ÉCOLE POLYTECHNIQUE DE L'UNIVERSITE FRANÇOIS RABELAIS DE TOURS

Spécialité Aménagement et environnement

35 allée Ferdinand de Lesseps

37200 TOURS, FRANCE

Tél +33 (0)247.361.450

www polytech univ-tours fr

Master Thesis 2019

Research Master Planning and Sustainability: Urban and Regional Planning

Integrating Cultural, Religious & Social Elements in River Management- Examples from India

A study on eco-social approach in river management in India and the threats on it analyzed with the case of Delhi and the river Yamuna

Supervisor: Wantzen, Karl M.

Student: Vazhayil, Alvin Manuel

ACKNOWLEDGMENT

I thank God Almighty, for giving me the strength and knowledge to complete the research thesis for validating the international masters in Urban planning and sustainability.

I also thank the University of Tours for allowing me to do this research.

I express my sincere gratitude to the Director, Mr. Emmanuel Neron, and to Prof. Abdel-Illah Hamdouch, Prof. Jose Serrano, Prof. Christophe Demaziere who supported me throughout the course of research and providing access to library facilities and online database.

Words are not enough to convey my gratitude and respect to my supervisor Prof. Karl M. Wantzen, for guiding and encouraging me in the right way to complete my thesis.

I also thank Ms. Katie Jo Walter Shoemaker, Mr. Birj Gopal, and Mr. Dias Mario Antony for sharing their valuable time and knowledge for the research.

Last but not least, I thank my family and friends for extending their support throughout the research work.

ALVIN MANUEL VAZHAYIL

TABLE OF CONTENTS

INTRODUCTION 2

RESEARCH METHODOLOGY 4

RIVER CULTURE (DEPENDENT VARIABLE) 4
DIMENSIONS 4
Ecological approach in river culture 4
Social approach in river culture 5
WORKING INDICATORS 5

EFFECTS OF URBANISATION ON RIVER CULTURE IN INDIA (EXPLANATORY VARIABLE) 6
DIMENSION 7
WORKING INDICATORS 7

HYPOTHESIS 7

SCOPE 8

CHAPTER 1: HOW IS CULTURAL DIVERSITY LINKED WITH BIODIVERSITY CONSERVATION? 9

INTRODUCTION 9

CULTURE 9
CULTURAL DIVERSITY 10
INDIAN CULTURE 10
Biocultural Diversity in India 11
Why I chose Indian Culture ? 11

BIODIVERSITY RELATION WITH CULTURAL DIVERSITY 13
How do faith and culture play a role in conserving the biodiversity ? 14
Ecosystem services 14

WATER IN CULTURE 15

RIVERS 15
Urban Rivers 17
River culture 17
Social connectivity – A link between culture and river health 18

CONCLUSION 18

CHAPTER 2: WHAT ARE THE RIVER CULTURES EXISTING IN INDIA? 19

INTRODUCTION 19

INDIAN RIVERS 19

THE ECO-SOCIAL APPROACH 25

THE SOCIAL APPROACH **26**
Semiotics 27
Rivers and Indian Mythology 27
Community Based Conservation Initiatives (CBCIs) 31
Traditions, Festivals and Rituals 33

ECOLOGICAL APPROACH **37**
ARCHITECTURAL PRACTICES 38
The Ghats 39
Chang Ghar 40
Check Dams of Contemporary India 41
AGRICULTURE 45
Below Sea Level farming 46
INDIGENOUS KNOWLEDGE FOR FLOOD PREDICTION 47

AN EXAMPLE OF THE ECO-SOCIAL APPROACH **49**
KUMBHA MELA 49

CONCLUSION **59**

CHAPTER 3: WHY IS URBANISATION A THREAT TO THE RIVER CULTURE IN INDIA? 61

INTRODUCTION **61**

URBANISATION **61**
Urbanisation and impacts on the environment 62
Urbanisation in India 62

THE CASE OF DELHI **63**
Delhi becomes the Capital (1912-45) 65
Delhi after partition (1945- 1970) 66
Delhi in the Independent India (1975 -1990) 67
The Rise of Yamuna Pushtas 68
The Contemporary Delhi 71

YAMUNA FLOWING THROUGH DELHI – PRESENT THREATS **71**
Urbanisation 74
The sewage system and wastewater discharge 76
Built up areas in the floodplains 77
Peri-Urban Agriculture in Delhi 79
Pollution of Yamuna in Delhi 83

POLICIES AND STEPS **85**
MPD 2021 86

INTERVIEWS **87**
Analysis of Interviews 92

CONCLUSION **92**

SUMMARY 94

CONCLUSION 95

BIBLIOGRAPHY 95

LIST OF FIGURES

Figure 1: Visual representation of Sacred in Nature 14
Figure 2:River Systems in India 19
Figure 3: Ganga Aarti 35
Figure 4:Yoga practiced on the banks of Ganga 36
Figure 5: The Riverfront architecture in Delhi 39
Figure 6: Ghats of Varanasi 40
Figure 7: Chang Ghars 41
Figure 8: Jhalaras 44
Figure 9: (a)&(b) Construction of Dykes and strengthening by turfing and plantation for ponds 46
Figure 10:Char Kanta Fishing 49
Figure 11: The site of Kumbha Mela 50
Figure 12: The river changing its flow, Figure 13: Grids formed according to the flow 52
Figure 14:The area fully occupied during the Kumbh Mela (a) & (b) 53
Figure 15:Prayagraj after Kumbha Mela 56
Figure 16: Schematic diagram of River Culture Approach 60
Figure 17: Demographic profile 65
Figure 18:The 1912 New Delhi Plan 66
Figure 19:Growth of Delhi (1803-1969) 69
Figure 20:Delhi master plan 1962 70
Figure 21:Barrages in the river Yamuna 72
Figure 22:The Yamuna river basin 73
Figure 23:Types of settlements, Source: Delhi Urban an infrastructure improvement Project 76
Figure 24: Mean total organic and BOD loads (x 103 kg/ day) entering the Yamuna river Basin 77
Figure 25: Map showing geographic expanse of River Yamuna and its floodplain along with river bottlenecks in the NCT of Delhi. 78
Figure 26: Built up area maps for the years 1977,1993,2006 and 2014 79
Figure 27: Agriculture in Delhi 80
Figure 28: Forest cover in Delhi 82
Figure 29: Species abundance-biomass relationship at various stages of river Yamuna 83
Figure 30: BOD in the river 2007-08 84
Figure 31: Analysis of Threats of Urbanisation to River Culture in Delhi 93

LIST OF TABLES

Table 1: Characteristics of the River Basin 24
Table 2: Characteristics of the River Basin 25
Table 3: State of Ganga before Kumbha Mela 55
Table 4: Land Use Statistics in Delhi 75
Table 5: Agricultural land holdings in Delhi 81

ABBREVATIONS

ES – Ecosystem Services

CBCI – Community Based Conservation Initiatives

DDA – Delhi Development Authority

GOI – Government of India

GOD – Government of Delhi

NCT – National Capital Territory

MPD – Master Plan of Delhi

INTRODUCTION

"Thousands have lived without love, not one without water."- W.H. Auden.

Water and air are the two fluids which sustain life. Our earth's surface is covered with 71% of water, out of which 97% of it is found in the ocean. According to the U.S. Geological Survey, in the remaining 3%, most of it is inaccessible. Only about 0.3% percent is found in lakes, rivers, and swamps. Most of us have seen or experienced rivers in our lives. Even though negligible in quantity when compared to the amount of water available on the planet, these rivers have played a pivotal role in the survival of life and especially in the civilization of humanity. Rivers became a vital part of the human race such that they were treated as magical or even as Gods from time unknown. In Greek mythology, Thetis, mother of Achilles dipped him in the Styx to make him immortal. Rivers were so life-giving that the earliest human civilizations started on river banks. Hence with significant intervention in life, progress, and formation of culture, rivers placed themselves as the backbone of humanity.

Even with such importance, in quality and quantity, rivers around the world have been facing severe threats. Many of the rivers around the world are on the verge of dying due to reasons like pollution, human intervention, and climate change. But the present scenario contradicts everything that we have seen in the beginning. The question that we have in mind might be familiar, where did we go wrong? This thought leads us to the foundation of the thesis, connectivity of humans with rivers. People used to see rivers not only as a source to meet their daily needs but also developed their lives around it, adjusting to the flow patterns and floods, practicing agriculture along the fertile banks or even building structures not hindering its flow. In short, it can be said that a "River Culture" existed.

With changes in lifestyle, modernization, this culture started to fade away. This resulted in gradual ignorance of the nodes of any settlement, the rivers. They were started to be regarded as just a source of water for irrigation and much worse, to dump the sewage. Urbanization worsened the situation by blocking the social connectivity, when in some cases tall buildings blocked the view, while some cities reduced its importance for mere beautification, distancing the public from accessing it. New river management techniques and riverfront architecture might have been able to find a solution for the revival of rivers in urban areas, but also at the same time has killed the social connectivity. The modern river culture in urban areas seems to revive the blue bodies and conserve them, but most of them focus only on the aesthetic beauty of the city.

This was when I decided to focus on India and its profound river culture. Indians from a very long time have developed a culture which respects the environment and sees rivers as Goddesses. Almost

everything in the history of the country, be it temples, schools, poetry has had its foundation laid on the banks of various rivers. Great scholars have done their literary works praising the river Ganges, the Yamuna for the blessings they have showered, the peacefulness it provided. Priests offered their prayers to Gods in the river, offering flowers. For the Hindus, life begins from the river and ends in it, one of the reasons why many wish to die in the banks of the river Ganga, which many believe has healing powers both spiritually and physically.

But again, as seen in other parts of the world, rivers in India face threats of pollution despite being considered holy. The Ganges has been recorded as one of the most polluted rivers in the world. Especially in the sacred city of Varanasi, where the river is most polluted. This is a paradox. Is the Indian river culture under threat? If so, what is the reason behind this? We will find answers to in these questions in this thesis, examining the effects of urbanization on Indian rivers.

The thesis is divided into three chapters, answering three questions – How What and Why? The first chapter discusses how culture is linked with biocultural diversity; the second chapter talks about What are the various river cultures in India, while the last chapter analyses the hypothesis, "Why is urbanization a threat to river culture in India.

RESEARCH METHODOLOGY

RIVER CULTURE (DEPENDENT VARIABLE)

In many cultures, rivers have been the driving force for transformation. Rivers have thus always been anchors of civilization and bones of contention (the word rival is cognate with rivulet (Klaver, 2007). In the early 1500s, Leonardo da Vinci and Niccolò Machiavelli conspired to divert the Arno River from the city of Pisa in what is today Italy. This diversion would have deprived the city of water, thereby giving victory to Pisa's rival, Florence, after a 10-year war. For various reasons, the plan failed, inspiring Machiavelli to compare fortune to a river—something unpredictable, violent, and irresistible. Even though the scheme to divert the Arno did not come to fruition, the underlying paradigm of the control of fortune through a powerful combination of economic practices, engineering, and strategic planning was a precursor of modern river management.

The early development of cultures is mostly linked to specific technologies to use natural resources. People learned from the natural remedies on how to use the technology, the best moment, and time. The rhythm inflow of water determined the changes in cultural activities, farming, and fish migrations into or from the flood plain. With dependence on riverine systems and closeness to nature, some examples such as fishes were seen as divine by some indigenous communities (Gupta et al., 2015). The resources from rivers, the linkage with the community that lived around, even helped shape and structure social groups (Oliveira and Nogueira, 2000; Neuburger and Da Silva, 2011). Even separation of genders took place, like fishing and hunting by men, while women accustomed to doing pottery. The concept of water as a source of life, the flood or fertility in floodplains or as a destructive force might have given the idea of rivers to be considered sacred in many countries, including India.

DIMENSIONS

Hence the idea of river culture is broad, extending to various dimensions and approaches, including social, economic, or spiritual. But it has been specific; these approaches maintained a strong relationship with the community and rivers, conserving them. Therefore ecological and social methods define the dimensions of the concept of river culture.

Ecological approach in river culture

There are large incompatibilities between human and ecosystem needs (Richter et al., 2003) that require improved management of environmental flows (Arthington et al., 2010). The ecological

approach in river culture defines the dependence of humans on rivers. It is an approach in which people learn from the river. Here nature serves as a generator of values, providing ecological services like fish (Wantzen, 2016). The approach describes how we should use the environment without threatening biodiversity. A large amount of eroded fine particles produced are from agriculture that poses as a threat to biodiversity. The ecological approach in the context of learning from the river also includes ecosystem bionics, like adapting to floods, survival strategies, power generation from floods, etc. rivers provide with renewable resources, due to the interdependency of their ecosystem elements. But human activities in the catchment area like reducing infiltration, accelerating surface runoff, and favouring the leakage of soil carbon and natural and artificial nutrients into the stream network have caused diffuse pollution and increased hydrological stochasticity that goes beyond climate change effects and local point source pollution (Wantzen, 2016). An approach with considering the ecology helps in preserving the water body with a sustainable perspective.

Social approach in river culture

The second, social approach, is the influence of the rivers on the society and its cultures. E.g., the expansion of the wine culture along with the European River systems in the Roman period. This approach proposes to reconsider how we see water bodies. All aspects that improve biological diversity will also enhance human wellbeing and culture at the same time. The restoration of the Thur River (Switzerland) is an excellent example of this (Schirmer et al., 2014). As the river was restored, the social valuing of the river also increased. Observations and interviews have shown that visiting restored habitats improves the wellbeing of the visitors (Abraham et al., 2010). Visiting rivers brings a sense of freshness and peacefulness into the minds of people. Rivers in a great ecological state improves the attractiveness of the region. It unites the society through various cultural reformations. When such a social approach considering the rivers as a part of the community is taken, it brings life into the area. It can be seen from various practices in the past that societies had such a social perspective towards rivers. In civilizations like the Indus Valley, the Indus river influenced the city planning and culture of the community. Moreover, many rivers in the country are considered divine in many religions. The river banks have given rise to many social reforms, poetry, education, spirituality, politics, science, etc.

