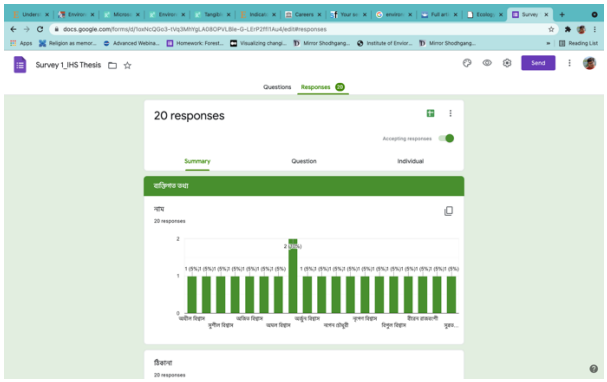
Today is the first day of the survey. Today we are covering Patuli. I got up very early and talked to the research assistants over the phone. They started the survey at 11.00 AM IST. Before beginning the survey, I talked with the local village head named Asim Biswas. He was nice and polite. He asked me to continue my work. He wants to help the fishermen in his jurisdiction. I stated him that, for the time being this an academic exercise. In future, I shall share my results with them and they can use it to create a proposal. I also secured a timeslot from him for personal interview.

The research assistants have done good job so far. According to them, the questionnaire is easy to understand and people are responding correctly. I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies. If some doubts arise, I am communicating with the research assistants via Whattsapp.









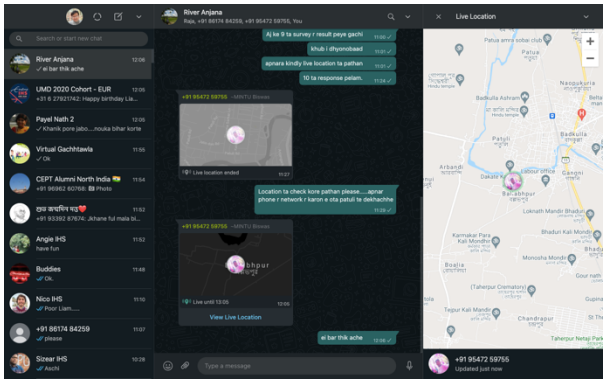
23/07/21 Quantitative data— Second day of Survey

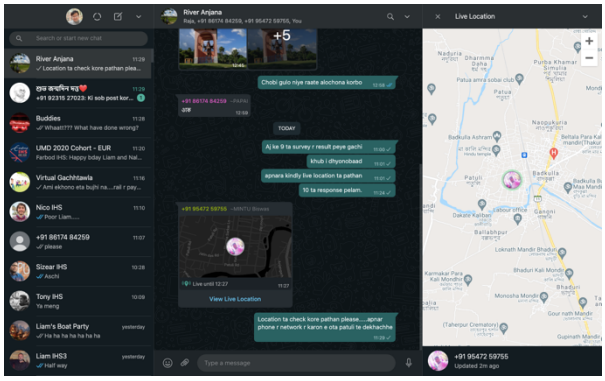
Today is the second day of the survey. Today we are doing survey at Ballavpur- opposite side of Patuli. I again got up very early and talked to the research assistants over whattsapp call. They faced a problem. The local village head Sudhir Rajowar was absent. So the research assistants had to wait for a while. However, I could not help them.

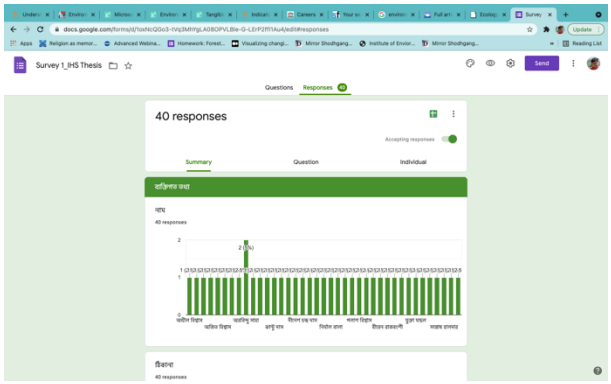
They started the survey at 11.00 AM IST. Today I did not talked with the local village head to avoid any expectations. Instead, I asked the research assistants to politely inform the purpose of the survey to the village head.

The research assistants are doing good job so far. Again, I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies.

Survey of Day 2 has been completed at 16.38 PM IST. The survey took 5.5 hours to complete the canvasing of 20 respondents. 2 research assistants worked with the help of local village head Sudhir Rajowar. The survey started on the western side of Ballavpur and progressed towards the eastern side. Monitoring was done to check for discrepancies. Also, live location feature in Whattsapp is used to track the physical progress. No politcal resistance is faced. People are found to be co-operative. Feedback from research assistants are awaited. Their feedback is important for forming the FGD and Interview questions.







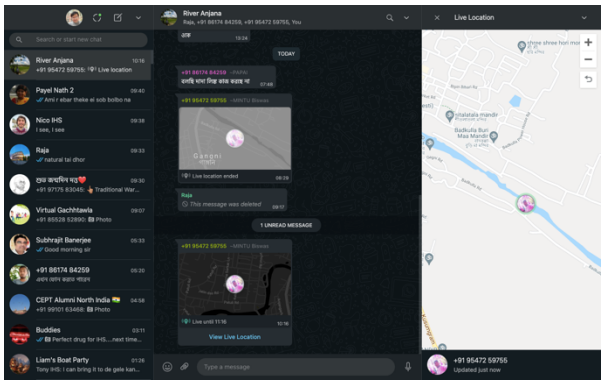
24/07/21 Quantitative data— Third day of Survey

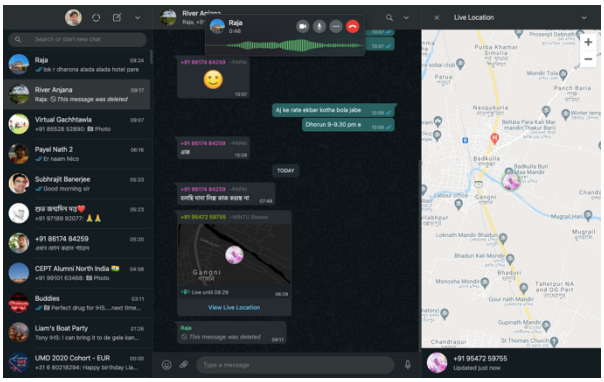
Today is the third day of the survey. Today we are doing survey at Gangni- opposite side of Badkulla. I again got up very early (02.00 AM) and talked to the research assistants over whattsapp call. Today we talked about the feedback. They found, some questions are not adequate. For example, the width of the river has naturally shrunken due to garbage dumping

and siltation. However, government did some efforts to widen the river. Therefore, there is a confusion whether the river is wide or not. We solved the issue.

Survey started at 11.00 AM IST. Nirmalendu Nath supervised the whole process. There was some issue with the voter list. It was solved later.

The research assistants are doing good job so far. Again, I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies. It is going a bit slow than the previous day because of the rains. They have to stop the surveys due to heavy rains frequently.



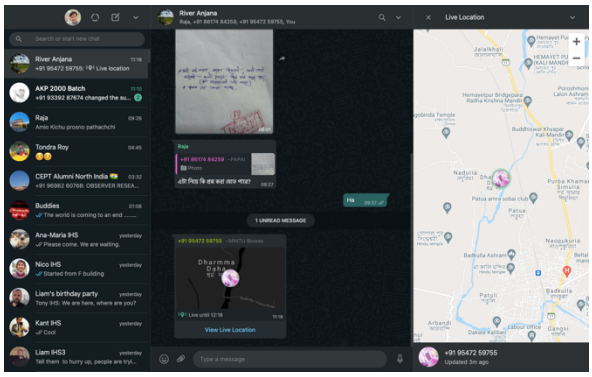


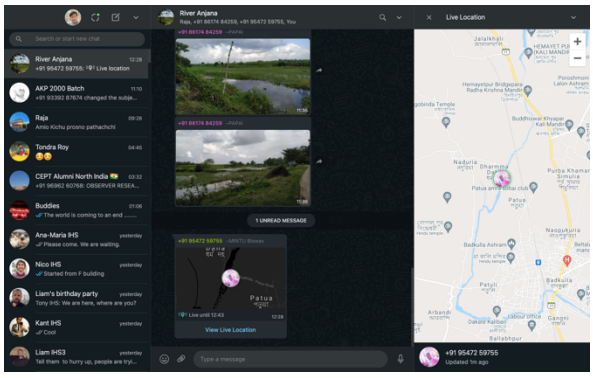
25/07/21 Quantitative data— Fourth day of Survey

Today is the fourth day of the survey. Today we are doing survey at Dharmadaha. I again got up very early (02.30 AM) and talked to the research assistants over whattsapp call. Today we talked about the feedback. They found, some questions are not adequate. For example, the width of the river has naturally shrunken due to garbage dumping and siltation. However, government did some efforts to widen the river. Therefore, there is a confusion whether the river is wide or not. We solved the issue.

Survey started at 11.00 AM IST.

The research assistants are doing good job so far. Again, I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies. Today survey progressed smoothly. One knowledgable person is identified for interview.



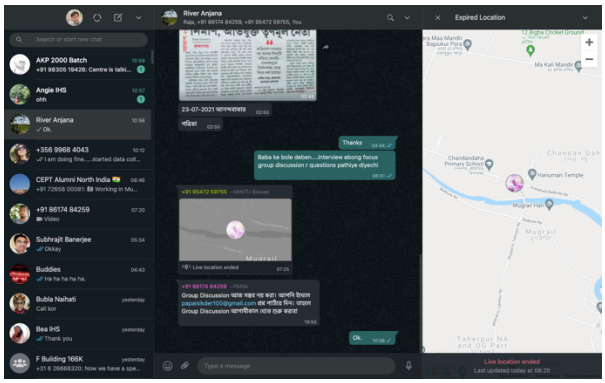


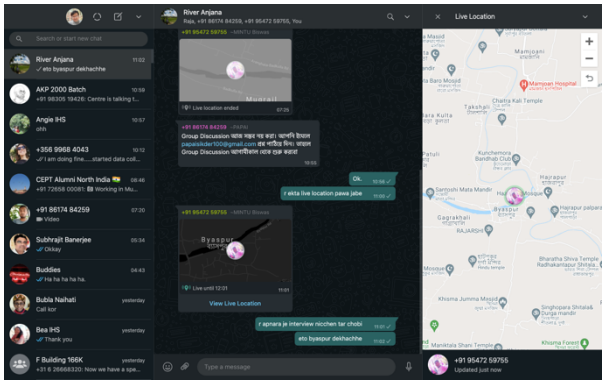
26/07/21 Quantitative data— Fifth day of Survey

Today is the fifth day of the survey. Today we are doing survey at Mugrail. I again got up very early (02.00 AM) and talked to the research assistants over whattsapp call.