WORKING INDICATORS

The working indicators of these two dimensions, the eco-social approach for this research is the practices in the Indian context. The scope is limited to the various cultural, religious, and traditional practices that exited and is still practiced in Indian rivers. Research shows that the Indus valley

civilization might have fell not due to warfare, but due to climate change leading up to the drying of Sarasvati around 1900 BC (Agoramoorthy, 2015). Almost all rivers in India are considered divine. People had a very close social and spiritual linkage to the river that they used to take baths and believed that the river had healing powers. Even the name of the river defines the divinity in Hind religion. One of the famous festivals, Kumbha Mela, is celebrated in the banks of Ganga where millions come together. The main advantage of this cultural linkage is that people have taken initiatives themselves to save the polluted river from deterioration. The communities have learned to adapt to the changes in the river flow and floods and have agriculture close to the river banks. The river provided with irrigation and fertility to the soils. Check dams constructed in ancient India for conserving water from rivers. (Agoramoorthy, 2015). After check dams were built, farmers did not need to gamble with rains, and access to irrigation water ultimately attained self-sufficiency in food production in villages.

EFFECTS OF URBANISATION ON RIVER CULTURE IN INDIA (EXPLANATORY VARIABLE)

The explanatory variable to the river culture concept is urbanization and its effect on Indian river culture. Rivers in urban areas are facing a severe threat not only by pollution from industries and households but also negligence from the community. Many constructions in the riverfront is a hindrance between the people and the river, such that people are not even aware of what is happening to the water body. The cities have to import freshwater for everyday use when the primary life source of the town is dying. Many modern river management methods are adopted by governments across the world which are innovative. The key processes and controls that shape and disrupt the social connectivity of rivers can be summarized in terms of geographic setting, political/ institutional controls, and the resulting anthropic physical modifications (Kondolf, 2017). Geographic setting includes natural navigability, connection to the sea, height of river banks, position of the river in the city, the flow of the river, etc. hindrance to any of these factors can be inadequate for the river. Political and institutional controls include enforcement of public use in river banks, flood control, navigation. Anthropic modifications are the construction of embankments and flood walls, transportation infrastructure, deepening of river beds for navigation. These management techniques are useful, and they are opening up a chance to readdress the city-river relationship. There are two types of connectivity with urban rivers, which are lateral connectivity and vertical connectivity. The lateral connectivity is the interrelation of people with the river in where people use it for their day to day activities, while the vertical connectivity is the construction of buildings and concerning height

along the banks of the rivers. The third chapter will observe whether social connectivity is stable between the people and the rivers in India, based on a case study.

DIMENSION

To explain the explanatory variable, we will be moving in the dimension of urbanization in the most crucial area of the country, the capital of Delhi. Delhi represents how the rest of the country will change in its fast developing urban areas. We focus on the history of Delhi, from the time of its formation under the colonial rule to present. The changes in the floodplain of Yamuna will be studied together and hopefully find an answer to our hypothesis.

WORKING INDICATORS

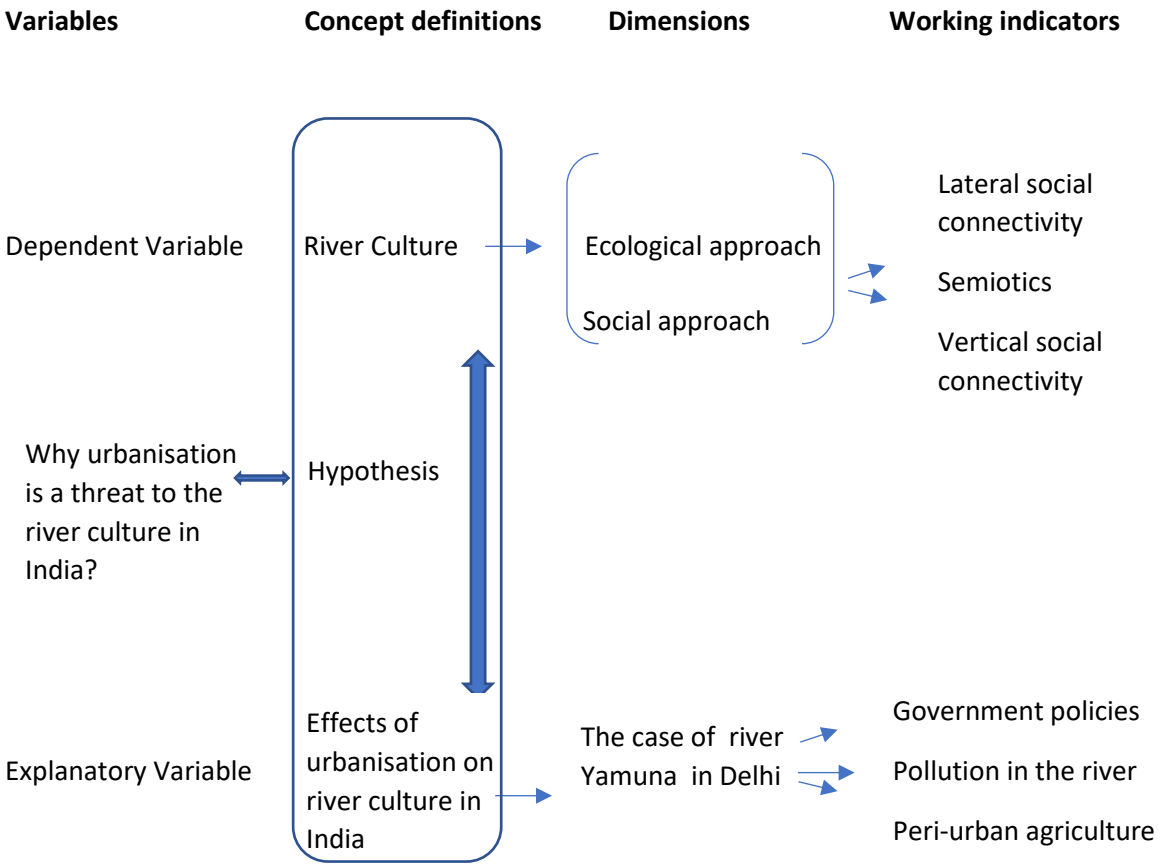
To see if urbanization is indeed the reason for the current state one of the holiest rivers in India, the Yamuna, we will look into major historical events, the master plan of 1962 and 2021. The pollution of the river and its causes will also be discussed. The Peri-urban agriculture, how it is considered by the authorities and the situation of the farmers practicing it in the city, will be an essential indicator to define the concept. Key interviews will be done, who can answer on the evolution of NCT of Delhi and Yamuna and the current policies of the government on bringing back the floodplain to its natural state.

HYPOTHESIS

With the river cultures and river management as a dependant and explanatory variables, the question of "Why urbanization is a threat to the river culture in India?" will be the hypothesis. By now, it is evident that river culture from the past, including its traditional cultures, social connectivity, ecological considerations and eco bionics from which the community gained knowledge, were vital in not only conservation but the sustainability of the river. From the examples that, many schools and religion were started from the banks of the river shows that rivers with their aesthetic beauty were able to influence generations. Though many studies have been conducted in this area of how rivers were considered in the past, and presently about the condition of the rivers, what led to it, very few studies have been done on how we can integrate the management techniques of the past to face the crisis now. With improvements in water quality, some cities in Western Europe and North America are now rediscovering these elements of direct interaction with formerly polluted rivers, often lost during the Industrial Age (Kondolf, 2017). It is impressive to see that governments and authorities are undertaking necessary steps and stricter laws to protect the natural bodies, but all this wouldn't be effective if they are not interacted with by the most intelligent beings in the planet. The hypothesis will be analysed using the case study of the river Yamuna and the national capital, Delhi. Here we are

addressing the riverine community who followed these cultures and protected the river. In most of the cases, this community is often ignored. What are the reasons for this? Is it necessary to protect them from the rapid urbanization happening in the country?

ANALYTICAL MODEL



SCOPE

The scope of this thesis is limited to the study of riverine communities and their practices in India. Since the majority of the population in India follow Hinduism, the mythology and Hindu traditions are given more importance. Since time was limited, the case study has been limited to one city, the National Capital of Delhi, which has the most complex situation politically and demographically and the river Yamuna. Here, the study follows the displacement of people on the banks of the Yamuna and the policies by different stakeholders about them. The research will also focus on settlements along the banks of the river.

CHAPTER 1: HOW IS CULTURAL DIVERSITY LINKED WITH BIODIVERSITY CONSERVATION?

INTRODUCTION

The chapter begins by talking about culture and explains how cultural diversity is vital in conserving biodiversity. This connection is profoundly noticed in how many beliefs were formed to protect the natural habitat and the tangible and intangible ecosystem services that nature provides for various species. The author then justifies his choice on selecting the Indian culture, which is unique in its relation and views on the environment. The final section of the chapter starts with examining the role of water in culture and then discusses about rivers and river culture.

CULTURE

UNESCO describes culture as," In its broadest sense, culture can today be considered as the set of distinctive, spiritual, material, intellectual and emotional traits that characterize a society or group. It includes besides the arts, the letters, and the sciences, the lifestyles, laws, value systems, traditions, and beliefs." Culture is universal. It develops when a community comes together and shares their beliefs and understandings about their environment and surrounding. It is passed on to generations when some become beliefs, superstitions, but the fundamental goal in most of the cultures remains the same, to conserve the environment. "Cultural heritage is usually defined as the legacy of biophysical features, physical artifacts, and intangible attributes of a group or society that are inherited from past generations, maintained in the present, and bestowed for the benefit of future generations"(Daniel C., et al., 2012). Many communities enjoy a way of life that sustains the local environment while nourishing the social relationships and cultural meanings that define their community. The production and reproduction of a way of life involve a way of knowing that is a result of long-term systemic interaction between people and their surroundings (Klaver et al., 2010). Culture defined the interactions and the relation; people had with their local environment. It is a way of living that sustained the human race throughout the years. It is something which has been acquired from studying and immersing with the laws of nature and society. While modern western culture improved the lives of by science and industry, the Chinese solved life problems from a social point of view, with the thought of "Man a social Being". Ancient Indian culture based itself on the Self, "Atmanam Viddhi"

or Know Thy Soul. Hence the Greeks, European, Chinese, and the confluence of the Indian cultures together to improve the lives of humanity as a whole. However, the conception of the surroundings changes as we acquire more knowledge. This view has created changes in the culture of a society too, where misconceptions are uprooted, and culture evolves to accept new changes.

CULTURAL DIVERSITY

UNESCO describes Cultural Diversity as a driving force of development, not only in generating economic growth but also helps in leading a more fulfilling intellectual, emotional, moral, and spiritual life. It is the diverse cultures and societies existing in a particular region in the world. Cultural diversity is similar to biocultural variety, which comprises the diversity of life in all its manifestations – biological, cultural and linguistic- which are interrelated (and likely co-evolved) within a complex socio-ecological adaptive system(Luisa Maffi & Ellen Woodley, 2010). It explains that diversity is not confined to plants and animal species but also includes human cultures and languages and that these do not exist in a parallel realm but as a whole. These links developed over time and are co-evolutionary. We are linked to nature in some way, even if we are not aware of it. However, this link is weak in urbanized and industrialized areas. When there is a breakdown in the connection between cultural diversity and biodiversity, it serves as the cause of many problems in the world. When such inanimate relation is disregarded, it destroys diversity, making communities homogenous, and also reduces the adaptive capacity of humanity as a whole.

INDIAN CULTURE

In his book 'Civilisations: culture, ambition and the transformation of nature', historian and scholar of civilizations Felipe Fernandez-Armesto, says that" civilizations commonly over exploits nature, often to the point of self-destruction." Indian culture and civilization, however, has been an eco-friendly one, which might have been altered after the rise of industrialization in the nation. The essence of the spiritual dimensions of Indian culture is wisdom (Sheth, 1999). Indian culture always taught that nature is to be revered, and examples of these can be found in all the religious texts and teachings. Rig – Veda establishes this idea when it says, "The heaven is my father, the vast earth my mother, my close kin." Even after the amalgamation of various other cultures, religion, and trends, the environmental consciousness in Indians remained regardless of the region or borders across the nation. However, due to multiple invasions, merchandise for spices and visits, the Indian culture has been influenced by many cultures from the west and Arabs. In the novel, Untouchable by Mulk Raj Anand, it is said," It is India's genius to accept all things." The personification of natural entities such

as rivers, trees, air, etc. has helped in the sustainability of the environment and also in the existence of the people. These conceptions play a vital role, even today, in the age of technology and advancement for creating a link between society and nature, which eases the process of conserving and revival of natural features. The significant role can be seen in instances like the Chipko movement took place in the 1970s, where 27 women protested against the cutting down of trees by hugging on to them. With numerous cases like these in history and importance given to nature in religion and culture, we can understand how Indians valued their surroundings. But is Hinduism, which comes to vastly represents the Indian culture, eco-friendly? Westerners misinterpreted the ideas of Shankara in "Advaita Vedanta" terming Maya as just an illusion, and the Indian view of the world is not ecological, rather just a temporary place to settle. However, the interpretation of Gita embraces a positive view of the world. Where Krishan considers the world as his own, and Maya, to Vedantic thoughts, is instead a divine creative power than just illusion. And hence, Lina Gupta writes about the Hindu Culture that, Nature being the womb of God, is a living organism and as such is not to be treated as an "Other."