Survey started at 10.30 AM IST. Today I talked with the local village head.

The research assistants are doing good job so far. Again, I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies. Monsoon is coming. Rain is playing havoc.

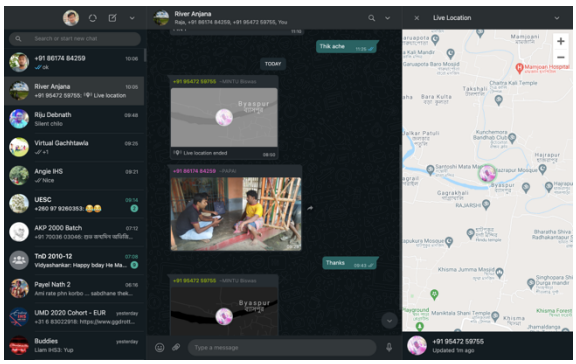


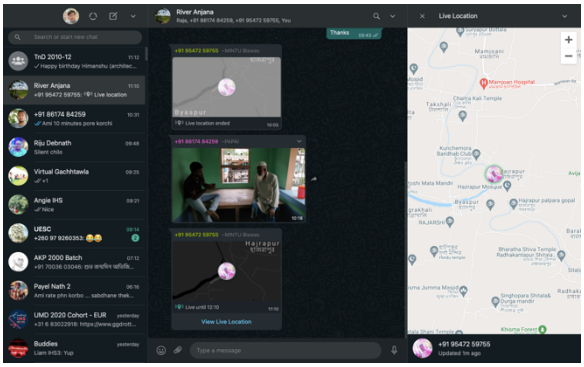


27/07/21 Quantitative data— Six day of Survey

Today is the sixth day of the survey. Today we are doing survey at Vyaspur. I again got up very early (02.00 AM) and talked to the research assistants over whattsapp call. No problems were found.

Survey started at 11.00 AM IST.





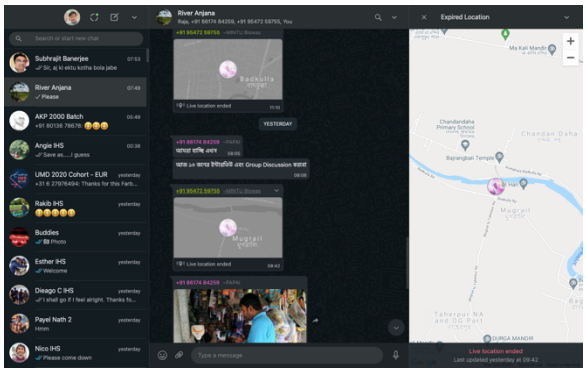
The research assistants are doing good job so far. Again, I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies.

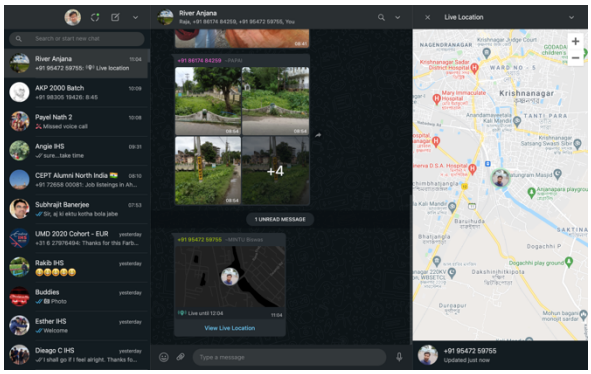
30/07/21 Quantitative data— Seventh day of Survey

Today is the seventh day of the survey. Today we are doing survey at Vyaspur. I again got up very early (02.30 AM) and talked to the research assistants over whattsapp call. No problems were found.

Survey started at 10.00 AM IST.

The research assistants are doing good job so far. Again, I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies. Survey was stopped for last 2 days due to heavy monsoon.



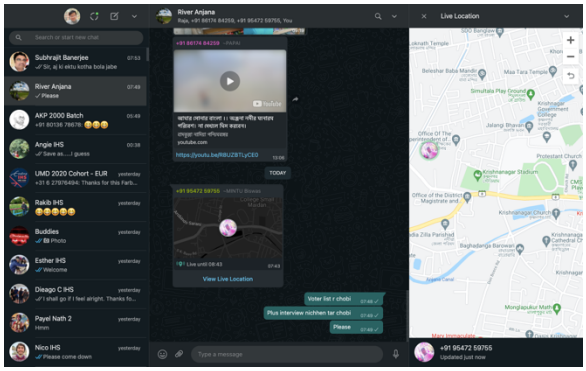


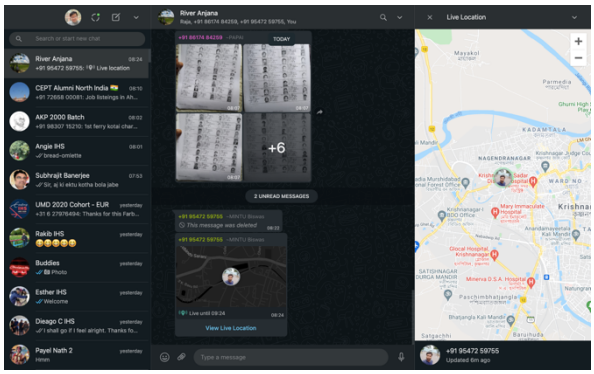
30/07/21 Quantitative data— Eighth day of Survey

Today is the eigth day of the survey. Today we are doing survey at Krishnanagar. I again got up very early (02.30 AM) and talked to the research assistants over whattsapp call. No problems were found.

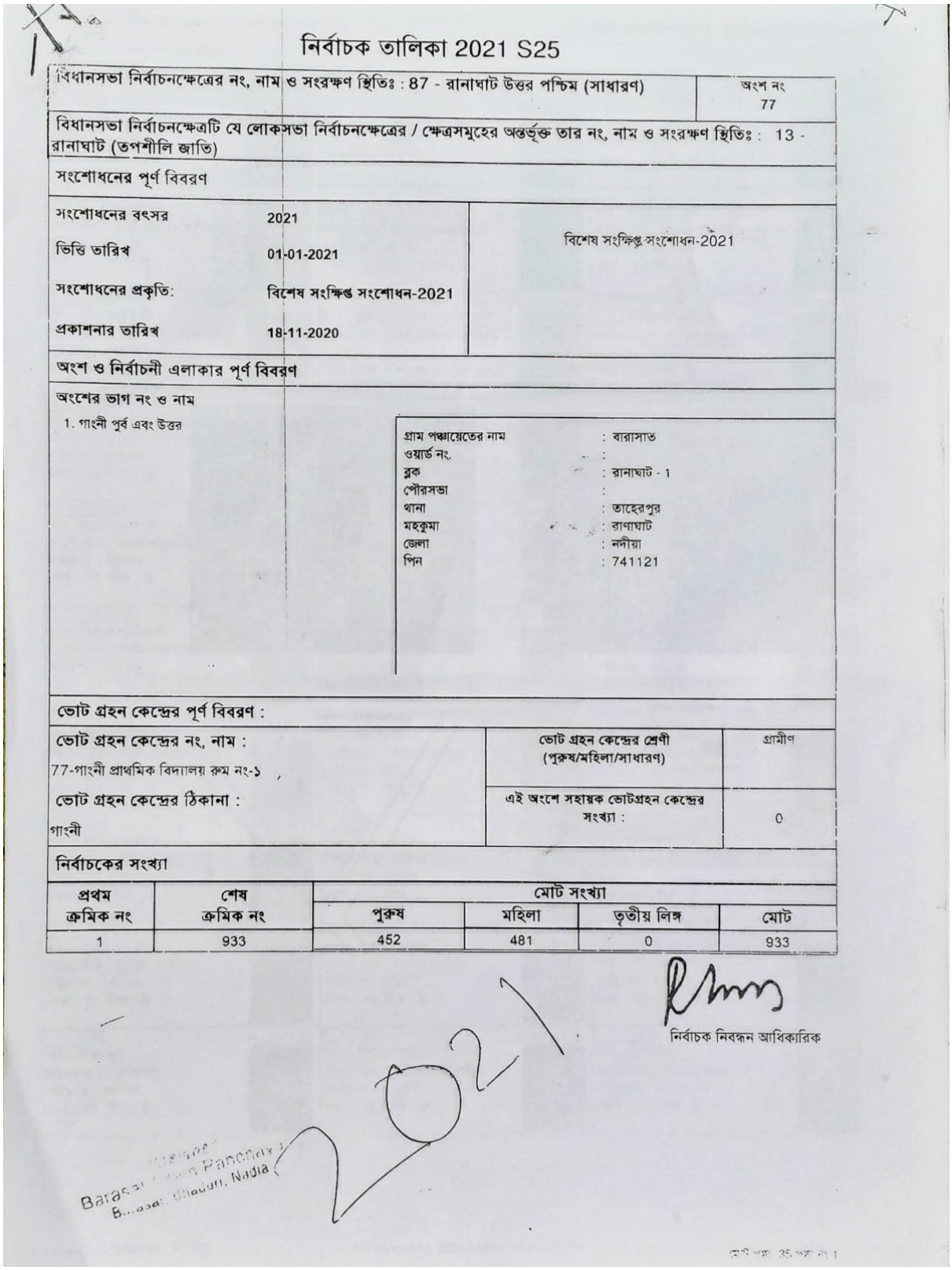
Survey started at 10.00 AM IST.

The research assistants are doing good job so far. Again, I have asked them to send me live location on Whattsapp for double checking of their progress. Also, I am constantly monitoring the results of responses in Google Form to understand if there are any discrepancies.