Biocultural Diversity in India

Indian culture evolved amongst a physical and ecological landscape that is rarely found across the globe. The relation has been so deep that they are intertwined with each other. E.g., one species of rice has been diversified into over 50,000 verities by the farmers in the country. The country has tried its best to conserve the cultural diversity, reviving the community pride of various regions, linking the traditions to livelihood, thus overcoming the threats from modernization. Many of the societies developed beliefs and strategies for conserving the natural resources and nature itself. These practices are followed even today in parts of the country. "They include *toteism* in which one or more species of plants or animals are protected as spiritual ancestors, restraint on hunting female animals, conserving certain species for rituals, keeping aside patches of forests and water bodies in the name of local deities and so on" (Gokhale, 2001). These are also influenced by the religion and the myths, like the personification of river bodies, viewing them as divine, etc. Thus these traditions and beliefs have projected an intense man-environment relationship. Hence the culture got evolved through the environment, and it affected the environment. Together, they created many life-forms in India.

Why I chose Indian Culture ?

The Department related to Parliament Standing Committee on environment and Forest (India) in its report of May 2012 has described the man-environment relation in its report, " Relationship between people and the environment/ecosystem in ancient India had been one of harmony, coexistence,

mutual care, and concern – the two supporting and complementing each other in their way." This way of living paved road for the attitude, care, and respect for the environment in the Indian way of life.

"At the risk of simplification, the mainstream faiths can be divided into two broad philosophical streams. Those originating in the Indian subcontinent, China and Japan (Buddhism, Daoism, Hinduism, Jainism, Shinto, Sikhism, and Zoroastrianism) all regard nature as a critical aspect of the Divine that should accordingly be treated with reverence" (Dudley, 2005). But the three monolithic faiths (Christianity, Judaism, and Islam), the concept of attachment with nature has been more variable, in some worst cases disregarded. Due to the ancient cultures emerging from the subcontinent, majority of Indians have worshiped nature as God.

Buddhism emerged in the 5th century BC when towns and expansion of economy led to the clearing of forests. To know how important this has been to biodiversity, we need to study the practice of 'Ridam,' which annually prohibits entering a mountain forest from mod-August to mid-October. This practice helps conserve young animals and plants during the late monsoon growing season.

Hinduism being considered as the world's oldest surviving faith revere the earth as 'mother earth.' Kautilya's Arthashastra describes varying levels of sines for those who destroy trees, groves, and forests. Many references of trees and rivers can be found epics and poems. In some sacred texts, trees are compared to children. The Matsya Purana also describes a festival of tree planting and tells the story of Goddess Parvathi who planted and cared for the Asoka Tree. As described by Hindu Ecofeminist Lina Gupta, Hinduism can help us awaken the deep connection that already exists, if we have eyes to see.

Jainism has been another version of Hinduism and has been peaceful environmentalists; they believe that those who neglect or disregard the existence of earth, air, fire, water, and vegetation ignores his existence which is entwined with them. Parasaropagraho jivanan is a Jain sutra which translates as all life is bound together by mutual support and interdependence. Palitana, in India, the largest Jain pilgrimage destination put into practice to reforest the hills in the region. Religion focuses more on the importance of nature protection and rehabilitation.

The founder of the philosophical movement of deep ecology, Arnes Naess was influenced by Gandhi, who said, " I believe in Advaita. I believe in the essential unity of man and for that matter of all that lives." (Habberma, 2006). Lynn white acknowledges European and American Christianity, with its ideology that physical creation has no value rather than to serve human purposes (Anthropocentric belief) has been an unexpected problem in the ecological crisis.

On the other hand, Gandhi had a radical deviation from "real" Hinduism, which was heavily influenced by Buddhism. A tradition which is regarded as eco-friendly, Gandhi had a finding of seeking-realization by serving the world. Hence we can see that confluence of all religions which emerged in India, formed the Indian culture, which with its radical changes was eco-friendly. Finally, to quote Betty Heinmann, " In India, the worship of Nature has never been discarded as outdated or primitive. On the contrary, primitivity is here appreciated in its productive ambiguity and inexhaustible potentialities."

BIODIVERSITY RELATION WITH CULTURAL DIVERSITY

It is evident that without a proper understanding of the linkages between cultural diversity and biodiversity, any attempt to preserve biodiversity may prove ill-addressed. It is argued that the biodiversity crisis should be nuanced based on the interaction among a wide range of social, cultural, economic, political, and ecological variables (WWF-Terralingua, 2000). It is widely said that there is only one earth, but many different worlds, which highlights the fact that natural ecosystems cannot be understood nor preserved unless we recognize the human culture which shaped them. Cultural heritage has been deeply linked with ecosystem features. Many ecosystems which are managed for an extended period achieve cultural importance in a society or region, like terraced landscapes in Portugal, Satoyama concept of small scale agriculture in Japan, etc. Culture always drives the change in the ecosystem. Thus it benefits both nature and humans. E.g., the Kaavu, sacred forests in India helps preserve the trees and ecosystem. This view was critical in the British colonial era, also when they had to acknowledge this concept to avoid revolts from the locals. Spirituality and religious services may not value in monetary terms but are vital in conserving the biodiversity in nature. This might be where the idea 'Deep ecologism' coined by Norwegian Philosopher Arne Naess become significant. The idea is, through a process of deep questioning seeks to transform problematic socio-political systems and achieve an environmentally sustainable socially equitable, and spiritually prosperous way of life(Habberman, 2006). In the international symposium for conserving cultural and biological diversity, it was said that globalization of mainstream lifestyle practices could endanger cultural practices and only by the promotion of such traditional methods can create a positive impact on biodiversity. The 2003 convention recognized the importance of intangible heritage not only like oral traditions, arts, dance, songs, but also traditional knowledge about nature. WWF report states that the word 'Sacred' has gained more than a spiritual status since this has helped in preserving the natural state of surroundings during over-exploitation of resources by humans.

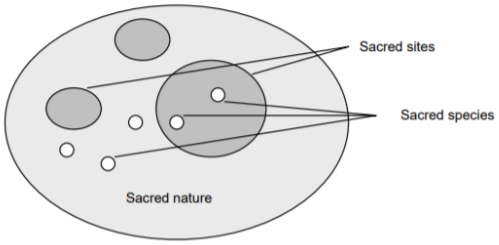


Figure 1: Visual representation of Sacred in Nature

Source: World Wide Fund for Nature report, 2005

How do faith and culture play a role in conserving the biodiversity ?

The first argument being, concepts continue to evolve in most faiths, a growing awareness of conservation prevails, a pivotal interaction to nature is possible through such culture and beliefs, many natural sites are under threat due to the disappearance of culture. Medievalist Lynn White, in his work "The Historical Roots of Our Ecologic Crisis" states that ."What People do about their ecology depends on what they think about themselves in relation to things around them. Human ecology is deeply conditioned by the beliefs about our nature and destiny- that is, by religion." Emerging fields like Religion and Ecology recognizes that religions play a significant role in shaping human attitude towards the natural environment. The current ecological crisis, according to white is the product of a religious problem, since in his words, "every culture, whether it is overly religious or not, is shaped primarily by its religion." And as we know, this culture is not parallel to the environment but dependent on each other.

Ecosystem services

"ESs arise when an ecological structure (e.g., wood fiber) or function (e.g., filtering function of vegetation and soils) directly or indirectly contributes toward meeting a human need or want. Such services (e.g., provision of clean drinking water) generate benefits (e.g., improved human health) that contribute to overall well-being" (Daniel C. et al., 2012). Ecosystem services are therefore naturally available from the environment and its features and maintaining a healthy relationship, to specify keeping the authenticity of our surroundings is vital to our survival. But are these services related to cultural services? Yes. Cultural services are in most cases intangible with ecosystem services, such that they are developed by nature, like the sacred forests for the conservation of the environment. The *United Nations Educational, Scientific, and Cultural Organization World Heritage Convention*, concluded that cultural heritage was associated with built environment and artefacts which included myths, knowledge, and skills which may not be visible but has a significant influence. Hence we must

know that ecosystem services provided by nature is not just water and food provisions, but more which includes both animate and inanimate objects. As in the case of rivers, improving the biological diversity will, in turn, improve the material and immaterial cultural diversity and learning from the river allows improving the technology and management options to a sustainable future. "Ecosystem Bionics" is an idea where people can learn from the rivers, an ecosystem service, like adapting to flooding by using its power, etc.

WATER IN CULTURE

Water is crucial for the survival of life that we can't live without it. Early humans relied on water for existence even before they started building a fire or the invention of the wheel. The human body comprises of 60% of water. Water is abundantly found on the surface of the earth that we call it the blue planet. The ancient civilizations of Rome, China, India, Mesopotamia and Pre-Colombian Mexico were all irrigation based cultures, and the prominent civilizations of the world were river valley civilizations. Availability of water brought people together, which proved that life could exist. Mentions of water are also found in cultures, including Buddhism, Christianity, Islam, and Hinduism. In most of the customs, it can be seen that water is considered to have the power of purifying, cleansing the body and soul. "[Nevertheless] different nations have their specific versions or characteristics of the flood myth, and even manifest their different national spirits and cultural values. As an example, the western flood myths are usually God-centred or theocentric and embody a strong sense of religion with the theme of asylum, while Chinese flood myths are human-oriented and take "harnessing water" as a theme to reflect the use and control of flood" (Jahren P., 2017). Lao Tsu suggested that water is the best example for leadership because, despite all its powers, it accepts the lowest places. Cultural differences play a key role in how water is perceived and used in different regions of the world. "For researchers in social anthropology and political ecology, water is a link between people, through which various social and political dimensions are acted out. Struggles over water are simultaneous struggles for power over symbolic representations and material resources"(Olivia &Ignatius,2011).

RIVERS

"To write history without putting any water in it is to leave out a large part of the story. Human experience has not been so dry as that."- Donald Worster, Rivers of Empire, 1985

Rivers are life-giving sources, more than just water flowing towards the sea, creating life wherever it goes and is the node of most of the human settlements in the world. A river is the indication of prosperity, the richness of the biodiversity and helps in sustaining humanity. A river is defined as a natural stream of water, usually freshwater flowing towards sea, ocean, lake or another river. The significant milestones of human civilizations took place by the banks of rivers. From our earliest known hominid ancestor who lived by Ethiopia's Awash River to the first civilizations in the third millennium BC along Euphrates, Tigris, Nile, and Indus, rivers have been the backbone of human sustenance (Patrick, 2019). Technology historian describes rivers as " All the great cultures have thriven through the movement of men and institutions and inventions and goods along the natural highway of a great river." Many cultures regard rivers as mothers or Narmadai, Mother Narmada; the Volga is Mat Rodnaya, "Mother of the Land." In ancient Egypt, the floods of the river Nile was considered the tears of the goddess Isis. Ireland's River Boyne was worshipped as a goddess by Celtic Tribes. But it is evident that man has changed the fate of riverine systems intruding with its natural flow, flooding and controlling over it. Disposing of wastes, both industrial and domestic, overexploiting of resources has led to the death of many rivers. Davis (1899) divided rivers into three classes based on relative stages of channel developments—youthful, mature, and old age. Qualitative and descriptive delineations were developed – physical and biotic. Another primary classification was based on headwater elevation of rivers (high mountain, mountainous, upland, lowland and coastal plain rivers) and one based on the quality of water in streams (black water rivers, white water rivers, and clear water rivers). (Padmalal, D. et al., 2014).

Youthful rivers – Has a very steep gradient with few tributaries and flows quickly. E.g., Trinity and Brazos(US), Ebro (Spain).

Mature rivers - The river is not very steep when compared to youthful rivers and flows even slower. It has more tributaries feeding into it. E.g., Thames (UK), Ohio (US).

Old Age River – Old aged rivers have shallow gradient and low erosive energy. They are dependent and characterized by their floodplains. E.g., the Ganges, Indus (India), Tigris, Nile (Egypt).

Under the Biotic classification, a system of river zonation is used in Europe, which divides the river into three different zones (Hawkes, 1975):

Crenon – It is the uppermost zone, which is situated at the source of the river. The water in this zone has a slow rate of flow, low temperature, and reduced oxygen.

Rhithron – The zone of the river which follows Crenon. The flow of water if relatively fast, turbulent, with high temperatures and high oxygen levels.

Potamon – The downstream stretch of the river with warmer temperatures, lower oxygen levels with sandier bed and slow flow.

Urban Rivers

Urban rivers are natural streams that flow through densely populated areas. Almost all of the prominent urban centers were developed around urban rivers such that these rivers define life and settlement. However, urbanization has posed a threat to the existence of rivers. Consequently, many of the world's rivers are impacted by urbanization; 50% of the global population lives in urban centers, and is predicted to increase (UNFPA 2007). This problem has occurred due to various factors including an increase in impervious surfaces, channel modification, a disconnection of rivers and floodplains, increase in water demand and contamination. It directly affects the ecosystem services provided by the river. But recently, from the range of services and benefits rivers offer, river restoration efforts are taken in many of the urban areas. Such efforts in enhancing the ecosystem services will boost not only the biodiversity but also cultural services paving the way for recreation, social cohesion, etc.