Annex 6: Sample of voter list



নির্বাচক তালিকা 2021 S25

বিধানসভা নির্বাচনক্ষেত্রের নং, নাম ও সংরক্ষণ স্থিতিঃ : 87 - রানাঘাট উত্তর পশ্চিম (সাধারণ) | অংশ নং 77

বিধানসভা নির্বাচনক্ষেত্রটি যে লোকসভা নির্বাচনক্ষেত্রের / ক্ষেত্রসমূহের অন্তর্ভূক্ত তার নং, নাম ও সংরক্ষণ স্থিতিঃ : 13 - রানাঘাট (তপশীলি জাতি)

সংশোধনের পূর্ণ বিবরণ

সংশোধনের বৎসর	2021
ভিত্তি তারিখ	01-01-2021
সংশোধনের প্রকৃতি:	বিশেষ সংক্ষিপ্ত সংশোধন-2021
প্রকাশনার তারিখ	18-11-2020

বিশেষ সংক্ষিপ্ত সংশোধন-2021

অংশ ও নির্বাচনী এলাকার পূর্ণ বিবরণ

অংশের ভাগ নং ও নাম

1. গাংনী পুর্ব এবং উত্তর

গ্রাম পঞ্চায়েতের নাম	: বারাসাত
ওয়ার্ড নং.	:
ব্লক	: রানাঘাট - 1
পৌরসভা	:
থানা	: তাহেরপুর
মহকুমা	: রাণাঘাট
জেলা	: নদীয়া
পিন	: 741121

ভোট গ্রহন কেন্দ্রের পূর্ণ বিবরণ :

ভোট গ্রহন কেন্দ্রের নং, নাম : 77-গাংনী প্রাথমিক বিদ্যালয় রুম নং-১	ভোট গ্রহন কেন্দ্রের শ্রেণী (পুরুষ/মহিলা/সাধারণ)	গ্রামীণ
ভোট গ্রহন কেন্দ্রের ঠিকানা : গাংনী	এই অংশে সহায়ক ভোটগ্রহন কেন্দ্রের সংখ্যা :	0

নির্বাচকের সংখ্যা

প্রথম ক্রমিক নং	শেষ ক্রমিক নং	মোট সংখ্যা			
		পুরুষ	মহিলা	তৃতীয় লিঙ্গ	মোট
1	933	452	481	0	933

নির্বাচক নিবন্ধন আধিকারিক

2021

Barasat ... Banerjee
B...sat, Dhauni, Nadia

বিধানসভা নির্বাচনক্ষেত্রের নং, নাম : 87-রানাঘাট উত্তর পশ্চিম

অংশ নং : 77

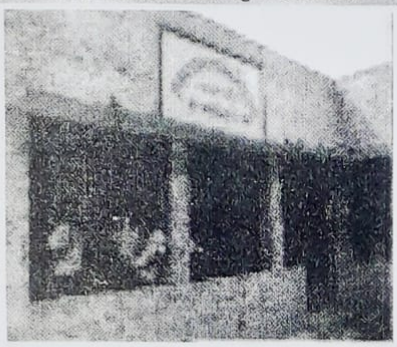
Nazri Naksha

Gangni Prathamick Vidyalaya -ROOM 1
AC_87 / Booth No – 77

Google Map View

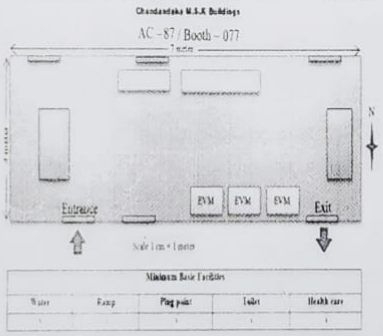
Chandandaha M.S.K Buildings
Room - 1
AC - 87 / Booth No - 077