River culture

In his book, "Silenced rivers: The ecology and politics of Dams," Patrick McCully writes, the essence of a river is that it flows, a wild river is dynamic, depositing silt, eroding its bed, seeking a new course, bursting it's banks, drying up. It [River Culture] is introduced to delineate an eco-social approach to mitigate the biological and cultural diversity crisis in riverscapes. It is based on the insight that current environmental change endangers both, biological and cultural diversities in rivers and their basins, and those activities to improve ecosystem functions, biodiversity and capacity of the biological species to evolve will have a similarly positive effect on human cultural diversity (Wantzen, et al., 2015). When there is an increased deterioration of ecological services, which leads to limited resource relations, less does nature serves as a generator of values. River culture thus states that human wellbeing and environmental diversity depends on each other, and guides to deliver a framework to prioritize such features to bring in a balance in river management. It defines more than the aesthetic beauty or ecological status, but the inanimate relationship that we have with the environment, considering it as we see a fellow human being. For instance, native Americans in the Pacific Northwest believed salmon to be superior beings who ascended rivers for the benefit of humans, died, and then returned to life. These beliefs gave salmons great importance that everyone who tastes the fish would acquire an understanding of everything of the world, such that some tribes welcomed the first salmon of the season with a ceremony. In many parts of the world, rivers are worshipped as a natural form of

divinity, usually mothers. In France, there is archaeological evidence of a temple for the worship of river Seine. This perspective relationship between man and nature may reveal intense energies for restoring rivers, which we are just beginning to understand. This relation is, however affected due to modernization, which distances the people from waterways, thus the positive experience of living with the river is not found or appreciated. This lifestyle leads to ignorance of rivers and hence their gradual depletion.

Social connectivity – A link between culture and river health

As we come to the end of this chapter, we have seen how human impacts can positively affect the ecosystem too. We have learned that culture was developed to preserve our surroundings and was always compromised as humans evolved. But to answer the question of how culture is vital for the health of the river, we have to understand the idea of social connectivity. Mathias Kondolf, in his paper, the social connectivity of urban streams focuses on a framework of lateral, longitudinal, and vertical connectivity to explain the concept. While longitudinal connectivity is based on using water bodies such as rivers for transportation and other business purposes, lateral and vertical social connectivity are more important in the context of this research. Both these are in concern with the people's social interaction with the river. The river's social role changes according to economic trends, livelihood practices, and political decisions (Kondolf, 2017). It also alters vertical connectivity, the activities that are done above the banks of the rivers, let it be cycling, walking, or recreation. But a factor which can still keep humans socially connected with rivers is culture. It is a major driving force in India. While referring to the current situation of Ganga, Ecofeminist Lina Gupta writes," .., pollution is the result not only of inappropriate technologies and management of resources, but also a failure to be connected with, to, and for one another and the rest of the planet. External pollution begins with internal pollution, the corruption of thinking we are utterly separate from the rest of existence." Those who consider a river sacred treat it differently than those who don't. The designation of rivers as 'sacred' greatly enhances its protection from the factors affecting its hydrological cycle.

CONCLUSION

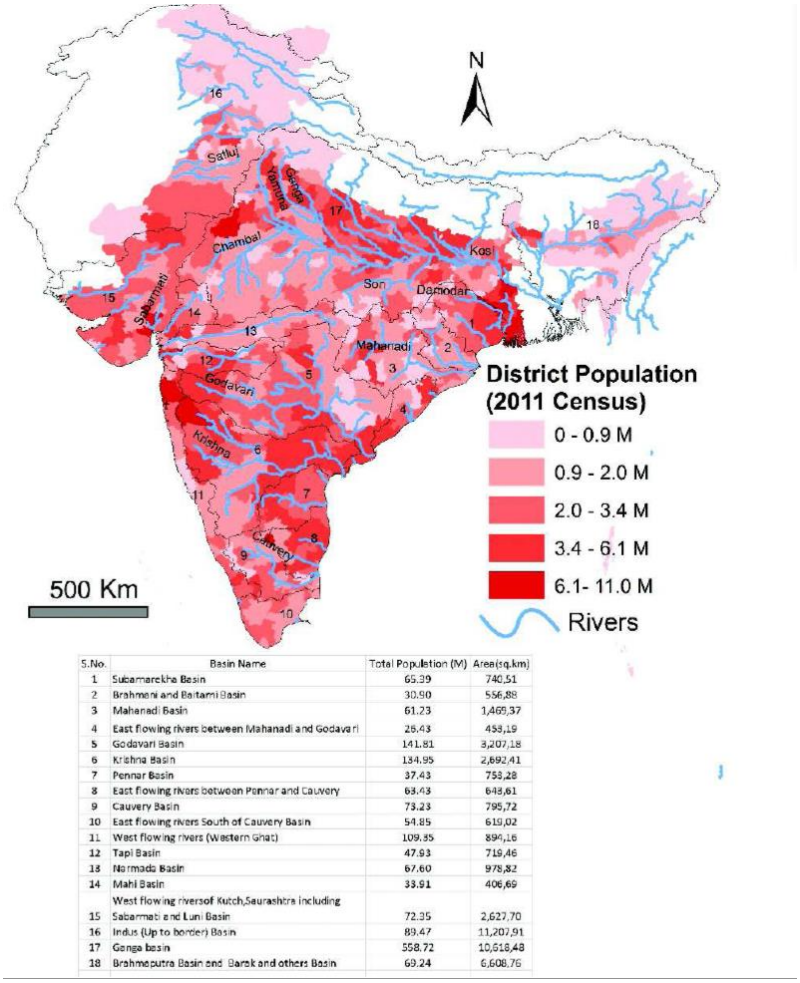
This chapter explains how river culture, the dependent variable of the research, is an essential factor in river management. With examples from various cultures, the author has shown how important is faith and traditions to maintain the balance in nature. The aim of the chapter was to introduce the importance of protecting cultural diversity, which can protect the ecosystem. With an introduction to the river culture in the end, the author has instigated the concept of social connectivity which links culture and river management. The next chapter will be about the significant river cultures in India.

CHAPTER 2: WHAT ARE THE RIVER CULTURES EXISTING IN INDIA?

INTRODUCTION

This chapter deals with the "WHAT" question. We discussed how cultural diversity plays a crucial role in preserving the natural habitat. Now, let us take a more precise look into how this concept can be essential in river management. This concept is studied by examining the rivers and river culture in India. The chapter has been divided into two parts mainly, the social and ecological approaches, and explained with examples.

INDIAN RIVERS



S.No.	Basin Name	Total Population (M)	Area(sq.km)
1	Subarnarekha Basin	65.39	740,51
2	Brahmeni and Baitarni Basin	30.90	556,88
3	Mahanadi Basin	61.23	1,466,37
4	East flowing rivers between Mahanadi and Godavari	26.43	458,19
5	Godavari Basin	141.81	8,207,18
6	Krishna Basin	134.95	2,692,41
7	Pennar Basin	37.43	753,28
8	East flowing rivers between Pennar and Cauvery	63.43	648,61
9	Cauvery Basin	73.23	795,72
10	East flowing rivers South of Cauvery Basin	54.85	619,02
11	West flowing rivers (Western Ghat)	109.85	896,16
12	Tapi Basin	47.93	719,46
13	Narmada Basin	67.60	978,82
14	Mahi Basin	33.91	406,69
15	West flowing riversof Kutch,Saurashtra including Sabarmati and Luni Basin	72.35	2,627,70
16	Indus (Up to border) Basin	83.47	11,207,91
17	Ganga basin	558.72	10,618,48
18	Brahmaputra Basin and Barak and others Basin	69.24	6,608,76

Figure 2:River Systems in India

Source: 2011 Census

Rivers are the lifeline of India. Agriculture contributing to 18 percent of India's GDP and supporting 50% of the country's workforce, depends on these rivers for various purposes like irrigation, soil fertility, etc. The nation also depends upon hydropower and again mostly depends on rivers for this purpose. Hence it can be said that rivers, found abundantly across the nation is an inevitable part of its economy and development. Most of the rivers in India either flow into the Arabian Sea or the Bay of Bengal, which is determined by the watershed and the physical features of the country (Balasubramanian A., 2007). The rivers in India are classified into three based on their origin, topography, and the basin they are formed (SANDRP,2014).

Origin

There are two types of rivers based on their origin; these are the Himalayan rivers and the Peninsular rivers.

Himalayan Rivers – They originate from the Himalayas and are perennial. They are fed throughout the year by melting of ice or rainfall.

The Himalayan rivers are further subdivided into 2, the Trans Himalayan and the Himalayan rivers. Those which originate beyond the Himalayas are known as Trans-Himalayan rivers, which are the Indus, Sutlej and the Brahmaputra. Those rivers such as the Ganga, Yamuna and their tributaries, which originate from the Himalayas and flow the northern plains are known as the Himalayan rivers. As said above, rivers like the Ganges are Old age rivers, meandering along the flatlands, characterized by their floodplains and their banks has given rise to significant towns and cities in India.

Peninsular Rivers – This includes the Narmada, Tapti, Kaveri, Krishna, Mahanadi and Tapti and their tributaries. These are more or less dependent on rain and are not perennial. Commonly known as the Dakshin Ganga, the Godavari is the most extensive peninsular river system. The rivers of South India can be further subdivided into west-flowing and East-flowing streams. The west flowing rivers originate from the Western Ghats.

Based on Topography

This classification includes the Himalayan rivers, the Deccan rivers, Coastal rivers, rivers of the Inland Drainage Basin, and the Island rivers. Out of these, the Himalayan and the Deccan rivers form the most important river systems in the country.

Basin

Concerning the basin formed, there are ten major river systems in India (Central Water Commission, 2011).

The Indus river system

The Indus, also locally known as Sindhu, is the largest and national river of Pakistan. In enter India the Indus George in the Himalaya and flows 709km of its total length of 2897 km through India. The majority of its catchment area lies in Pakistan and its significant tributaries being Shyok, Shigar, Gilgit, and Zaskar. In India, its branches are namely, Jhelum, Chenab and Ravi and Baes. The Sutlej is the largest is one of the most important tributaries of the Indus, with a length of 1050km and is equally vital to the states of Punjab, Haryana, and Rajasthan. The river system has given rise one of the most massive human habitations in the ancient world, the Indus valley civilization and as of date over 1000 cities have been identified. The name India is derived from the Indus river. The Indus water treaty between India and Pakistan is considered to be one of the most successful water-sharing agreements in the world.

Ganga River system

Ganga is the largest river system of India with a length of 2525 Kms. It is the national river of India, the most sacred and lifeline to millions in the country. The Ganga begins at the confluence of two headstreams, Alakananda and the Bhagirathi rising at Garhwal and Gangotri glacier at Gomukh. The flow ends in the Bay of Bengal after flowing through the Himalaya Ganga, entering the vast plains of Haridwar, flowing south, south-east up to Mirzapur in Bangladesh. The major tributaries of Ganga are Yamuna, Son, Ramagnag, Ghaghara, Gandak, Gomathi, Sarada, and Kosi. The river system flows through the states of Uttar Pradesh, Madhya Pradesh, Bihar, Rajasthan, West Bengal, Haryana, Himachal Pradesh, and Delhi. Major irrigation projects and hydropower projects are carried out in the Ganga Basin. The Hindu Pilgrimage centers such as the Haridwar, Gaya, and Varanasi are located in the banks of the Ganga. The Ganges is also home to great biodiversity including a variety of plants, animals and aquatic species. About 47 percent of the total irrigated area in India is located in the Ganga basin alone and densely populated by 37 percent of India's population (Sharma Y., 1997).

Yamuna River System

Also known as Jumna or Jamuna, is the second largest tributary of the Ganges and the longest in India, flowing for a length of 1367km through 5 states including Uttar Pradesh, Himachal Pradesh, Haryana, Rajasthan, and Madhya Pradesh and union territory Delhi. The river originates from Yamunotri glacier in Uttarakhand and has Hindon, Chambal, Sind, Betwa, and Ken as its major tributaries. It meets Ganga at Triveni Sangram, Prayag where the festival of Kumbh Mela is held.

Brahmaputra River system

The river also goes by the name 'Tsang Po' which means purifier and rises from the Chemayundung glacier. With a total length of 2580km, it has many tributaries including Dihang, Dibang, Subansiri, Dhansiri, Kameng, Kapoli, Bhareli, Lubit, and Tista. It is a trans-boundary river, also the highest and third largest river in the world, flowing through both China and India, therefore being known in different names. It empties into the Bay of Bengal, before which it joins Padma (the Ganges in Bangladesh) in the Ganges Delta. It is interesting to note that the Brahmaputra basin is the least exploited river in India. However, the India govt has massive plans to generate Hydroelectricity from the river recently. The total forest cover is 54 percent of its drainage basin in India and boasts high biodiversity. (SANDRP,2013). Due to excessive flooding in the basin, the Chinese government has proposed the construction of Dam across the Brahmaputra.

Narmada River System

It is also known as Rewa and is also one of the largest rivers in central India. It rises in the Amarkantak hills in Maikala, Madhya Pradesh and flows through a length of 1312km through the states of Madhya Pradesh, Maharashtra, and Gujarat and is often referred to as 'Lifeline of Gujarat and Madhya Pradesh.' Narmada's significant tributaries are Burhner, Banjer, Shar, Shakkar, Dudhi, Hiran, Orsang, and Barna. Asia's largest dam, Indira Sagar dam is on the Narmada river. The locals are protesting against the construction of a secondary dam below the Sardar Sarovar dam which will restrict the flow to the downstream, the river which had flow continuous freshwater flow which allowed the breeding of fish.

Tapti River System

With a length of 724 km, the river Tapti flows through central India between Godavari and Narmada rivers, being the second largest in west flowing rivers. The main tributary is Purna, also Betul, Patki, ganjal, Datharni among others. It flows through the states of Maharastra, Madhya Pradesh, and Gujarat and finally joins the Arabian Sea.

Godavari River system

Referred to as Dakshin Ganga, the river flows through the states of Maharashtra, Madhya Pradesh, Southern Chhattisgarh, Telangana, and Andhra Pradesh and joining the Bay of Bengal at its end, the river is 1465Km long and rises from the Triambak. The major tributaries include Manjra, Penoganga, Wanuganga, Vardha, Pranahitha, Indravathi, and Sabari. It is the second longest river after Ganga in India and is the largest in peninsular India. It has great significance in Hindu Mythology and has several sacred places along its banks. The river supports one of the most diverse biodiversity with the majority

of the forests located in its banks. Many dams have been constructed across the stream, while some like Marathwada faces water scarcity, some more dams are being built raising a concern about the ecology of the region and its impact on the river.

Krishna River system

Rising near Mahabaleshwar in the Western Ghats, Krishna is an east flowing river and covers the states of Maharashtra, North Karnataka and South Andhra Pradesh for a length of 1400km. The major tributaries include Konya, Yerla, Varma, Panchaganga, and many others. "The basin is roughly triangular in shape and is bounded by Balaghat range on the North, by the Eastern Ghats on East & the South and by the Western Ghats on the west" (SANDRP,2016). The borders of the river are lined with Western and Eastern Ghats with native species of plants and animals. National Pollution Control Board has identified the tributaries of the river as highly polluted, and sugarcane cultivation, dams, and urbanization have posed threats on the river basin.

Kaveri River System

A famous river in south India, also known as 'Ponni' and referred to as Ganga of South India, runs for a total length of 850km at joins the Bay of Bengal at Kaveripatanam in Tamil Nadu. The tributaries include Hemavathi, Harangi, Lokapavani, Arkavathi, Simsha, Kabini among others. It is the largest river in Tamil Nadu and provides water for irrigation, water for household and generation of electricity and an estimated 90 percent of its surface flow has been utilized. Water disputes often happen with Tamil Nadu and its neighboring states.

Mahanadi River System

Flowing through a length of 851km in the states of Chhattisgarh and Orissa, Mahanadi is an east flowing river of Central India and has tributaries such as Seonath, Hasdeo, Mand IB and Jonk. Puri is a famous Hindu pilgrimage centre located at one of its mouth, the river which is also one of the most active silts depositing rivers in the subcontinent. The river has had devastating floods and came to be known as the sorrow of Orissa.

Table 1: Characteristics of the River Basin

River systems	Indus	Ganga	Yamuna	Brahmaputra	Narmada
catchment elevation (max-min(m))	4255 - 0	3892	3293-74	5,210 - 0	1048 - 0
Catchment area (km^2)	1,165,000	861,000	366,223	712,035	98796
Length (Km)	2880	2525	1376	2900	1312
Mean annual discharge (m^3/s)	6,600	38,129	2,950	19,800	1,447
Mean annual precipitation (mm)	230	1078	714	2800	1250
Mean air temperature (°C)	21.5	9.7	19.8	14.4	17.6
Name the most important ecological regions	Karakoram mountains, Rann of Kutch	The Himalayas, The Ganga Delta	Yamunotri Glaciers, Upper Gangetic moist decidious forest	Manasarovar lake	Amarkantak Plateau
Most important Land use	Agriculture, Industrial settlemets, forest	Agriculture-65.57% Forest – 16%	Builtup area, wasteland, agriculture	Agriculture, Wetland, Grassland, forests	Forest, open land, agriculture, wasteland

Table 2: Characteristics of the River Basin

River systems	Tapti	Godavari	Krishna	Kaveri	Mahanadi
catchment elevation (max-min(m))	748 - 0	920 - 0	914 - 0	1276 - 0	890 – 0
Catchment area (km^2)	65,145	312,812	258,948	81,155	141,600
Length (Km)	724	1465	1400	805	900
Mean annual discharge (m^3/s)	489	3,505	2213	677	2,119
Mean annual precipitation (mm)	814	1738	780mm	1075	1572
Mean air temperature (°C)	20	23.2	25	26	25
Name the most important ecological regions	Satpura range	Someshwar Waterfalls, Gangapur waterfalls	Western Ghats	Shivanasamudra falls, Hoggenakkal falls	Chattisgarh Plain, The eastern Ghats
Most important Land use	Dryland, cropland, wetland	Cropland, vegetation, fallow land	Shrublands, agriculture, rangelands	Agriculture	Grassland, cropland, forest

THE ECO-SOCIAL APPROACH

''River Culture has two dimensions, including (a) the influence of the biophysical setting of rivers (specifically, their pulsating flow regimes and their biological features) on the expression of elements of human culture in general and (b) the aspect of ''learning from the river'' for the development of technologies and management options that are targeted to maintain and improve ecosystem functions and diversity in a more sustainable way." (Wantzen, 2015). It has been understood that for sustainable development to be active, a rational social approach with an ecological approach is required. Social balance is critical in conserving the ecosystem. This is the reason why an eco-social

approach is a better option in river management. In India, the social aspect plays a significant role and has been entwined with ecology from ages. The ecological approach, as stated above, is through learning from the river and incorporating the traditional methods and practices of the community that lives along the river. We will take a look at the social approach on the rivers in India first.

THE SOCIAL APPROACH

"The rationale for integrating social considerations into conservation planning - from the perspective of planners - is that the actions that emerge are more likely to achieve their goals and to be more sustainable." (Natalie, et al., 2013). The advantage of adding a social approach is the opportunity for the planning process to become more realistic and practical, where one can identify the hard choices and know what is good for the people and the ecosystem. This approach also helps in following the ethical responsibility of considering the stakeholders, the local communities to be part of the process.

It helps in understanding and also developing the most critical factor – the man-river relationship. Without a social approach, conservation of a river is possible, but only when the relationship of humans with rivers are ensured, sustainability comes into the picture. In short, a social approach helps in developing a long term goal for future generations, a new way of protecting the culture. Planning. "These assessments contextualize aspects of the social systems that exist in the planning region, describing the social, cultural, economic, and political conditions in the area." (Natalie, et al., 2013). However, since this is a broad topic to cover, we will be focusing on social (community relationship), religious (mythology) and cultural aspects (traditions, rituals), which are the main factors in India.

The Social approach by Patrick Geddes

Culture is often seen in contrast to urbanization. "The cultural dimension of development is still too often misunderstood or undervalued, or seen as an optional extra to be added when the hard work of 'real' development is done" (UCLG, 2016). When culture is compromised for tradition, it not only affects the nature but also the mentality of people. This is what Patrick Geddes talks about, associating this effect with Neurasthenia. Neurasthenia, according to Geddes, was depression brought on by the deprivation of things beautiful and inspirational as much as by malnutrition and fatigue (Naveeda, 2011). In his plan to transform the city of Indore with more gardens and recreational places, he knew he had to be sensitive towards the culture and history of the town. He designed as a procession of the Diwali festival similar to the masques in Scotland, which could convey ideas to the public. He chose the places of the city best cleaned and portrayed many of his views, including agriculture, crafts of Indore, etc." There was, on the one hand, the logic of similitude and substitution at work within the display. Spectators were encouraged to understand that dirt equated to rat equated to Ravana the

demon-king. There was also an additive quality at work such that dirt added to rat added to Ravana, producing an echo chamber of fear. Similarly, the Goddess Lakshmi, homemakers and sweepers, and the new goddess Indore City were to add up to the feeling of continuous striving and triumphant victory. Thus Geddes's effort in the Diwali procession was equally to produce or intensify emotions as to lead the mind along with a distinct narrative possibility" (Naveeda, 2011).

Similarly, in our context of uniting man with the rivers to conserve them, these traditions play a significant role. It teaches the younger generations and the uneducated public on the importance of the rivers and why we should preserve them. These are like simplified capsules in which more complex ideas of sustainability and conservation are broken down in the form of stories and beliefs. These not only help to save the rivers but also keep the lateral connectivity with the people, focusing on the sustainability of rivers. I had the concern of how to connect religion with environmental work on rivers, but as I studied more, I came to understand the role it plays in the Indian context. As said by Habberman in his book about the Yamuna, "Religion is the main motivation for environmental work. If religion is not there, people will not work to clean the Ganges."

Semiotics

Semiotics is the study of signs, a field which sees signs and symbols as a significant part of communication. The culture of humanity also follows semiotics. Famous semiotician and novelist Umberto Eco stated that every cultural phenomenon might be studied as communication. It is often said that Hinduism is more a culture than a religion, where it urges people to respect their environment. Hence many of the traditions and rituals follow this eco-friendly concept. These traditions directly or indirectly communicate with the society about the protection of natural phenomenon. An observation made by Umberto Eco is relevant to our study. "A sign is everything which can be taken as significantly substituting for something else. Semiotics is in principle the discipline studying everything which can be used to lie. If something cannot be used to tell a lie, conversely it cannot be used, to tell the truth." This concept is relevant in examining and integrating the traditions and culture in modern river management. The rituals, even if they imply something else, if used intelligently, can be useful, like that used by Patrick Geddes in India, which we will look into later. Similarly, the myths and beliefs that the rivers have been wrapped in have laid a good foundation for developing these practices and passing it on to generations.

Rivers and Indian Mythology

Indian culture has been deeply entangled with rivers. As we have seen earlier, the Indian culture is more eco-friendly, that has deeply involved in nature. A country, known for its religion and spiritualism, all natural forces, including rivers, are worshipped as gods, and many rituals are

conducted on the banks of rivers. This reverence is evident when it guides the society in praying to the rivers. Indian rivers are filled with more myths and tales than rivers in any other nation. The sacred texts describe the holiness of various streams, such as "all sins are washed away by bathing thrice in the Saraswati, seven times in the Yamuna, once in the Ganges, but the mere sight of Narmada is enough to absolve one of all sins!" All the places of origins of rivers, Gangotri of Ganga, Yamunotri of Yamuna have a temple built in honor of the rivers. Such temples for these rivers shows how rivers were perceived in the country. The national river of India, the Ganges was considered as the Mokshadayini. The reverence of rivers is indisputable since the times of Rig Veda. The culture does not see rivers as just water bodies, instead of as Gods or Goddesses that purifies everything it touches. A holiest place in the Hindu culture is the place where the Ganga, Yamuna and Saraswati, the trinity of divinity in Indian culture confluence, at the Prayag Sangam, the site of Kumbha Mela.

As discussed earlier several times, rivers are worshipped and (was) seen as divine or a maternal figure in many countries. But no river worship has sustained as much as we have seen in Hindu India (Habberman, 2006). What differentiates this culture from that of the west is that, even though aesthetic beauty is appreciated and sustained, rivers had always been something that could be negotiated, conquered, explored or exploit in contrast to the Indian view of a female divine power sent to earth to assist humanity, writes Bill Atkens.

Coming to the Rig Vedas, water had an extraordinary role. It attributed several Gods to water like Apas, who is mentioned in four Suktas is the God of waters. Indra, Varun, Parjanya also had connections with water directly or indirectly. The Padma Purana states that all rivers are Holy. Of all the rivers, Ganga Yamuna, Narmada, and Sarasvati are the most excellent.

But one might wonder how does is this culture significant in protecting rivers. In the book, The Ramayana and Mahabharata, Dutt explains, that understanding the religious, cultural and societal significance of waterways has been crucial, and then only, necessary restraints can be put in place to decelerate exploitation of rivers that go beyond nature's threshold. The need for restrictions to guide human endeavours is along and established rationality of human wisdom. The ancient Hindu scriptures have promoted the importance of such restraints over centuries. In this chapter, we will have a detailed look into the sacred designation of rivers in India.

Large rivers are considered sacred in Hinduism; they are also personified as deities (Agoramoorthy, 2014). There are seven holy rivers in India, known as the Sapta Sindhu, which are Ganga, Yamuna, Indus, Saraswathi, Godavari, Narmada and Kaveri.

The Ganga is related to Lord Shiva, the trinity God, along with Brahma, the creator, and Vishnu, the protector. The Puranas says that a person can gain salvation by bathing in the Ganga. Some parts of the river are named according to the legends. One of the prominent stories, the story of Ashwamedh Yagna (Horse Sacrifice), Bhagirath Performed tapasya, to please mother Ganga. Mother Ganga pleased asked him to please Lord Shiva so that he would control her waters once released on earth. After meditating more, Lord Shiva was pleased, unwrapping each of his locks, Ganga was released down from the heavens of Gangotri, without any destruction of the earth. Hence, the river until Devaprayag is known as Bhagirathi. Another story goes as, Lord Vishnu, when faced with the evil king Bali, took three great strides placing one foot on earth, one in heaven and the other on Bali's head. The water fell into Brahma's pot and became Ganga. Being touched by two members of the Trinity, Ganga became holy. Whereas in another legend, Ganga is considered to be the daughter of King Meru, who is the personification of Himalayas and as the wife of Shantanu in Mahabharata (Dilip Kumar, 2017). Hindus exhibit reverence to all these myth and belief. In the country, the river is not usually referred by its name, but Ganga Ma(Mother Ganga). Ganga being respected in India irrespective of religion, the Hindus believe that dying at its banks is a way to reach heaven and considers it as the sacred bridge to heaven. 'Gangajal' is given utmost importance and is an ingredient in many Hindu rituals. Even though much scientific research has not been done, Gangajal has been observed to remain pure for long periods. The British physician C.E. Nelson noted that water taken from even the dirtiest part of Ganga remained fresh during the journey back to England (Dilip Kumar, 2017). The Uttarakhand High Court on 19th March accorded the status of "Living human entities" to the Ganga and Yamuna, two of India's most sacred rivers (PTI, 20 March 2017). The Ganga basin is also the centre for Hindu and Buddhist pilgrimage and culture. From the holy shrines at Tapovan, Gomukh, Nhojbasa, and Gangotri to Kedarnath and Badrinath, the banks of Ganga are filled with spiritual centers. Such places in Hinduism are called tirthas (place for pilgrimage near the river). One of the exciting rituals is the Ganga Aarti, which we will look in detail later.