Polling Station Building Front View

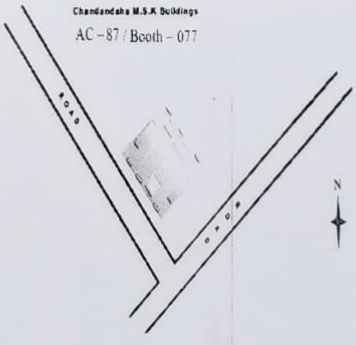


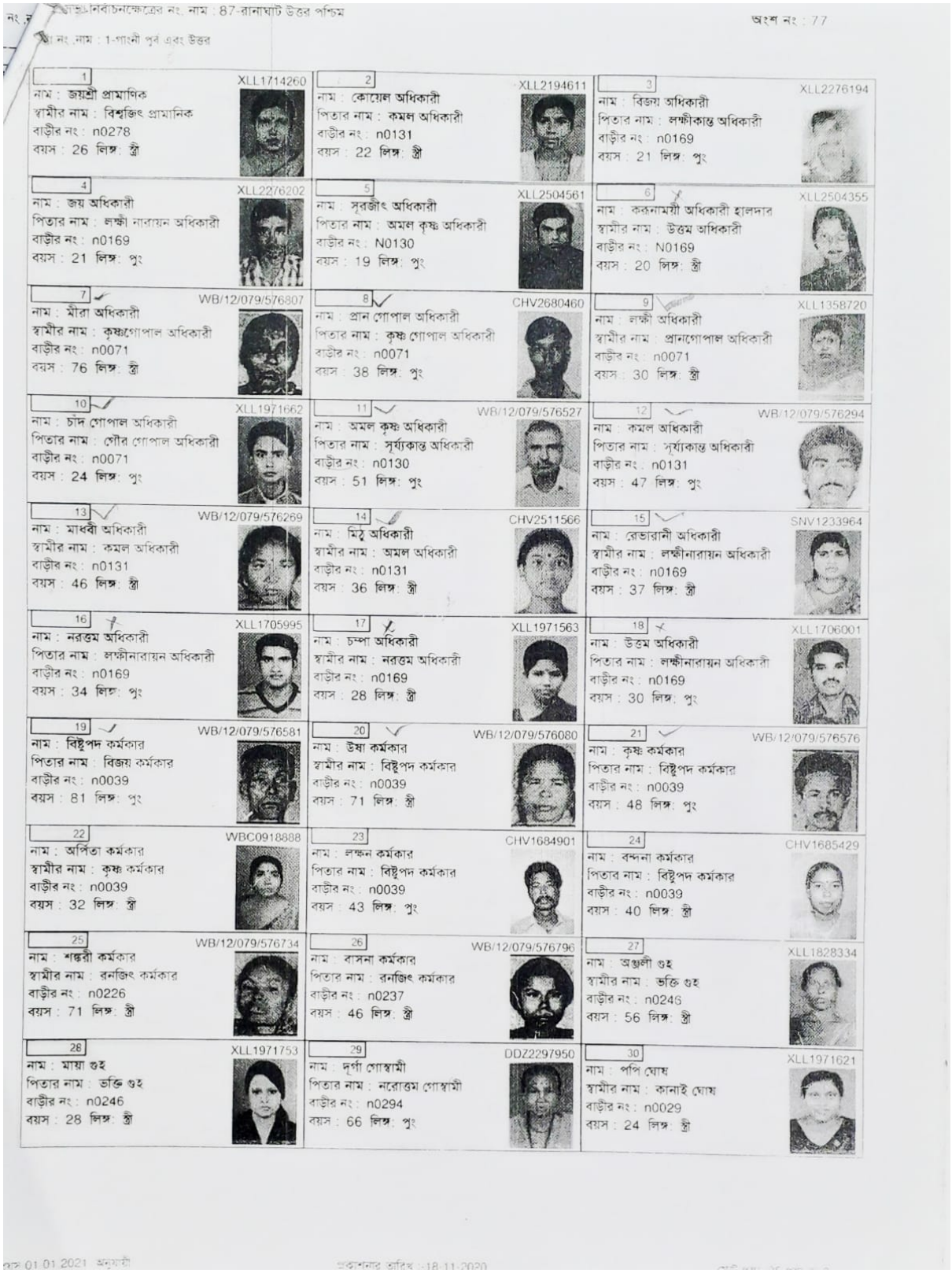
Polling Station Front View

CAD View



Key MAP View





নং : ... বিধানসভা নির্বাচনক্ষেত্রের নং, নাম : 87-রানাঘাট উত্তর পশ্চিম

অংশ নং : 77

... নং, নাম : 1-গাংনী পূর্ব এবং উত্তর

1 XLL1714260
নাম : জয়শ্রী প্রামাণিক
স্বামীর নাম : বিশ্বজিৎ প্রামানিক
বাড়ীর নং : n0278
বয়স : 26 লিঙ্গ: স্ত্রী

2 XLL2194611
নাম : কোয়েল অধিকারী
পিতার নাম : কমল অধিকারী
বাড়ীর নং : n0131
বয়স : 22 লিঙ্গ: স্ত্রী

3 XLL2276194
নাম : বিজয় অধিকারী
পিতার নাম : লক্ষীকান্ত অধিকারী
বাড়ীর নং : n0169
বয়স : 21 লিঙ্গ: পুং

4 XLL2276202
নাম : জয় অধিকারী
পিতার নাম : লক্ষী নারায়ন অধিকারী
বাড়ীর নং : n0169
বয়স : 21 লিঙ্গ: পুং

5 XLL2504561
নাম : সুরজীৎ অধিকারী
পিতার নাম : অমল কৃষ্ণ অধিকারী
বাড়ীর নং : N0130
বয়স : 19 লিঙ্গ: পুং

6 XLL2504355
নাম : ককনাময়ী অধিকারী হালদার
স্বামীর নাম : উত্তম অধিকারী
বাড়ীর নং : N0169
বয়স : 20 লিঙ্গ: স্ত্রী

7 WB/12/079/576807
নাম : মীরা অধিকারী
স্বামীর নাম : কৃষ্ণগোপাল অধিকারী
বাড়ীর নং : n0071
বয়স : 76 লিঙ্গ: স্ত্রী

8 CHV2680460
নাম : প্রান গোপাল অধিকারী
পিতার নাম : কৃষ্ণ গোপাল অধিকারী
বাড়ীর নং : n0071
বয়স : 38 লিঙ্গ: পুং

9 XLL1358720
নাম : লক্ষী অধিকারী
স্বামীর নাম : প্রানগোপাল অধিকারী
বাড়ীর নং : n0071
বয়স : 30 লিঙ্গ: স্ত্রী

10 XLL1971662
নাম : চাঁদ গোপাল অধিকারী
পিতার নাম : গৌর গোপাল অধিকারী
বাড়ীর নং : n0071
বয়স : 24 লিঙ্গ: পুং

11 WB/12/079/576527
নাম : অমল কৃষ্ণ অধিকারী
পিতার নাম : সূর্য্যকান্ত অধিকারী
বাড়ীর নং : n0130
বয়স : 51 লিঙ্গ: পুং

12 WB/12/079/576294
নাম : কমল অধিকারী
পিতার নাম : সূর্য্যকান্ত অধিকারী
বাড়ীর নং : n0131
বয়স : 47 লিঙ্গ: পুং

13 WB/12/079/576269
নাম : মাধবী অধিকারী
স্বামীর নাম : কমল অধিকারী
বাড়ীর নং : n0131
বয়স : 46 লিঙ্গ: স্ত্রী

14 CHV2511566
নাম : মিঠু অধিকারী
স্বামীর নাম : অমল অধিকারী
বাড়ীর নং : n0131
বয়স : 36 লিঙ্গ: স্ত্রী

15 SNV1233964
নাম : রেভারানী অধিকারী
স্বামীর নাম : লক্ষীনারায়ন অধিকারী
বাড়ীর নং : n0169
বয়স : 37 লিঙ্গ: স্ত্রী

16 XLL1705995
নাম : নরত্তম অধিকারী
পিতার নাম : লক্ষীনারায়ন অধিকারী
বাড়ীর নং : n0169
বয়স : 34 লিঙ্গ: পুং

17 XLL1971563
নাম : চম্পা অধিকারী
স্বামীর নাম : নরত্তম অধিকারী
বাড়ীর নং : n0169
বয়স : 28 লিঙ্গ: স্ত্রী

18 XLL1706001
নাম : উত্তম অধিকারী
পিতার নাম : লক্ষীনারায়ন অধিকারী
বাড়ীর নং : n0169
বয়স : 30 লিঙ্গ: পুং

19 WB/12/079/576581
নাম : বিষ্টুপদ কর্মকার
পিতার নাম : বিজয় কর্মকার
বাড়ীর নং : n0039
বয়স : 81 লিঙ্গ: পুং

20 WB/12/079/576080
নাম : উষা কর্মকার
স্বামীর নাম : বিষ্টুপদ কর্মকার
বাড়ীর নং : n0039
বয়স : 71 লিঙ্গ: স্ত্রী

21 WB/12/079/576576
নাম : কৃষ্ণ কর্মকার
পিতার নাম : বিষ্টুপদ কর্মকার
বাড়ীর নং : n0039
বয়স : 48 লিঙ্গ: পুং

22 WBC0918888
নাম : অর্পিতা কর্মকার
স্বামীর নাম : কৃষ্ণ কর্মকার
বাড়ীর নং : n0039
বয়স : 32 লিঙ্গ: স্ত্রী

23 CHV1684901
নাম : লক্ষন কর্মকার
পিতার নাম : বিষ্টুপদ কর্মকার
বাড়ীর নং : n0039
বয়স : 43 লিঙ্গ: পুং

24 CHV1685429
নাম : বন্দনা কর্মকার
পিতার নাম : বিষ্টুপদ কর্মকার
বাড়ীর নং : n0039
বয়স : 40 লিঙ্গ: স্ত্রী

25 WB/12/079/576734
নাম : শঙ্করী কর্মকার
স্বামীর নাম : রনজিৎ কর্মকার
বাড়ীর নং : n0226
বয়স : 71 লিঙ্গ: স্ত্রী

26 WB/12/079/576796
নাম : বাসনা কর্মকার
পিতার নাম : রনজিৎ কর্মকার
বাড়ীর নং : n0237
বয়স : 46 লিঙ্গ: স্ত্রী

27 XLL1828334
নাম : অঞ্জলী গুহ
স্বামীর নাম : ভক্তি গুহ
বাড়ীর নং : n0246
বয়স : 56 লিঙ্গ: স্ত্রী

28 XLL1971753
নাম : মায়া গুহ
পিতার নাম : ভক্তি গুহ
বাড়ীর নং : n0246
বয়স : 28 লিঙ্গ: স্ত্রী

29 DDZ2297950
নাম : দুর্গা গোস্বামী
পিতার নাম : নরোত্তম গোস্বামী
বাড়ীর নং : n0294
বয়স : 66 লিঙ্গ: পুং

30 XLL1971621
নাম : পপি ঘোষ
স্বামীর নাম : কানাই ঘোষ
বাড়ীর নং : n0029
বয়স : 24 লিঙ্গ: স্ত্রী

... 01.01.2021 অনুযায়ী ... তারিখ : 18.11.2020

বিধানসভা নির্বাচনক্ষেত্রের নং, নাম : 87-রানাঘাট উত্তর পশ্চিম

ভাগ নং, নাম : 1-পাংনী পুর এবং উত্তর

31 নাম : পূজা অধিকারী মাতার নাম : রাজলক্ষী অধিকারী বাড়ীর নং : n0026 বয়স : 23 লিঙ্গ: স্ত্রী XLL2077360 	32 নাম : পম্পা ঘোষ পিতার নাম : সমীর ঘোষ বাড়ীর নং : n0030 বয়স : 24 লিঙ্গ: স্ত্রী XLL2144426 	33 নাম : স্বপ্না ঘোষ পিতার নাম : গৌতম ঘোষ বাড়ীর নং : n0021 বয়স : 22 লিঙ্গ: স্ত্রী XLL2194637 
34 নাম : পদ্ম ঘোষ স্বামীর নাম : শম্ভু ঘোষ বাড়ীর নং : n0024 বয়স : 65 লিঙ্গ: স্ত্রী XLL2500403 	35 নাম : রাজলক্ষী অধিকারী (ঘোষ) স্বামীর নাম : রবীন্দ্র নাথ অধিকারী বাড়ীর নং : n0026 বয়স : 42 লিঙ্গ: স্ত্রী CHV2680536 	36 নাম : সঙ্ঘ ঘোষ পিতার নাম : সন্তোষ ঘোষ বাড়ীর নং : n0126 বয়স : 24 লিঙ্গ: পুং XLL2077220 
37 নাম : রিন্টু ঘোষ পিতার নাম : অসীম ঘোষ বাড়ীর নং : n0029 বয়স : 23 লিঙ্গ: পুং XLL2077295 	38 নাম : পাপিয়া ঘোষ স্বামীর নাম : বাপি ঘোষ বাড়ীর নং : n0143 বয়স : 25 লিঙ্গ: স্ত্রী XLL2077303 	39 নাম : সাথী ঘোষ স্বামীর নাম : সুখেন চন্দ্র ঘোষ বাড়ীর নং : n0143 বয়স : 24 লিঙ্গ: স্ত্রী XLL2077311 
40 নাম : বাপী ঘোষ পিতার নাম : গৌরগোপাল ঘোষ বাড়ীর নং : n0143 বয়স : 35 লিঙ্গ: পুং CHV2680593 	41 নাম : রাকেশ ঘোষ পিতার নাম : রবীন্দ্র নাথ ঘোষ বাড়ীর নং : এন0028 বয়স : 20 লিঙ্গ: পুং XLL2323434 	42 নাম : রিমি ঘোষ স্বামীর নাম : রাম চন্দ্র ঘোষ বাড়ীর নং : N0001 বয়স : 25 লিঙ্গ: স্ত্রী XLL2323210 
43 নাম : বিজয় ঘোষ পিতার নাম : অমল ঘোষ বাড়ীর নং : n0183 বয়স : 23 লিঙ্গ: পুং XLL2273662 	44 নাম : গোপাল ঘোষ পিতার নাম : কালাচাদ ঘোষ বাড়ীর নং : n0020 বয়স : 21 লিঙ্গ: পুং XLL2273613 	45 নাম : রুম্পা ঘোষ পিতার নাম : রবি ঘোষ বাড়ীর নং : n0034 বয়স : 21 লিঙ্গ: স্ত্রী XLL2276129 
46 নাম : অনিমা ঘোষ পিতার নাম : মানিক ঘোষ বাড়ীর নং : n0036 বয়স : 21 লিঙ্গ: স্ত্রী XLL2273712 	47 নাম : বিজন কুমার ঘোষ পিতার নাম : বীরেন্দ্র নাথ ঘোষ বাড়ীর নং : n0156 বয়স : 43 লিঙ্গ: পুং XLL2273605 	48 নাম : নিলিমা ঘোষ পিতার নাম : মানিক ঘোষ বাড়ীর নং : n0310 বয়স : 25 লিঙ্গ: স্ত্রী XLL2273704 
49 নাম : চাঁপা ঘোষ স্বামীর নাম : বিজন কুমার ঘোষ বাড়ীর নং : n0181 বয়স : 34 লিঙ্গ: স্ত্রী XLL1257005 	50 নাম : পুর্ণিমা ঘোষ পিতার নাম : মানিক ঘোষ বাড়ীর নং : এন0036 বয়স : 20 লিঙ্গ: স্ত্রী XLL2323384 	51 নাম : প্রদীপ ঘোষ পিতার নাম : শম্ভু ঘোষ বাড়ীর নং : n0024 বয়স : 32 লিঙ্গ: পুং CHV2973105 
52 নাম : শম্ভু ঘোষ পিতার নাম : সূর্য্যকান্ত ঘোষ বাড়ীর নং : n0024 বয়স : 72 লিঙ্গ: পুং XLL2500395 	53 নাম : অভিজিৎ ঘোষ পিতার নাম : শ্রীপদ ঘোষ বাড়ীর নং : . বয়স : 26 লিঙ্গ: পুং XLL1828599 	54 নাম : রবি ঘোষ মাতার নাম : বেলা ঘোষ বাড়ীর নং : n0174 বয়স : 32 লিঙ্গ: পুং XLL1460716 
55 নাম : মামনি ঘোষ স্বামীর নাম : রবি ঘোষ বাড়ীর নং : n0174 বয়স : 27 লিঙ্গ: স্ত্রী XLL1828276 	56 নাম : শেফালী ঘোষ স্বামীর নাম : কালাচাঁদ ঘোষ বাড়ীর নং : n0020 বয়স : 46 লিঙ্গ: স্ত্রী WB/12/079/576688 	57 নাম : সতীরানী ঘোষ স্বামীর নাম : কেষ্ট ঘোষ বাড়ীর নং : n0021 বয়স : 71 লিঙ্গ: স্ত্রী WB/12/079/576774 
58 নাম : গৌতম ঘোষ পিতার নাম : কেষ্ট ঘোষ বাড়ীর নং : n0021 বয়স : 44 লিঙ্গ: পুং CHV2426831 	59 নাম : ফুলকলী ঘোষ স্বামীর নাম : গৌতম ঘোষ বাড়ীর নং : n0021 বয়স : 36 লিঙ্গ: স্ত্রী CHV2973758 	60 নাম : স্বপনকুমার ঘোষ পিতার নাম : কেষ্ট ঘোষ বাড়ীর নং : n0021 বয়স : 33 লিঙ্গ: পুং CHV2973725 

Annex 7: Details of Ethics, Validity and Reliability

3.7.1 Ethics

The research tries to uphold the following ethics to protect the respondents, institutions, data and the researcher himself:

1. *Beneficence*: The research protects the anonymity and confidentiality of participants to avoid any prosecution via data anonymisation.
2. *Veracity*: The research disclosed the intent of the research to the respondents clearly from beginning.
3. *Privacy*: Before data collection, it was stressed that respondents can withheld any data if they feel uncomfortable.
4. *Confidentiality*: Before data collection, it is clearly indicated how the data will be used both to the respondents, issuing authorities and end users.
5. *Informed consent*: Before data collection, informed consent was seek from respondents to carry out the study and publish the results later.