River Narmada is only second to Ganga in terms of sacredness and one of the canonical seven holy rivers of India. It also has a lot of temples and cremations sites along its banks. Again, the river Narmada too is wrapped with Indian myths. One myth goes as Lord Shiva once mediated so hard that he started perspiring. The sweat gathered in a tank and started flowing as river Narmada, while another legend days that two drops of tears from Lord Brahma formed the rivers Narmada and Sone. Quoted as even the sight of Narmada can purify one's sins, mythological beliefs dictate that the Narmada is capable of relieving a man from suffering and rebirth. Gita Mehta in her novel A River Sutra, while giving a human aspect to the river, cites some of the important rituals associated with the

river, such as the waters can heal snakebites as Goddess Narmada is related to Nagini, and the British in colonial India oversaw the criminal attempt of suicide. The Puranas say that pebbles on the beds of River Narmada take Shiva's emblem which is called Banalinga or Banashivalingas.

The river Cauvery is seen as the companion of Lord Vishnu in the state of Tamil Nadu. Legend has that the Lopamudra, the wife of sage Agasthya, is flowing like the river Kaveri. She was called Kaveri after flowing like a river since she was king Kaveri's daughter. She prayed to Lord Vishnu to be holier than Ganga. But Vishnu refused, saying Ganga flows from his feet, but agreed to make her his garland close to his heart and hence most sacred. To understand the influence of these myths about Kaveri on Indian culture, one should know that three of the holiest shrines of Vishnu are found at Srirangapatna, Shivanasamudra and Shrirangam called Adi-ranga, Madhya-ranga, and Antya-ranga respectively. These temples are on an island with the river Cauvery encircling it, just like a garland. Some local legends also say that the Ganges joins Kaveri through an underground linkage to relieve millions of sinners bathing in its water (Agoramoorthy, 2014).

The Indian mythology surrounding the river Yamuna is instead an interesting one. Yama and Yami (Yamuna) were twins born to Surya, the Sun, and hence the name Surya Putri or the "Daughter of the Sun." Yami develops a sexual desire for her brother and approaches him. Yama being righteous denies. Yami, representing passion, later in the Puranas is transformed from seductress to river Goddess of life-giving water(Habberman, 2006). It is also believed that the Yamuna was Lord Krishna's lover, Krishna grew up in the banks of the river at Braj. And hence Braj has the most concentration of Yamuna temples. In Mahabharata, the Pandava capital of Indraprastha was situated on the banks of Yamuna, the present day Delhi. Geological evidence also states that the Yamuna once had been a tributary of the Ghaggar river, which is referred to as river Saraswati in the Vedas, later changing its course eastwards, becoming a tributary of the Ganges. Even in history, most of the empires were situated in the banks of Ganga-Yamuna basin, the land being fertile.the images of Ganges and Yamuna are found in the shrines and royal seals of Chalukyas, Rashtrakutas in the southern part of the subcontinent. The architecture in the Chola empire was inspired by the rivers too. Habberman, in his book about the Yamuna, describes the reverence of people for the Yamuna. He writes, " I observed many pilgrims remove their shoes, approach the river, and touch the water with great reverence."

The river Saraswati is often regarded as a mystical river which is no more existing. However, the Rig Vedas describe her as " coming together, loudly roaring, Saraswati, Mother of floods," depicting how people viewed and revered the river and floods in ancient culture. It is believed that the Rig Veda was composed in the banks of the river and that she is a part of the Trinity along with Lakshmi and Parvati.

Geologists and historians claim that this is the now dried up Ghaggar river which once sustained the Harappan civilization.

Let us see how mythology plays a critical role in river conservation and the social approach of Indians on rivers.

Community Based Conservation Initiatives (CBCIs)

The Case of Kali Bein River – A Seechewal Model

The Ministry of water resources under national mission for clean Ganga picked up the village Seechewal in Jalandhar district in Punjab as a model village for their steps in sewage treatment, waste management and setting up public toilets in more than 1600 locations along the banks of Ganges. The national mission for clean Ganga (NMCG) noticed the initiatives taken by the people in solving the various problems that lead to pollution in the river. It ranged from communities coming together to set up low-cost sewage treatment structures. Before explaining more about the Seechewal model, first let us take a look into the community-based conservation which is popular in the subcontinent, especially the rural areas.

Community based Conservation

It has been often seen that when the authorities or officials fail or do not care to conserve the ecosystem from degradation, it is usually the alienated local communities that come together and take initiatives to protect the environment. Such self-initiated efforts by local communities to save the natural resources are known as community-based conservation initiatives or CBCIs. These, operating at a local level are voluntary, people-centered, and participatory with community members making management decisions (Murphree, 1994). The motivation could be biodiversity conservation, livelihood, security, water harvesting, or others (Kanna Kumar S. et al., 2011).

CBCIs in India

The CBCIs in India dates back even before the British era. From what we have seen at the beginning of the chapter, religion and culture play an essential role in Indian communities for such initiatives. It might be the fear of being cursed by the gods or making the deities unpleasant, which motivates them. Indian history is peppered with numerous of such examples, many reported by the British and in recent times by many other scholars and researchers such as Chandran and Kalam (1997), Chandrasekhara and Shankar (1998), Das and Malhotra (1998), Gadgil (1995), Gadgil and Guha (1992) and Pathak (2009). These initiatives were the result of spontaneous reaction to increasing resource scarcity caused by government's commercial exploitation of the forests, decrease in wildlife, depletion

of vital natural resources such as water, or cultural linkages with nature are among other reasons. They show diversity in origin, management systems, institutional arrangements, benefit sharing mechanisms, conflict resolutions for a particular conservation model, which has been evolved through various interacting factors (Kanna Kumar S. et al., 2011). The advantage of CBCIs is that if they succeed, biological losses can be minimized, and this helps to improve the environment and ecosystem from the grassroots level. It is vital as the local community as they have indigenous knowledge of the situation and their surroundings, the exotic species, and the ecosystem.

Getting back to the Seechewal model, it is also an example of a community-based conservation initiative where the local community is involved in the decision-making process. They have combined environmental and religious factors. The main objective was the cleaning of the Kali Bein river; others include the construction of roads, sewerage systems, etc. The case of Seechewal started first in 1991, while people faced hardship in a religious procession trying to cross through Seechewal. The roads covered by dunes were reconstructed clearing the obstacles. The second one was the rejuvenation of the Kali Bein river. Here also the protagonist was urbanization and the industrialization that followed, a typical case throughout the country. The sewerage system was designed such that the wastewater was directly discharged into the river. The toxic chemicals were seeping into the ground and polluting the underground water which the people relied upon for drinking. It also prevented the replenishing of underground water. The environmental flow in the rive also reduced due to excessive pollution. It was coupled with encroachments along the river. The riverbanks were illegally taken over and by real estate giants and even by framers. After the construction of Pong dam across the river, it led to a decrease in the water level. And the barrage across the Baes which used to supply water to the river, also lead to a reduction of flow. As the water body came to a stagnation, along with pollution, provided a favorable condition for the growth of hyacinth.

A meeting of the villagers was held where everyone expressed their concern over the revival of the natural source. The villagers came together for voluntary works pledging to clean the river. Some of the objectives included the removal of water hyacinth which was blocking the Bein, removal of deposits of silts from the riverbed, boundary of the area of the Bein to prevent encroachments, restoration of the flow of freshwater by eliminating the blockages of weeds. The first step taken was to spread awareness about the devastating condition of the river, and hence, a campaign was organized. The villagers were asked to volunteer for cleaning the river. Also, they associated spreading awareness during religious festivals along the banks of Bein during the anniversary of Guru Nanak Dev. They linked leaning the river with spiritual teachings on preserving the natural resources. It gave rise to a sense of responsibility to the community in stepping forward to protect the river.

Then was the cleaning of the kanji wetland. The hyacinth was removed from the river, which was near 1000 tonnes. It allowed ease of flow of the river through the channel. Once this was regulated, boulders were erected along the banks of the river to help it stay on its course. It also prevented seasonal flooding of the river. Later Ghats were constructed to provide easy access to the river, which also became a tourist attraction.

The community didn't stop from just cleaning the river. The next step taken was to stop the incoming wastewater distributed into the river. For this, they developed a low-cost water treatment network. Unlike government undertaken projects, this has been well maintained and functions well. The untreated water in the drainage is diverted through pipes to a cemented channel and then to an open well 13m deep and diameter of 20 feet with iron grills in the opening to filter the solid materials. Cementing is done at the bottom to avoid underground water pollution. This water is then pumped using centrifugal pumps to an open tank and later retaken to a heightened platform to improve the Dissolved Oxygen content. While flowing down, this slurry is separated from the water, which is used as fertilizer. From here the water flows to four different flows with gravitational force, getting cleaner in each stage. The water gets clean at the fourth stage, where it allows organisms to grow and birds come to prey. In the final tank, which is the sixth, the water becomes clear and transparent, which is then used for irrigation for 300 hectares of land. The framers now are less dependent on chemical fertilizers, and the yield has gone up by 20 to 30 percent. It has reduced the exploitation of the river body for irrigation purposes, improved the ecosystem, allowing the natural organisms and plants to grow and enhance tourism giving a boost to the economy of the area.

Hence, the community-based conservation initiative, by using their indigenous knowledge changed the fate of a river, without losing its connectivity with the river but also improved its economy and lifestyle at the same time.

Traditions, Festivals and Rituals

Lateral Social Connectivity

Before talking about the rituals and cultures, let us take a look in their importance and relevance. For this, we have first to get used to the idea of Social connectivity of urban rivers. Since the term social connectivity is far too much to comprehend, let us focus only on the notion of connectivity with waterways. The connectivity structure of a landform is one of the fundamental characteristics to define the process dynamics and to assess the risk associated with any river. This connectivity is threefold. "..we focus on applications of the concept to urban waterways, borrowing a framework of

longitudinal, lateral, and vertical connectivity from the environmental sciences. These connectivity concepts can serve as an organizing framework for understanding river-city interactions, improve the relationship between cities and their rivers, and inform the increasingly widespread efforts to restore urban rivers (Kondolf, 2016). In the case of lateral connectivity, where people have easy access to the river, for their daily uses such as bathing, washing clothes or drawing water, religious traditions have been seen as a proof to the lateral connectivity. Kondolf has said that Indian rivers have long served such needs of the people and the connectivity remains intact. Why are such practices still relevant? When we look into the case of the river Seine in Paris, the lateral connectivity was sacrificed for the longitudinal connectivity, for the navigational purposes. As a result of this, the Seine was not accessible visually due to large masonry walls. Now the authorities are taking up initiatives such as the Paris-Plages to re-establish the connectivity between people and the river. It is in this context, Indian River and cultural practices become relevant even when the rivers in urban areas are highly polluted.

The Indians had a very intense relationship with the rhythm of nature. The cultural landscape of the Ganga riverfront reflects this Hindu view in which all the natural phenomena is celebrated as the manifestation of cosmic order. The traditional belief is that participation in rhythms of nature brings harmony and happiness and reaffirms the universal law (Sinha, 2018). Thus be it the riverfronts of Ganga or the holy city of Varanasi, the influence of the Hindu world-view, of human interactions with natural phenomena has found its place in the spatial planning also. It is safe to conclude that the Indian lifestyle is by the flow of nature. In the case of Ganga, the holiest river in the country, rhythms are sung in her banks in the ritual namaskar and the evening aarti. Let us take a look into some of the rituals and festivals concerning the rivers of the country.

Aarti

The Aarti is a Hindu ritual, in which lights from wicks soaked in ghee or camphor is offered to deities. They also mean songs sung praising the gods when the lamps are being offered. The objective of such a ritual was to tackle the evil influence of evil eye and ill-effects, which might arise from the jealous and spiteful looks of ill-intentioned people (Shah, 2014). But something more interesting is that this has evolved to be of more significance in spreading awareness of conservation of Ganga. As explained by Gaurav Shah in his case study, the Ganga Aarti was started by an NGO in 1992, and the ritual which was performed only on special occasions were performed daily. It was by performing Ganga Aarti to the river, followed by prayers and discourses. This initiative has given light to the efforts to awaken the people in the current state and pollution of Ganga.

Figure 3: Ganga Aarti

Source: Google images

Ganga Yoga

The Yoga is a pre-Vedic Indian Tradition, dating back to the fifth century BCE and has been mentioned in the Puranas. It is being practiced worldwide; however, in India, it is more of meditation and spiritual exercise than just physical. The UN in 2016 has declared Yoga as an Intangible cultural heritage. This popularity of Yoga and its cultural importance has been put to good use for the protection of the Ganges. The new art of Ganga Yoga, practicing Yoga on the banks of the river Ganga has evoked the importance of conserving the river, where people come together and clean the river by taking out trash from waters. The practice of Yoga defines an ecological balance and gives a more exceptional feel of satisfaction when practiced on the banks of the river. This notion is evident from the story of the world-famous band, "The Beatles" composed 48 songs during their time in the Ashram on the banks of the river. The group visited Rishikesh during their hard time, and the meditation, connection with nature and serenity of the environment along the banks of Ganges helped them get back to their state of mind. The enlightenment and peace of mind, from being in a river bank has been proven in the past, also when many schools have laid their foundation. This tradition of practicing yoga shows the man-river relationship in the country and how this can be used to spearhead in the conservation of the river through river culture.

The International Yoga Festival

The international Yoga festival is celebrated yearly on the banks of Ganga in Rishikesh where people from different parts of the world attend. The festival which takes place in the river banks and practicing yoga gives a different experience, helping one to connect themselves with their soul, says

the governor of Uttarakhand. The course includes morning dip in the river Ganges, musical meditation along the Ganges, the aarti performed in the evenings, all of which can be experienced only from the river banks in Rishikesh. It is a magnetic experience, sitting along the Ghats with the Ganga flowing alongside, listening to the chanting and singing while the sun sets in the horizon (The Hindu, 2018). Festivals as such are imposing on the value of lateral connectivity with the rivers, how they can uplift the state of minds of people and build a connection with nature.