3.7.2 Reliability and validity

1. *Triangulation*: To improve external validity, triangulation is used via i) several measurement instruments developed in the operationalization phase, b. data will be sourced from people, published documents and earlier studies to data sources and c. GIS analysis and document analysis will be done to cross-reference primary data.
2. *Distinguish sub-units*: To improve the low number of units associated with case study, careful approach will be taken to distinguish sub-units. Moreover, different methods will be compared to understand the exact nature of process tracing.
3. *Adequate operationalization for questionnaire*: The operationalization must be exhaustive. The questions used in questionnaire must be close to the operationalization. This is necessary to improve internal validity.
4. *Non-response*: Online questionnaire often met with non-response. Too much non-response can lead to non-representativeness of sample which will further fail to respect external validity. To avoid this problem, both door-to-door and online method will be used for data collection. Also, to arrange proper responses small complimentary lunch will be arranged for door-to-door respondents. This idea is derived from practical experience. For online respondents, a small lucky draw prize will be arranged. Finally, although only 100 respondents are needed for current study, 40% extra survey will be done to counter this problem.
5. *Clear guidelines for interview*: Interviews will be conducted using clear guidelines and in semi-structured manner. The questions will be formulated with close relationship with independent and dependent variables.
6. *Selection of respondents*: Respondents will be chosen carefully to represent all user groups. The number of the respondents will be kept high to increase internal validity.
7. *Updated database*: To improve low reliability, a database and logbook will be maintained to document all steps of the research. In addition, to increase internal validity, independent opinion of experts will be taken.
8. *Unbiased relationship*: The research will focus on good but unbiased (subjectively and selectively) to maintain good reliability (Van Thiel, 2014 p. 92, 100, 154).

Annex 8: Caste system in Bengal

Caste system is a form of rigid social stratification based on hereditary transmission of occupation-based identification of people practiced in India. It is one of the founding elements of Hindu religious system which often dictates a person's position in the society, social value, marriages, occupations, spatial location in urban/rural areas, social privileges and access to resources/ social benefits. Although, it is an explicit feature of Hindu religion, Muslims and other religions in India also practice this form of social stratification.

"The Hindu caste system consists of the Varna model (with Brahmin, Khastriya, Vaisya and Shudra as the four varnas, and below them Avanra or outcast) and of the innumerable localized jati, groups who are supposed to have a specific rank in one of the varnas. Jatis are ascriptive endogamous status groups. They are hierarchically ranked, ideally according to religiously sanctioned beliefs in ritual/ racial purity and pollution, and are by and large associated with the specific occupation, at least in earlier times. The varna identity and the rank vis-à-vis other jatis of the same varna is often not clear. Caste, as M. Srinivas (1962) has put it, has always been 'an ongoing system', incorporating the economic changes within its stratification." (Lieten, 1992)

The Varna structure in Bengal look like the social structure of South India. It consists of Brahmin, , Khastriya, Vaisya and a large body of Shudra and *Osprishyo* (untouchable) caste. It is said that Brahmins (priests) were invited by the Pal Kings (8^{th}-11^{th} Century) from Kannauj to perform Hindu revitalization. These priests/ religious scholars were settled by Kings in villages in the Rarhi region of Bengal. The descendants of these original Brahmins are Bondopadhyays, Chottopadhyays, Ghosals, and Gongopdhyays. Supposedly, other Brahmins followed them, probably during the Sen dynasty and settled in the then frontier Barendro region. They are Bhaduris, Lahiris, Sanyals, Moitros etc. Since those days, these Brahmins have formed the cream of the society or *bhadrolok* (gentlemen). Later, all these Brahmins migrated to Nobodwip and Bhatpara and continued to practice religious discourse. In order to the keep their genealogy pure, they practiced *Kulin protha* and have relegated the other people originating from different lineage. They have imposed strict religious sanctions on other castes and kept the social benefits and privileges for themselves.

After the Brahmins, *Kayasthas* holds the second rank in terms genealogical purity. They have unique position in Hindu caste system, as they do not belong to the four varnas, yet they enjoy high ranking. Originally working as accountants or important government officials, the Kayasthas (Mitra, Sen, Dutta and so on) continue to occupy a high social position just below the brahmins. They are the *sat* (clean) castes.

The social rank of Khastriyas (warriors) in West Bengal is different than other provinces. Here, Khastriyas are ranked below Brahmins and Kayasthas. They are equated with the Vaishyas (traders) or even lower strata, whereas in other provinces they occupy higher status. It is said that Khastriyas came to West Bengal from Agra with Suja, brother of Shahjahan. They also settled in the Rarhi region. The descendants of these warriors are Roy, Chowdhury, Samanta, Roy Chowdhury, Mondal, Hazra, Mallick, Singha, Singha Roy, Daa, Panja, Shome, Rudra, Paul, Barman etc.

The traditional traders or Vaidhyas are deemed to have lower level of genealogical purity and cleaniness. Originally, they were nine types or *nobo-shakha* trading and artisan castes: the higher raking Sadgop (agriculturists) and Tambuli (traders), and the lower ranking Napit (barbers), Karmakar (blacksmith), Goalas (milkmen), and so on. Now there are fourteen types present.

The lowest ranking castes are *osat* castes. Traditionally, these people used to be hunters, bonded labours, undertakers, sweepers, cleaners etc. Because of their nature of jobs, they are deemed untouchables or *osprishyo*. They are (Namashudra, Bagdi, Pod, Dom, Dule, Bauri) are the descendants of the indigenous Dravidian people of Bengal who, according to N.K. Dutta (1969), 'were gradually Arvanised'.

Apart from the above-mentioned castes, there are other castes in West Bengal like Nath, Motua etc. Naths are believed to have Buddhist origin. Although they are proclaimed as Brahmin, because of their traditional occupation of fisherman and weaver, they are attributed to lower caste. Similarly, Motuas (originally *osprishyo* boatmen, fishermen) formed their own group for upward social mobility. Relegated by others, now they have formed separate identity outside the traditional four varnas (Biswas, M., 2018). Similarly, other indigenous groups of Santals, Lodhas and Mundas retained their tribal identity.

The British administrators codified caste formally in 1935 by Order of "Scheduled Caste". No valid definition was given about Scheduled Caste and only some jatis are included. It is understood that these jatis are socio-economically very poor, who have historically faced extreme social discrimination and oppression in India on account of their perceived 'low status' in terms of racial purity as compared to upper castes and do not have access to any social benefits. After India got independence, the same codification was retained and expanded. Constitution of India also does not give any proper definition or criterion of Caste, yet attributes various jatis (identified by surname) to Other Backward Class (OBC) and Scheduled Caste (SC) and Scheduled Tribe (ST). Thus, the customary caste system is overlapped with the formal caste system. Today, both aspects are used to identify social position of a person. It is said that the Government of India acknowledges the need of these socio-economically very poor and large segment of society. Thus, to devise access to basic social services and give them upward economic mobility, all traditional varnas and jatis are re-casted into General, OBC, SC and ST. However, this view is highly contested among scholars and common people alike. One section favours this stratification by saying that indeed this reservation of caste is required to boost the economic conditions of otherwise unprivileged segment of society while others argue for a merit-based system over reservation-based system. Today, caste has become an important factor in election and power in politics. It is also an important criterion for accessing government jobs, subsidized ration and other subsidized necessities like housing and health services.

Another important aspect of Constitution of India is the four varnas are restricted to Hindu religion. Buddhist and Sikh religion belong to Scheduled Caste as per Constitution and Muslims are majorly excluded from OBC, SC and ST. These rules are followed everywhere in the union territory of India including West Bengal.

Annex 9: SPSS Codebook

Variable	Label	Measurement Level	Valuesl
NAME	Respondent's name	Nominal	N.A.
ADD	Name of area	Nominal	1= Patuli West 2= Ballavpur Telultola 3= Patuli 4= Ballavpur 5= Badkulla 6= Gangni East 7= Dharmadaha West 8= Dharmadaha East 9= Chandandaha 10= Mugrail 11= Vyaspur 12= Krishnanagar Arshipara 13= Krishnanagar Manindarpalli
LOCATION	Rural— peri-urban—urban	Nominal	1= Rural 2= Peri-urban 3= Urban
AGE	Age of respondents	Nominal	1= 0-20 2= 20-30 3= 30-40 4= 40-50
SEX	Sex of respondents	Nominal	1= Male 2= Female
CAST	Caste of respondents	Nominal	1= General 2= OBC 3= Schedule cast 4= Schedule tribe

INCM	Monthly Income	Ordinal	1= 0-5000 2= 5001-10000 3= 10001-20000 4= 20001-30000 5= 30001-50000
C_OCCU	Current occupation	Nominal	1= Fishmonger 2= Fisherman 3= Farmer with land 4= Farmer without land 5= Agricultural labour 6= Small Business 7= Animal husbandry 8= Weaver 9= Daily labour 10= Govt. employee 11= Expat 12= Private tutor 13= Student 14= Retired 15= Unemployed

P_OCCU	Previous occupation	Nominal	1= Fishmonger2= Fisherman3= Farmer with land4= Farmer without land5= Agricultural labour6= Small Business7= Animal husbandry8= Weaver9= Daily labour10= Govt. employee11= Expat12= Private tutor13= Student14= Retired15= Unemployed
CH_OCCU	Time of change	Ordinal	1= 1 to 3 years 2= 3 to 5 years 3= 5 to 8 years 4= 8 to 10 years 5= 10 to 15 years 6= 15 years and above 7= N.A.
I_MON_L1	whether change in floodplain is monitored	Nominal	1= Very little 2= Little 3= Medium 4= High 5= Very high

I_MON_L2	Actor	Nominal	1= State government 2= Local government 3= Business cooperatives 4= NGO 5= Environmentalists 6= Others 7= Does not happen
I_MON_L3	Frequency of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_L4	Mode of monitoring	Ordinal	1= Written 2= Oral 3= Not applicable
I_MON_L5	Ease of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_L6	Cost effectiveness of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_L7	Overall level of monitoring	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
I_MON_W1	whether change in waterflow is monitored	Nominal	1= Very little 2= Little 3= Medium 4= High 5= Very high

I_MON_W2	Actor	Nominal	1= State government 2= Local government 3= Business cooperatives 4= NGO 5= Environmentalists 6= Others 7= Does not happen
I_MON_W3	Frequency of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_W4	Mode of monitoring	Ordinal	1= Written 2= Oral 3= Not applicable
I_MON_W5	Easiness of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_W6	Cost effectiveness of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_W7	Overall level of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_F1	whether change in fish is monitored	Nominal	1= Very little 2= Little 3= Medium 4= High 5= Very high

I_MON_F2	Actor	Nominal	1= State government 2= Local government 3= Business cooperatives 4= NGO 5= Environmentalists 6= Others 7= Does not happen
I_MON_F3	Frequency of monitoring	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
I_MON_F4	Mode of monitoring	Ordinal	1= Written 2= Oral 3= Not applicable
I_MON_F5	Easiness of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_F6	Cost effectiveness of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_MON_F7	Overall level of monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_L1	% Of change in area floodplain	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

I_ROC_L2	% Of change in encroachment of floodplain	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_L3	% Of change in land use of floodplain	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_L4	% Of change in garbage dumping	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_W1	% Of change in waterflow	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_W2	% Of change in using riverbed for economic purposes	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
I_ROC_W3	% Of change in water lifting from river	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_W4	% Of change in width of river	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_W5	% Of change in depth of river	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

I_ROC_W6	% Of change in amount of extraction of water	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_F1	% Of change in availability of fish in river	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_F2	% Of change in species of fish in river	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_F3	% Of change in population, male, female, primary, tertiary, income, occupation	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_D1	% Of change in population dependent on river	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_D2	% Of change in occupation which are dependent on river	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_ROC_D3	% Of change in exploitation technology regarding river	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
I_SC_1	% Of change in trust over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

I_SC_2	% Of change in reciprocity over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_SC_3	% Of change in capacity of groups over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_SC_4	Presence of knowledge sharing	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_SC_5	% Of change in level of engagement of groups over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_SC_6	Presence of inter group connection	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_SC_7	% Of awareness of the issue in group	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_SC_8	% Of change in effective leadership of groups over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_PO_1	% Of change in income per group	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

I_PO_2	% Of change in level of outsider engagement	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
I_PO_3	% Of change in level of physical monitoring by user groups	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_PO_4	Actor	Nominal	1= State government 2= Local government 3= Business cooperatives 4= NGO 5= Environmentalists 6= Others 7= Does not happen
I_US_1	% Of change in level of technical support by user groups	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_US_2	% Of change in level of financial support by user groups	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_US_3	% Of change in level of capacity building by user groups	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
I_US_4	% Of change in level of public engagement	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

D_PRI_1	Availability of information about stock of resources among user group	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PRI_2	Condition of flow of information about stock of resources among user group	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PRI_3	Condition of flow of information about stock of resources among horizontal institutions	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
D_PRI_4	Condition of flow of information about stock of resources among vertical institutions	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PRI_5	Transparency about process of governance	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PRI_6	Congruency of the information regarding environmental governance	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_CR_1	Presence of number of existing legal disputes	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_CR_2	Level of synergy between communities and local government	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

D_CR_3	Level of informal conflict resolution	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PP_1	% Of change in level of non-participation over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PP_2	% Of change in level of Therapy over time	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
D_PP_3	% Of change in level of Informing over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PP_4	% Of change in level of Consultation over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PP_5	% Of change in level of Placation over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PP_6	% Of change in level of Partnership over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_PP_7	% Of change in level of Delegated power over time	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

D_RUC_1	Awareness of existing rules	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_RUC_2	Eagerness level of rule formation	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_RUC_3	Eagerness level of rule enforcement	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_RUC_4	Eagerness level of rule compliance	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_RUC_5	Eagerness to accept sanction	Ordinal	1= Very little2= Little3= Medium4= High5= Very high
D_INFRA_1	Presence of resource exploitation technology	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_INFRA_2	Presence of communication technology for monitoring	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_INFRA_3	Presence of physical infrastructure for monitoring including legal	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

D_INFRA_4	Presence of research infrastructure for governance	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_ADA_1	Preparedness for flood, waterlogging, encroachment, and availability of fish	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_ADA_2	Preparedness for change in new user population	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_ADA_3	Preparedness for new law, regulations, and govt. action	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high
D_ADA_4	Preparedness for new livelihood, protection of old livelihood	Ordinal	1= Very little 2= Little 3= Medium 4= High 5= Very high

Annex 10: Atlas ti Codebook

ATLAS.ti Report

IHS_Thesis_Sankha_2

Codes (selection)

Report created by Sankha Subhra Nath on 15-Nov-2021

- **D: D1: Providing information**

Linked Codes:

- ← is a - D:I:INFO1: AVAILABILITY_HIGH
- ← is a - D:I:INFO2: AVAILABILITY_LOW
- ← is a - D:I:INFO3: FLOW_HIGH
- ← is a - D:I:INFO4: FLOW_LOW
- ← is a - D:I:INFO6: VERTICAL GOVERNANCE_LOW
- ← is a - D:I:INFO7: HORIZONTAL GOVERNANCE_HIGH
- ← is a - D:I:INFO8: HORIZONTAL GOVERNANCE_LOW
- ← is a - D:I:INFO9: INSTITUTIONAL GOVERNANCE_HIGH
- ← is a - D:I:NFO5: VERTICAL GOVERNANCE_HIGH
- ← is a - D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
- ← is a - D:INFO11: FINANCIAL GOVERNANCE_HIGH
- ← is a - D:INFO12: FINANCIAL GOVERNANCE_LOW

- **D: D2: Conflict resolution**

Linked Codes:

- ← is a - D:I: RESO1: LEGAL DISPUTES_HIGH
- ← is a - D:I: RESO2: LEGAL DISPUTES_LOW
- ← is a - D:I: RESO3: FORMAL RESOLUTION_HIGH
- ← is a - D:I: RESO4: FORMAL RESOLUTION_LOW
- ← is a - D:I: RESO5: INFORMAL RESOLUTION_HIGH
- ← is a - D:I: RESO6: INFORMAL RESOLUTION_LOW
- ← is associated with - F: DESCRIPTION OF CONFLICT

- **D: D3: Rule compliance**

  Linked Codes:
  - ← is a - D:I: RULE1: AWARENESS LEVEL_HIGH
  - ← is a - D:I: RULE2: AWARENESS LEVEL_LOW
  - ← is a - D:I: RULE3: COMPLIANCE_HIGH
  - ← is a - D:I: RULE4: COMPLIANCE_LOW
  - ← is a - D:I: RULE5: ENFORCEMENT_HIGH
  - ← is a - D:I: RULE6: ENFORCEMENT_LOW

- **D: D4: Public participation**

  Linked Codes:
  - ← is a - D:I: PARTI1: NON PARTICIPATION
  - ← is a - D:I: PARTI2: THERAPY
  - ← is a - D:I: PARTI3: INFORMING
  - ← is a - D:I: PARTI4: CONSULTATION
  - ← is a - D:I: PARTI5: PLACATION
  - ← is a - D:I: PARTI6: PARTNERSHIP
  - - is associated with → F: DESCRIPTION OF PUBLIC PARTICIAPTION
  - ← is associated with - F: POLITICAL WILL

- **D: D5: Infrastructure**

  Linked Codes:
  - ← is a - D:I: INFRA1: PHYSICAL_HIGH
  - ← is a - D:I: INFRA2: PHYSICAL_LOW
  - ← is a - D:I: INFRA3: RESEARCH_HIGH
  - ← is a - D:I: INFRA4: RESEARCH_LOW

- **D: D6: Adaptability**

  Linked Codes:
  - ← is a - D:I: ADAP1: LIVELIHOOD CHANGE_HIGH
  - ← is a - D:I: ADAP2: LIVELIHOOD CHANGE_LOW
  - ← is a - D:I: ADAP3: ADAPTABILITY_HIGH
  - ← is a - D:I: ADAP4: ADAPTABILITY_LOW
  - ← is a - D:I: ADAP5: PREPAREDNESS_HIGH
  - ← is a - D:I: ADAP5: PREPAREDNESS_LOW

- **D:I: ADAP1: LIVELIHOOD CHANGE_HIGH**

  Linked Codes:
  - is a → D: D6: Adaptability
  - is associated with → D:I: PARTI1: NON PARTICIPATION
  ← is cause of - D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
  ← is cause of - I:C3: CHANGE IN FISH

- **D:I: ADAP2: LIVELIHOOD CHANGE_LOW**

  Linked Codes:
  - is a → D: D6: Adaptability

- **D:I: ADAP3: ADAPTABILITY_HIGH**

  Linked Codes:
  - is a → D: D6: Adaptability

- **D:I: ADAP4: ADAPTABILITY_LOW**

  Linked Codes:
  - is a → D: D6: Adaptability
  ← is associated with - D:I: ADAP5: PREPAREDNESS_LOW
  ← is cause of - I:USR2: PHYSICAL SUPPORT_LOW

- **D:I: ADAP5: PREPAREDNESS_HIGH**

  Linked Codes:
  - is a → D: D6: Adaptability

- **D:I: ADAP5: PREPAREDNESS_LOW**

  Linked Codes:
  - is a → D: D6: Adaptability
  - is associated with → D:I: ADAP4: ADAPTABILITY_LOW
  ← is associated with - F: DESCRIPTION OF SHOCK/FLOOD
  ← is cause of - I:SC8: AWARENESS_DECREASE

- **D:I: INFRA1: PHYSICAL_HIGH**

  Linked Codes:
  - is a → D: D5: Infrastructure

- **D:I: INFRA2: PHYSICAL_LOW**

  Linked Codes:
  - is a → D: D5: Infrastructure
  ← is cause of - D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
  - is associated with → F: DESCRIPTION OF CHANGE
  ← is associated with - I:C2: CHANGE IN WATER/ LEVEL/ WIDTH
  ← is associated with - I:OUT1: EXCLUDABLE_LOW