Ganga Mahotsav

The Dev Deepavali festival or the Festival of Lights is celebrated in the holy city of Varanasi in Uttar Pradesh India. It is celebrated during the Hindu month of Karthika, usually in November or December, fifteen days after Diwali. The belief is that Gods descend into the river Ganges to take a bath, and hence people float aartis in the river. The main rituals include the Kartik Snan, where the devotees take a holy dip in the river. The people access the river through the Ghats, where the lamps are lit on the steps of the Ghats. It is in confluence with Ganga Mahotsav celebrated in the city, where the residents, tourists, and devotees come together and observe in the name of the river Ganges, creating an ambiance of music, dance and other events. It is a time when the culture and the ecosystem get into a rhythm. The government and the NGOs alike use this festival and occasion to spread awareness on saving the river and the importance of its protection. Let's take a look when the group of people used belief and culture to encourage the community to protect the river Hindon in Delhi.

Figure 4:Yoga practiced on the banks of Ganga

Source: Google images

The case of Hindon River

Drawing inspiration from the dev Deepavali festival, the NGO Namami Harande Mission organized rituals and practices in the banks of the river Hindon. From humble beginnings in 2014, the numbers shot up in the coming years and people came together planning strategies and taking initiatives in

saving the river. As one of the members of the NGO testifies, the only way to keep the river was through the participation of the people who live around it. They have motivated the people through various means, be it advocacy, community events, river pond rejuvenation, or water conservation efforts. Wrapped with folklore and myths, the members educated the community about the conservation of the river and the importance of ecosystem services. They found out the encroached river ponds, of which seventeen of them were taken to the National Green tribunal and reviewed and stopped the encroachments. This event is helping to bring back the riverscape, and the initiative has strengthened the man-river relationship. Cases like this prove how vital the myths, beliefs, and traditions are not only in conserving the rivers but also preserve the man river relation. The cultural diversity here has helped in bringing back the biodiversity of the river and stop human intervention without keeping the people away from the river. That would have resulted in ignorance of the river, even though being protected or canalized, the river culture would be lost forever, which eventually results in the depletion of the biodiversity of the urban waterway.

ECOLOGICAL APPROACH

The ecological approach is meeting the needs of people, encouraging the social connectivity with the people and river without altering the natural habitat. It also includes the idea of ecosystem bionics, which in the context of the River Culture approach, means" ''learning from nature'' is here specifically meant as ''learning from the river."(Wantzen, 2015). In India, constructions along rivers were done keeping this idea that it benefited both man and river. The three different ecological approaches, which were developed in the culture in response to the natural surroundings, are architecture, agriculture, and indigenous knowledge.

Vertical Social Approach

"In contemplating the lateral connectivity of people and rivers, we can define a range of human activities about the height above the water (i.e., instream to bank top), a vertical dimension of human connectivity with rivers. "Some of these uses depend on prior programming, such as paved bicycle trails or the standing waves designed into urban river parks, but most can be classified as spontaneous uses, i.e., uses that are made opportunistically by children and adults taking advantage of natural features of the river and its banks, as well as human artefacts such as culverts large enough to crawl inside" (Kondolf, 2017). India also has developed a vertical approach like the Ghats, which allows people to conduct activities in the rivers, like fishing, bathing, thus maintaining the man river relationship. In most of the architectural practices that we discuss below, we can see that they are not

large structures which block the access of people to the river, but they enhance connectivity promoting recreation and livelihood and farming.

ARCHITECTURAL PRACTICES

Until now, we discussed how the human culture in India, including its mythology, faith, traditions and festivals such as the largest mass gathering like the Kumbha Mela has played and still can play a role in reviving the river. Even when we accept the fact that these practices have also had its negatives such as exploitation of the river which will be discussed later, these are factors by which the most polluted rivers in the world like the Yamuna and Ganga are still not ignored. The holiness these rivers hold has pushed the government to include saving the Ganges in its annual budget and had been included in the manifesto of the BJP party led by Narendra Modi in the 2014 elections. But it has been seen that many of these customs are just practiced for the sake of it without the actual motivation of respecting the river. Here, the riverfront architecture of the Indians stands out. The Ganga riverfront catches up the historically developed socio-religious ideas, values, place consciousness of pilgrims and their faith — altogether help to form a unique faith scape. This provides the hope for belonging, the firm belief among the residents and pilgrims, or visitors' thought and feelings to realize the cultural milieu of Hindu traditions.

Of course, modern man rarely has time for such vision and feelings, however with increasing mass of tourists and pilgrims one is bound to recognize the spirit of place which is intangible, especially the Ganga riverfront in the holiest city of Hindus, Varanasi, and that is why it is worth defending with a view to conserving our cultural heritage resource (Singh & Rana, 2018). This is when we realize how Indian mythology has laid its foundation in every aspect of the people's relation with the river. Everything that has been connected with the river is it architecture or cultural practices has a connection with the Indian mythology. The riverfront, including Ghats, connect the man with the river, giving a feeling of fulfilment, the intangible service, refreshing one's mind. This brings the man, the most vital creature in the ecosystem, one with it. The architecture and naturality are not just helping the river to preserve its biodiversity but assisting the person in visiting to find oneself. To quote Lewis Pierce, "to have a sense of place, to sense the spirit of place, one's place is as indispensable to the human experience as our basic urge for food or sex." I do not think one can survive as the humane creature on this earth without special attachments to particular places. This is where the natural habitat gives back. It gives us back, depending on how we treated it. Such examples are a lot, the most famous being Kabir Das, the famous Indian poet who was enlightened on the Ghats of Varanasi.

The Ghats

Ghats are riverfront steps leading down to the river. There are 84 Ghats in the city of Varanasi. The visual view of the Ghats descending into the Ganges is a treat to the eyes. While the picturesque view or its representation is primarily a visual experience and associated with nostalgia, the idea of the landscape as a situated event communicates the dynamic quality of sensation, cognition, and emotion merging seamlessly in embodied perception. The Ghats are defined by the quality of the aesthetic experience, an intensified version of every day, making it out of -ordinary. Among the 84 Ghats the five described as the most merit-giving and sacred that bestowing individual manifested merits, called Pañchatirthis, are Asi, Dashashvamedha, Manikarnika, Panchagaṅgā, and Adi Keshava (Sinha, 2017).

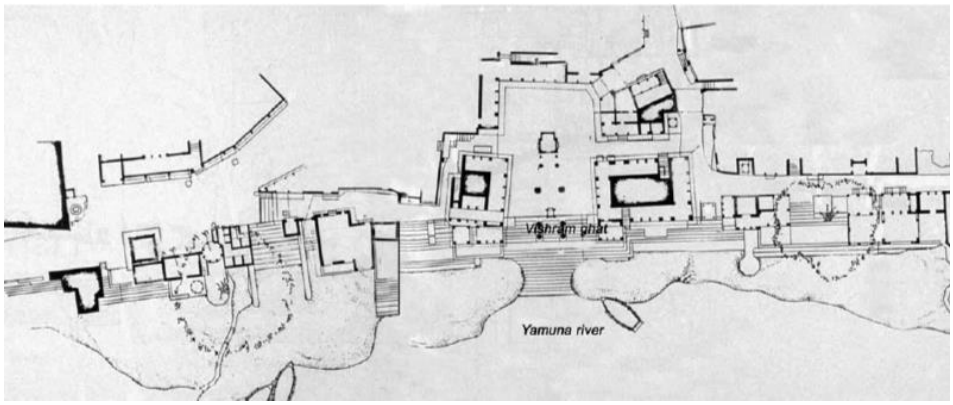


Figure 5: The Riverfront architecture in Delhi

Source: Amita Sinha, 2004

The History

Coming to the history of the Ghats, they have been mentioned in the Buddhist literature dating back to the 3rd century and had been used for transport and bathing. These were mostly of sand and mud embankments, not yet set and clad in stone. During the Gupta period, 3rd to 6th century CE, the Ghats became the centre of economic and cultural activities. Each Ghats is embodied in different myths and history. Among the great poets, reformers, philosophers, who passed most of their lives at the ghats, the notable had been Tulasi (CE 1547-1623), Madhusudan Sarasvati (CE 1540-1623), and the cobbler saint Raidas (1382-1505) (Singh, 2018).

The Design

The Ghats are in a width of 50 m to 500 m between Assi Nala and Varuna river on the banks of Ganga. These structures lie between the river and the city, including the historical places, commercial and residential buildings. The design usually consists of prototypical forms – bastions, balconies, aedicules, portals, pavilions, and platforms – in different sizes and materials and many combinations. The architecture is designed in response to the changing flood levels of the river with the upper levels have

windows and balconies for viewing and the lower floors without opening and with octagonal or circular towers to resist the thrust of rising water when the river floods. It thus unites the vertical architecture with the steps, thus withstanding floods while making space for lateral connectivity. (Sinha, 2017). Stairs descend in a rhythm, from the streets to the river. The area is enclosed with buildings, colonnades, pavilions, and niches situated at irregular interventions. Describing the architectural genius in Varanasi, which has not sacrificed it's connectivity, Sinha says, "In walking on the Ghats along the Ganga, with the embankment lined with large solid buildings punctuated with stairs on one side and the wide expanse of the river on another, the body experiences verticality and horizontality simultaneously."

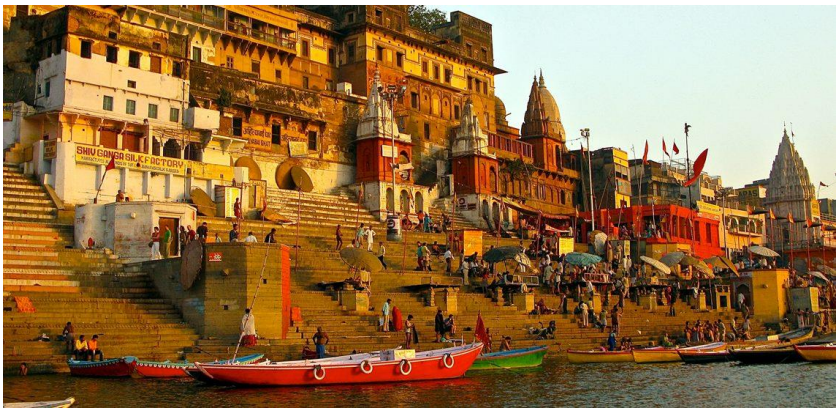


Figure 6: Ghats of Varanasi

Source: Google images

The design of Ghats is very innovative due to the purposes it serves. While the lateral connectivity of the river Seine in Paris was compromised to improve the longitudinal connectivity, on the contrast the Ghats resisted floods, allowed easy access to the river for daily use and viewing, meditation, spaces for shops and recreation, steps which could be used for spatial practices like rituals, prayers, performing aartis and also for navigation. Interestingly these structures served both the needs of the residents and the river, by protecting it from further encroachments as the city developed.

Chang Ghar

River adaptive culture by the Misings tribal community of Assam living along the Brahmaputra river is to be appreciated. One such method is the construction of eco-friendly houses from materials such as bamboo, cane, reed, wood, and thatch to tackle flooding of the rivers in the riparian areas. The heights of the silts vary from six to eight feet in height. The house is generally built facing the waters. These types of dwellings help them to adapt to the flooding in the river, which has been developed from the experience of the riparian community. The newly constructed houses from the year 2004 have high

floors adapting to the risen level of floods since 2004. These raised platforms also protect them from the attack of wild animals, and when there is no flood, they use these space to for other purposes such as the rearing of pigs, keeping and weaving looms and as storage of logs and bamboos. When the floodwater comes, it flushes out the dirt accumulated to their great advantage. Inside the house, the fireplace, called *'meram'*, is placed in the middle. Two shelves made from bamboo, perhaps and rape hangs from the ceiling above meram. While Perap is used for smoking fish and drying firewood during the rainy season, rape is used for preserving rice and sundries. The smoke from meram also helps to drive the insects away. These methods help them to survive during the flood period.

Figure 7: Chang Ghars

Source: Google images

The selection of places for habitation is made by a ritual called the "amo-yukang." Four holes are dug in the four corners of the area selected, and small packets of rice are put in these holes. It is dug out in the next morning and is examined. If the entrance of insects or termites is found, it refers to the damp soil, which might be an ideal breeding ground for various micro-organisms and termites which can destroy the Chang-gears quickly. If the separation of rice pairs is observed, it means the movement of underground burrowing animals, which may affect their cultivation as well as settlement. With modern construction methods, Chang Ghars are now built with concrete pillars and stairs, which increases durability (Sarma, 2015).

Check Dams of Contemporary India

India's former Prime Minister Rajiv Gandhi being skeptical of mega-dams said, " We can safely say that almost no benefit has come from big surface irrigation projects. For 16 years, we have poured out money. The people have got nothing back, no irrigation, no water, no increase in production, no help in their daily life." Here the importance of check dams, which were popular in India in the past become

relevant. Mainly two types of Dams are used in India, the large dams, and the check dams (Agoramoorthy et al., 2008). While large dams are used for irrigation, prevention of flooding, and generation of power, check dams are small barriers using stones, cement, concrete built across the direction of water flow to harvest rainwater.