- **D:I: INFRA3: RESEARCH_HIGH**

  Linked Codes:
  - is a → D: D5: Infrastructure

- **D:I: INFRA4: RESEARCH_LOW**

  Linked Codes:
  - is a → D: D5: Infrastructure

- **D:I: PARTI1: NON PARTICIPATION**

  Linked Codes:
  - is a → D: D4: Public participation
  ← is associated with - D:I: ADAP1: LIVELIHOOD CHANGE_HIGH
  ← is cause of - D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
  ← is cause of - I:OUT6: POSITIVE ENGAGEMENT_LOW
  ← is cause of - I:SC1: TRUST_INCREASE

- **D:I: PARTI2: THERAPY**

  Linked Codes:
  - is a → D: D4: Public participation
  ← is cause of - I:OUT6: POSITIVE ENGAGEMENT_LOW

- **D:I: PARTI3: INFORMING**

  Linked Codes:
  - is a → D: D4: Public participation

- **D:I: PARTI4: CONSULTATION**

  Linked Codes:
  - is a → D: D4: Public participation
  ← is associated with - F: DESCRIPTION OF PUBLIC PARTICIAPTION
  ← is cause of - I:SC5: ENGAGEMENT_INCREASE
  ← is cause of - I:SC7: AWARENESS_INCREASE

- **D:I: PARTI5: PLACATION**

  Linked Codes:
  - is a → D: D4: Public participation

- **D:I: PARTI6: PARTNERSHIP**

  Linked Codes:
  - is a → D: D4: Public participation
  ← is associated with - I:SC3: CAPACITY_INCREASE

- **D:I: RESO1: LEGAL DISPUTES_HIGH**

  Linked Codes:
  - is a → D: D2: Conflict resolution
  ← is cause of - D:I: RESO4: FORMAL RESOLUTION_LOW
  ← is associated with - F: DESCRIPTION OF CONFLICT
  - is cause of → I:C5: CHANGE_EXTREME
  ← is associated with - I:M1: MONITORING OF FLOODPLAIN

- **D:I: RESO2: LEGAL DISPUTES_LOW**

  Linked Codes:
  - is a → D: D2: Conflict resolution

- **D:I: RESO3: FORMAL RESOLUTION_HIGH**

  Linked Codes:
  - is a → D: D2: Conflict resolution

- **D:I: RESO4: FORMAL RESOLUTION_LOW**

  Linked Codes:
  - is a → D: D2: Conflict resolution
  - is cause of → D:I: RESO1: LEGAL DISPUTES_HIGH

- **D:I: RESO5: INFORMAL RESOLUTION_HIGH**

  Linked Codes:
  - is a → D: D2: Conflict resolution

- **D:I: RESO6: INFORMAL RESOLUTION_LOW**

  Linked Codes:
  - is a → D: D2: Conflict resolution
  - is cause of → I:C3: CHANGE IN FISH

- **D:I: RULE1: AWARENESS LEVEL_HIGH**

  Linked Codes:
  - is a → D: D3: Rule compliance
  - contradicts → D:I: RULE4: COMPLIANCE_LOW

- **D:I: RULE2: AWARENESS LEVEL_LOW**

  Linked Codes:
  - is a → D: D3: Rule compliance

- **D:I: RULE3: COMPLIANCE_HIGH**

  Linked Codes:
  - is a → D: D3: Rule compliance

- **D:I: RULE4: COMPLIANCE_LOW**

  Linked Codes:
  - is a → D: D3: Rule compliance
  ← contradicts - D:I: RULE1: AWARENESS LEVEL_HIGH
  - is associated with → D:I:INFO8: HORIZONTAL GOVERNANCE_LOW
  ← is cause of - F: OVERPOLITICISATION
  - is cause of → I:C3: CHANGE IN FISH
  - is cause of → I:C5: CHANGE_EXTREME
  - is cause of → I:USR1: PHYSICAL SUPPORT_HIGH

- **D:I: RULE5: ENFORCEMENT_HIGH**

  Linked Codes:
  - is a → D: D3: Rule compliance

- **D:I: RULE6: ENFORCEMENT_LOW**

  Linked Codes:
  - is a → D: D3: Rule compliance
  ← is associated with - F: DESCRIPTION OF RULE BREAKING
  ← is cause of - F: OVERPOLITICISATION

- **D:I:INFO1: AVAILABILITY_HIGH**

  Linked Codes:
  - is a → D: D1: Providing information
  ← is associated with - I:M5: MONITORING BY NGO/CBO/CBI

- **D:I:INFO2: AVAILABILITY_LOW**

  Linked Codes:
  - is a → D: D1: Providing information

- **D:I:INFO3: FLOW_HIGH**

  Linked Codes:
  - is a → D: D1: Providing information

- **D:I:INFO4: FLOW_LOW**

  Linked Codes:
  - is a → D: D1: Providing information

- **D:I:INFO6: VERTICAL GOVERNANCE_LOW**

  Linked Codes:
  - is a → D: D1: Providing information

- **D:I:INFO7: HORIZONTAL GOVERNANCE_HIGH**

  Linked Codes:
  - is a → D: D1: Providing information

- **D:I:INFO8: HORIZONTAL GOVERNANCE_LOW**

  Linked Codes:
  - is a → D: D1: Providing information
  - ← is associated with - D:I: RULE4: COMPLIANCE_LOW
  - is cause of → I:C3: CHANGE IN FISH
  - is cause of → I:C5: CHANGE_EXTREME

- **D:I:INFO9: INSTITUTIONAL GOVERNANCE_HIGH**

  Linked Codes:
  - is a → D: D1: Providing information
  - ← is associated with - D:I:NFO5: VERTICAL GOVERNANCE_HIGH
  - ← is property of - I:OUT1: EXCLUDABLE_LOW

- **D:I:NFO5: VERTICAL GOVERNANCE_HIGH**

  Linked Codes:
  - is a → D: D1: Providing information
  - is associated with → D:I:INFO9: INSTITUTIONAL GOVERNANCE_HIGH
  - ← contradicts - D:INFO12: FINANCIAL GOVERNANCE_LOW
  - ← is associated with - I:M5: MONITORING BY NGO/CBO/CBI
  - ← is associated with - I:M7: MONITORING_ORAL
  - ← is associated with - I:M9: MONITORING LEVEL_GOOD
  - ← is property of - I:OUT1: EXCLUDABLE_LOW

• D:INFO10: INSTITUTIONAL GOVERNANCE_LOW

Linked Codes:

- is a → • D: D1: Providing information
- is cause of → • D:I: ADAP1: LIVELIHOOD CHANGE_HIGH
- is cause of → • D:I: INFRA2: PHYSICAL_LOW
- is cause of → • D:I: PARTI1: NON PARTICIPATION
- is associated with → • F: DESTRUCTION OF SELF SUSTAINING ECONOMY
- ← is cause of - • F: OVERPOLITICISATION
- is cause of → • I:C3: CHANGE IN FISH
- is cause of → • I:C5: CHANGE_EXTREME
- ← is cause of - • I:OUT6: POSITIVE ENGAGEMENT_LOW
- is cause of → • I:SC2: TRUST_DECREASE
- is cause of → • I:USR1: PHYSICAL SUPPORT_HIGH

• D:INFO11: FINANCIAL GOVERNANCE_HIGH

Linked Codes:

- is a → • D: D1: Providing information

• D:INFO12: FINANCIAL GOVERNANCE_LOW

Linked Codes:

- is a → • D: D1: Providing information
- contradicts → • D:I:NFO5: VERTICAL GOVERNANCE_HIGH

• F: DESCRIPTION OF CHANGE

Linked Codes:

- ← is associated with - • D:I: INFRA2: PHYSICAL_LOW
- ← is associated with - • F: DESCRIPTION OF MONITORING
- is associated with → • I: D2: Change in resources
- ← is property of - • I:C3: CHANGE IN FISH

• F: DESCRIPTION OF CONFLICT

Linked Codes:

- is associated with → • D: D2: Conflict resolution
- is associated with → • D:I: RESO1: LEGAL DISPUTES_HIGH

F: DESCRIPTION OF MONITORING

Linked Codes:

- is associated with → F: DESCRIPTION OF CHANGE
- ← is property of - I:USR1: PHYSICAL SUPPORT_HIGH

F: DESCRIPTION OF PUBLIC PARTICIAPTION

Linked Codes:

- ← is associated with - D: D4: Public participation
- is associated with → D:I: PARTI4: CONSULTATION
- ← is associated with - I: D3: Social capital
- ← is associated with - I:SC5: ENGAGEMENT_INCREASE
- ← is associated with - I:SC7: AWARENESS_INCREASE

F: DESCRIPTION OF RULE BREAKING

Linked Codes:

- is associated with → D:I: RULE6: ENFORCEMENT_LOW

F: DESCRIPTION OF SHOCK/FLOOD

Linked Codes:

- is associated with → D:I: ADAP5: PREPAREDNESS_LOW

F: DESTRUCTION OF SELF SUSTAINING ECONOMY

Linked Codes:

- ← is associated with - D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
- ← is cause of - I:C5: CHANGE_EXTREME

F: OVERPOLITICISATION

Linked Codes:

- is cause of → D:I: RULE4: COMPLIANCE_LOW
- is cause of → D:I: RULE6: ENFORCEMENT_LOW
- is cause of → D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
- is cause of → I:C5: CHANGE_EXTREME

- **F: POLITICAL WILL**

  Linked Codes:
  - is associated with → D: D4: Public participation
  - is cause of → I:SC5: ENGAGEMENT_INCREASE

- **F: TIMELINE 1950-60**

- **F: TIMELINE 1960-70**

- **F: TIMELINE 1970-80**

- **F: TIMELINE 1980-90**

- **F: TIMELINE 1990-2000**

- **F: TIMELINE 2000-10**

- **F: TIMELINE 2010-15**

- **F: TIMELINE 2015-20**

● I: D1: Monitoring of resources

Linked Codes:

← is a - ● I:M1: MONITORING OF FLOODPLAIN
← is a - ● I:M2: MONITORING OF WATER
← is a - ● I:M3: MONITORING OF FISH
← is a - ● I:M4: MONITORING BY GOVT.
← is a - ● I:M5: MONITORING BY NGO/CBO/CBI
← is a - ● I:M6: MONITORING BY PEOPLE
← is a - ● I:M7: MONITORING_ORAL
← is a - ● I:M8: MONITORING_WRITTEN
← is a - ● I:M9: MONITORING LEVEL_GOOD
← is a - ● I:M10: MONITORING LEVEL_BAD
← is a - ● I:M10: MONITORING LEVEL_MODERATE

● I: D2: Change in resources

Linked Codes:

← is associated with - ● F: DESCRIPTION OF CHANGE
← is a - ● I:C1: CHANGE IN LAND/ ENCROACHMENT
← is a - ● I:C2: CHANGE IN WATER/ LEVEL/ WIDTH
← is a - ● I:C3: CHANGE IN FISH
← is a - ● I:C4: CHANGE IN LIVELIHOOD
← is a - ● I:C5: CHANGE_EXTREME
← is a - ● I:C6: CHANGE_MODERATE
← is a - ● I:C7: CHANGE_LOW

● I: D3: Social capital

Linked Codes:

- is associated with → ● F: DESCRIPTION OF PUBLIC PARTICIAPTION
← is a - ● I:SC1: TRUST_INCREASE
← is a - ● I:SC2: TRUST_DECREASE
← is a - ● I:SC3: CAPACITY_INCREASE
← is a - ● I:SC4: CAPACITY_DECREASE
← is a - ● I:SC5: ENGAGEMENT_INCREASE
← is a - ● I:SC6: ENGAGEMENT_DECREASE
← is a - ● I:SC7: AWARENESS_INCREASE
← is a - ● I:SC8: AWARENESS_DECREASE

● I: D4: Presence of outsiders

Linked Codes:

← is a - ● I:OUT1: EXCLUDABLE_LOW
← is a - ● I:OUT2: EXCLUDABLE_MODERATE
← is a - ● I:OUT3: EXCLUDABLE_HIGH
← is a - ● I:OUT4: POSITIVE ENGAGEMENT_HIGH
← is a - ● I:OUT5: POSITIVE ENGAGEMENT_MODERATE
← is a - ● I:OUT6: POSITIVE ENGAGEMENT_LOW

● I: D5: User support

Linked Codes:

← is a - ● I:USR1: PHYSICAL SUPPORT_HIGH
← is a - ● I:USR2: PHYSICAL SUPPORT_LOW
← is a - ● I:USR3: TECH SUPPORT_HIGH
← is a - ● I:USR4: TECH SUPPORT_LOW
← is a - ● I:USR5: FINANCIAL SUPPORT_HIGH
← is a - ● I:USR6: FINANCIAL SUPPORT_LOW

● I:C1: CHANGE IN LAND/ ENCROACHMENT

Linked Codes:

- is a → ● I: D2: Change in resources
← is cause of - ● I:C2: CHANGE IN WATER/ LEVEL/ WIDTH

● I:C2: CHANGE IN WATER/ LEVEL/ WIDTH

Linked Codes:

- is associated with → ● D:I: INFRA2: PHYSICAL_LOW
- is a → ● I: D2: Change in resources
- is cause of → ● I:C1: CHANGE IN LAND/ ENCROACHMENT
- is cause of → ● I:C3: CHANGE IN FISH
- is cause of → ● I:C4: CHANGE IN LIVELIHOOD

● I:C3: CHANGE IN FISH

Linked Codes:

- is cause of → ● D:I: ADAP1: LIVELIHOOD CHANGE_HIGH
- ← is cause of - ● D:I: RESO6: INFORMAL RESOLUTION_LOW
- ← is cause of - ● D:I: RULE4: COMPLIANCE_LOW
- ← is cause of - ● D:I:INFO8: HORIZONTAL GOVERNANCE_LOW
- ← is cause of - ● D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
- is property of → ● F: DESCRIPTION OF CHANGE
- is a → ● I: D2: Change in resources
- ← is cause of - ● I:C2: CHANGE IN WATER/ LEVEL/ WIDTH
- is cause of → ● I:C4: CHANGE IN LIVELIHOOD
- is cause of → ● I:C5: CHANGE_EXTREME

● I:C4: CHANGE IN LIVELIHOOD

Linked Codes:

- is a → ● I: D2: Change in resources
- ← is cause of - ● I:C2: CHANGE IN WATER/ LEVEL/ WIDTH
- ← is cause of - ● I:C3: CHANGE IN FISH
- ← is cause of - ● I:C5: CHANGE_EXTREME

● I:C5: CHANGE_EXTREME

Linked Codes:

- ← is cause of - ● D:I: RESO1: LEGAL DISPUTES_HIGH
- ← is cause of - ● D:I: RULE4: COMPLIANCE_LOW
- ← is cause of - ● D:I:INFO8: HORIZONTAL GOVERNANCE_LOW
- ← is cause of - ● D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
- is cause of → ● F: DESTRUCTION OF SELF SUSTAINING ECONOMY
- ← is cause of - ● F: OVERPOLITICISATION
- is a → ● I: D2: Change in resources
- ← is cause of - ● I:C3: CHANGE IN FISH
- is cause of → ● I:C4: CHANGE IN LIVELIHOOD
- ← is associated with - ● I:SC6: ENGAGEMENT_DECREASE

● I:C6: CHANGE_MODERATE

Linked Codes:

- is a → ● I: D2: Change in resources

• I:C7: CHANGE_LOW

Linked Codes:

- is a → • I: D2: Change in resources

• I:M1: MONITORING OF FLOODPLAIN

Linked Codes:

- is associated with → • D:I: RESO1: LEGAL DISPUTES_HIGH
- is a → • I: D1: Monitoring of resources

• I:M2: MONITORING OF WATER

Linked Codes:

- is a → • I: D1: Monitoring of resources

• I:M3: MONITORING OF FISH

Linked Codes:

- is a → • I: D1: Monitoring of resources

• I:M4: MONITORING BY GOVT.

Linked Codes:

- is a → • I: D1: Monitoring of resources

• I:M5: MONITORING BY NGO/CBO/CBI

Linked Codes:

- is associated with → • D:I:INFO1: AVAILABILITY_HIGH
- is associated with → • D:I:NFO5: VERTICAL GOVERNANCE_HIGH
- is a → • I: D1: Monitoring of resources

• I:M6: MONITORING BY PEOPLE

Linked Codes:

- is a → • I: D1: Monitoring of resources

- **I:M7: MONITORING_ORAL**

  Linked Codes:
  - is associated with → D:I:NFO5: VERTICAL GOVERNANCE_HIGH
  - is a → I: D1: Monitoring of resources

- **I:M8: MONITORING_WRITTEN**

  Linked Codes:
  - is a → I: D1: Monitoring of resources

- **I:M9: MONITORING LEVEL_GOOD**

  Linked Codes:
  - is associated with → D:I:NFO5: VERTICAL GOVERNANCE_HIGH
  - is a → I: D1: Monitoring of resources

- **I:M10: MONITORING LEVEL_BAD**

  Linked Codes:
  - is a → I: D1: Monitoring of resources

- **I:M10: MONITORING LEVEL_MODERATE**

  Linked Codes:
  - is a → I: D1: Monitoring of resources

- **I:OUT1: EXCLUDABLE_LOW**

  Linked Codes:
  - is associated with → D:I: INFRA2: PHYSICAL_LOW
  - is property of → D:I:INFO9: INSTITUTIONAL GOVERNANCE_HIGH
  - is property of → D:I:NFO5: VERTICAL GOVERNANCE_HIGH
  - is a → I: D4: Presence of outsiders

- **I:OUT2: EXCLUDABLE_MODERATE**

  Linked Codes:
  - is a → I: D4: Presence of outsiders

• I:OUT3: EXCLUDABLE_HIGH

Linked Codes:

- is a → • I: D4: Presence of outsiders

• I:OUT4: POSITIVE ENGAGEMENT_HIGH

Linked Codes:

- is a → • I: D4: Presence of outsiders

• I:OUT5: POSITIVE ENGAGEMENT_MODERATE

Linked Codes:

- is a → • I: D4: Presence of outsiders

• I:OUT6: POSITIVE ENGAGEMENT_LOW

Linked Codes:

- is cause of → • D:I: PARTI1: NON PARTICIPATION
- is cause of → • D:I: PARTI2: THERAPY
- is cause of → • D:INFO10: INSTITUTIONAL GOVERNANCE_LOW
- is a → • I: D4: Presence of outsiders

• I:SC1: TRUST_INCREASE

Linked Codes:

- is cause of → • D:I: PARTI1: NON PARTICIPATION
- is a → • I: D3: Social capital

• I:SC2: TRUST_DECREASE

Linked Codes:

← is cause of - • D:INFO10: INSTITUTIONAL GOVERNANCE_LOW

- is a → • I: D3: Social capital
- is cause of → • I:SC6: ENGAGEMENT_DECREASE

● I:SC3: CAPACITY_INCREASE

Linked Codes:

- is associated with → ● D:I: PARTI6: PARTNERSHIP
- is a → ● I: D3: Social capital

● I:SC4: CAPACITY_DECREASE

Linked Codes:

- is a → ● I: D3: Social capital

● I:SC5: ENGAGEMENT_INCREASE

Linked Codes:

- is cause of → ● D:I: PARTI4: CONSULTATION
- is associated with → ● F: DESCRIPTION OF PUBLIC PARTICIAPTION
- ← is cause of - ● F: POLITICAL WILL
- is a → ● I: D3: Social capital

● I:SC6: ENGAGEMENT_DECREASE

Linked Codes:

- is a → ● I: D3: Social capital
- is associated with → ● I:C5: CHANGE_EXTREME
- ← is cause of - ● I:SC2: TRUST_DECREASE

● I:SC7: AWARENESS_INCREASE

Linked Codes:

- is cause of → ● D:I: PARTI4: CONSULTATION
- is associated with → ● F: DESCRIPTION OF PUBLIC PARTICIAPTION
- is a → ● I: D3: Social capital

● I:SC8: AWARENESS_DECREASE

Linked Codes:

- is cause of → ● D:I: ADAP5: PREPAREDNESS_LOW
- is a → ● I: D3: Social capital

• I:USR1: PHYSICAL SUPPORT_HIGH

Linked Codes:

← is cause of - • D:I: RULE4: COMPLIANCE_LOW

← is cause of - • D:INFO10: INSTITUTIONAL GOVERNANCE_LOW

- is property of → • F: DESCRIPTION OF MONITORING

- is a → • I: D5: User support

• I:USR2: PHYSICAL SUPPORT_LOW

Linked Codes:

- is cause of → • D:I: ADAP4: ADAPTABILITY_LOW

- is a → • I: D5: User support

• I:USR3: TECH SUPPORT_HIGH

Linked Codes:

- is a → • I: D5: User support

• I:USR4: TECH SUPPORT_LOW

Linked Codes:

- is a → • I: D5: User support

• I:USR5: FINANCIAL SUPPORT_HIGH

Linked Codes:

- is a → • I: D5: User support

• I:USR6: FINANCIAL SUPPORT_LOW

Linked Codes:

- is a → • I: D5: User support

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