Kallanai or the Grand Anicut in Kaveri

The first check dam ever built in the country was the Grand Anicut or known as "Kallanai," which was created by the Cholla king in the Cauvery Delta in the second century and is still standing strong till date. This design was later used by the British to build check dams all over India. The Kallanai is made of stone to control the Kaveri river and is 329 meters long, 18.3 meters wide and 5.39 meters tall, located 16km east of Tiruchirappalli and 209 km below Mettur dam. It has three regulators and a surplus regulator and collectively called Kallanai or Grand Anicut, controlling the furies of floods which would have been unimaginably devastating in the past. The dam and the development around the dam made possible agriculture as the main occupation for nearly 60 percent of the population in the area. The dam built in the second century AD were was constructed according to the Vedic Shastra, based on the 12 principles of dam building (Agoramoorthy, 2014). These included a king who knew water and science, a river conveying clean water from a source nearly 40 km away, ensuring long and deep bed under the dam, water sluice sites from the high ground to develop steady eddies, etc. Along with these rules, it also suggested the six mistakes that engineers constructing should avoid which are the leakage of water from the dam, saline soil foundation, dam site at the boundary of two kingdoms, high ground in the middle of tank bed obstructing the valley, scanty supply of water and extensive land requiring irrigation and finally scarce ground and excess water (Agoramoorthy, 2014). This example shows how religious beliefs were based on scientific facts and how they shaped a culture conserving the ecosystem, especially the essential services and rivers.

In a report submitted by M.S. Swaminathan Research Foundation and Tamil Nadu Agricultural university about Anicut and associated farming system in Kaveri delta, it has been mentioned that the Kallanai has largely contributed to the biodiversity of the area. While supporting irrigation for agriculture, it helps sustain the riverine ecosystem, provides drinking water for the urban population, and promotes tourism in the region.

An NGO in India, the Sadguru foundation is focusing on natural resource management through eco-friendly community based, natural resources development projects built 306 check dams, converting drylands in western India (Agoramoorthy, et al., 2008). The farmers started receiving water for agriculture through lift irrigation from the check dams. These heck dams are eco-friendly since they

do not submerge nearby areas, neither do relocate anyone living nearby and help to recharge groundwater in aquifers and wells nearby. It was reported that check dams in south India reduced high levels of fluoride content in groundwater (1.5million parts/million) reducing health hazards to humans (Bhagavan &Raghu, 2005). In the dry season, these are very useful as they provide water for animals. Hence check dams maintain the connectivity of humans and rivers by providing them with services while fulfilling human needs such as irrigation while at the same time conserves the river environment as it is.

Apart from the check dams, there are many ecologically safe, traditional, and cost-effective techniques in different parts of India for sustainable river management. These are built depending on the terrain and ecology of the particular area. They are advantageous in conserving water and maintain the natural habitat in the rivers and reduces overexploitation. They also preserve social connectivity, giving easy access for people. Since agriculture is the main occupation in the country, these are constructed to support irrigation. Some of these traditional techniques are the following (Sanchari Pai, 2016).

Katta

Katta are bunds built with muds and loose stones which are available locally. They are usually built across small streams and rivers to reduce the flow of water. This water seeps into the ground and increases the water level in nearby wells. It will help in irrigation and lessens overexploitation of rivers in dry seasons. It is a cost-effective method, usually followed by the rural community in India and the villager come together for construction. This is another example of sustainable river management without altering the natural flow of the river.

Some of the techniques were not directly linked to rivers, but are creative groundwater recharge techniques or water harvesting techniques. These techniques improve the quality of floodplains and reduce the dependency on waterways. Thus rivers will not be crowded to meet all the demands of the community. They will be available for recreation, allowing people to spend time peacefully with the riverine ecosystem. "Many indigenous irrigation systems provide good examples of farmer management and are, therefore, being studied for learning principles of management. Behind the existing indigenous systems of irrigation, there are thousands of years of tradition ."(Divy, et al., 2012). These cost-effective traditional methods helped in improving the soil fertility, groundwater table, and the ecology of the floodplain. Some of them are:

Ahar Pynes

They are traditional floodwater harvesting method standard in south Bihar in which the floodwater from the rivers is collected. Ahars is a rectangular structure built with embankments on three sides for water harvesting, the fourth side being a natural gradient of the land itself. Pynes are the artificial channels constructed to utilize river water and excess floodwater (Divy et al., 2012). This is an original method in using water from the river for irrigation, sustainably.

Eri (tank) system

Eri is a water management system practiced in Tamil Nadu, south India. These are used for flood-control, preventing soil erosion, to avoid the wastage of runoff during heavy rainfall and recharging groundwater. They are fed either by diverting the river water or by collecting rainwater. "However, tanks are not only used for irrigation. They have multiple functions – economic, ecological and social – especially since their ecosystems provide many resources (water, fish, trees, grass, silt, etc.) that benefit different sectors of society other than farmers." (Olivia &Ignatius,2011). It is also used for leisure activities, flood control, and protecting the ecology of the surrounding.

Jhalaras

Another traditional method used in Rajasthan, a state which faces water scarcity is Jhalaras. Usually, urban areas which face water shortage either divert water from rivers, altering their natural flows and reduces the environmental currents in the dry season. Jhalaras, however, collects the seepage from upstream reservoir or river, from which the local community depends for drinking water, religious rites, etc. Thus, the traditional method proves to be sustainable. They are rectangular shaped step wells having steps on three or four sides.

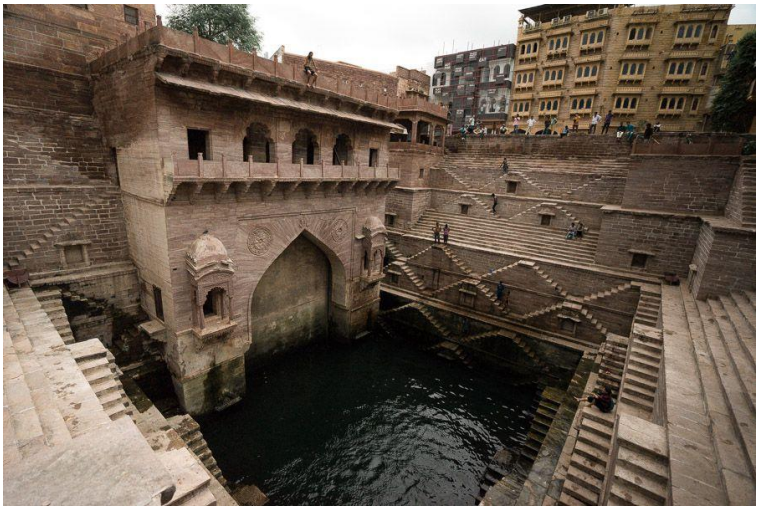


Figure 8: Jhalaras

Source: Google images

AGRICULTURE

Again looking into the case of the Misings community, in the plains of the Brahmaputra river cultivation is dependent on the natural floodplain and the riverine habitat. They practice their farming, so that very less alteration is made to the ecosystem around the river. The Misings usually grow three types of paddy – Sali, ahu, and bao. People rely more on Bao since it is ideal for marshy and swampy land and grow well in the flood-prone and waterlogged areas of the Brahmaputra valleys. Adapting to the flooding patterns, the tribes are now practicing mixing of bao and ahu cultivation so that at least one crop survives in case of early or high floods. Another plant grown is the millet which grows during insufficient rainfall and grows well during flood season. This is harvested before the flood season, which ensures nutrition to children and pregnant ladies. Another interesting factor to note is that they use very fewer pesticides and chemicals to keep the insects away. They use household ash as a repellent, and these are easily washed away by the seasonal floods, and this has helped both the farmers and the riverine environment (Sarma, 2015).

Another method in horticulture is the construction of ponds to resist the deficiency of water in water bodies. This is to overcome the water scarcity in the winter season after flooding. It is more like a survival strategy so that they don't need to migrate to fertile lands for survival. This is innovative as they don't make permeant changes to the environment but find a livelihood for themselves. The fishers in Dhemaji, Assam construct ponds with minimum excavation and high embankments, reducing construction costs, protects inundation, and a higher possibility of storage of water in the winter season. To prevent seepage, cow dung was mixed with water and overlay a layer on the bottom, improving the water retention capacity. Clay soil for dike construction is used to prevent soil erosion. Further land erosion is restricted by the plantation of plants like lemon, beetle-nut, pulses, etc. (Ranjit, 2015).

Figure 9: (a)&(b) Construction of Dykes and strengthening by turfing and plantation for ponds

Source: Ranjit, 2015

Below Sea Level farming

The below sea level farming practiced in Kuttanad is a unique practice of agriculture. It is a prime example of how the community adapted to the riverine ecosystem without encroaching or disturbing it. This system had been adapted from the Dutch polder system 150 years ago. They have modified the techniques by the nature of the area, conserving the biodiversity, ecosystem, and several ecosystem services. The report submitted by M.S. Swaminathan research foundation and government of Kerala has studied the system and prepared a report. The Kuttanad region mostly covered by water was formed by natural reclamation of flood deposits by four main rivers – Pamba, Achankovil, Maimala, and Meenachil streams. The wetlands of Kuttanad, which are abundant in sediments, sand, silts, buried timber, and dead vegetation, are used for farming. These turn into potential areas for fossil fuels if left without social pressure, but with years of efforts, these were converted into cultivable lands without causing many hindrances to the ecology. These are at a mean sea level of 0.6m- 2.00m and the traditional paddy cultivation is practiced by the flooding pattern. The rice paddies are known as "Padashekaram." The three unique landscape structures of Kuttanad are wetlands, Garden land, and water areas (MS Swaminathan report, 2013). The indigenous knowledge of people and eco-friendly practices have helped the river system and biodiversity. The agriculture tradition was developed 150 years ago and according to a traditional farmer named Joseph, " The major aspect of the traditional farming was that it was ecologically based. Farming operations were entirely based on the local water cycle in the region. Soil fertility was dependent on natural cycles, and fertilizers were entirely organic and low, and no chemicals were used. Only one crop was harvested a year to give time for the soil to retain its soil fertility. And salt water inclusion to the lake was permitted periodically

for maintaining the ecological balance. To develop agriculture, they built retaining walls with dry rubble packages known as 'Pulimuttu' which also protects the river strands. To tackle floods and other threats, bunds are built to protect the fields. Again these bunds created are with natural materials without causing hindrance to the surroundings. For creating bunds, the first step is the erection of bamboo poles and then covered with coconut leaves. The channel created would be filled with sand, twigs, sedges, and dead materials brought from different places and interspersed with high-quality clay that is dug 20-25m deep bottom lakes (MS Swaminathan report, 2013). This clay digging is done by experienced persons from the bottom of the lake. Once the bund is created, the land reclamation is done. Then the outer part of the bund is done to strengthen it from high tides and floods. Then the dewatering of the fields is done to plant crops. The annual repairs of the bund are the responsibility of the farming community. This is an example of community-based conservation where they come together in the maintenance of the bunds.

INDIGENOUS KNOWLEDGE FOR FLOOD PREDICTION

Local people around the world had developed their ways of adapting to nature before technology overtook. People in India also had developed several techniques. What makes these methods stand out from modern techniques is that unlike the latter, traditional techniques and indigenous knowledge never tried to tame the natural features or ecosystem, instead found a way to cope with nature, thus maintaining the balance in the surrounding.

In a study conducted by Ranjit Bordoloi and Armaan U. Muzaddadi, about the Indigenous knowledge and disaster management in the most flood-affected Dhemaji district of Assam, they observed many techniques those who live along the floodplains follow.

The first one was the early prediction of flood and rain by ethology or animal behavior. If in the morning of the last day of Assamese month, mid-January, that is the eve of Magh Bihu, the local festival of Assam, if the cattle are seen to be standing in their sheds, it is seen as a sign to the future floods. Animals can sense the disasters coming and show early signs of it. Those who lead a life close to nature and animals can understand these signs and prepare themselves for the disaster. Again, in the same community, if the cattle behave abnormally or furiously when brought for a bath during the morning of Goru Bihu, Assamese New Year Festival, it is believed that the flood is ahead. The Assamese months follow the Bengali calendar, which is a solar calendar based on the position and movement of celestial bodies. So the people are quite aware of the season in a particular month, and the signs from animals help them identify a natural disaster coming their way. Some other examples are related to the field of ecosystem bionics, described in chapter one, where people learn from the ecosystem to adapt to the changes. When insects like the locust, grasshopper, etc. come out from their hide and fly

around, it suggests a change in weather and a massive flood or rain is coming. Similar is the case when ants move their shelter along with their eggs and food to a higher altitude; it indicates a surge. This is why the preservation of the ecosystem around a river is critical. When the floodplains are encroached and turned into concrete structures, these creatures, usually gone unnoticed face threat to their environment forcing them to move to other natural areas, or some of the exotic species becoming extinct due to change in the situation. The Dhemaji community observe the howling of foxes, if they are howling from a high region, it indicates an upcoming dry season, while if it is from a lower part, it shows a flood. So does the doves, which cry monotonously before a flood. There are birds, locally known as Melong and Chatok which cries before a flood. So do the frogs and toads which makes continuous sounds before a significant rain or devastating floods.

The community also predicts floods based on the observations of nature. If a locally known plant, Torapat of the ginger plant buds with a tint of silt in it, it is a sign for a future disastrous floods. Similarly, if a massive bamboo is flowering before the summer season and if mango trees bear more flowers than jackfruit tree, again it's an indication for floods. These techniques of learning from nature, the changes in plants, animals adapting to new situations, reacting to the weather, has been developed from centuries-long interaction between humans and environment. These might have been transferred down to generation, modified and added on for survival. The positive side of this culture is that the people, unlike the urbanized community, never try to tame a river, but allows to be in its natural state. They live in harmony with the ecosystem, learn from the signs that the river itself provides through organisms and changes in conditions. Even after the flood, people have specific survival strategies that help them get through the year. A post-flood time, fish becomes abundant, and the price of fish if very low in the market. And as fish is scarce in the dry season, the cost of fish rises in summer. Hence the fish caught after the floods, are preserved b drying smoking and fermentation process. This preserved fish is also known as the poor man's diet.

Let's take a look in one more fishing technique followed by traditional fishermen in River Tawa in Madhya Pradesh, India which is known as Char Kanta. It is a traditional fishing technique, where 'Char' is an indigenously prepared bait, and 'Kanta' is the specific hooks used for different species of fishes. This method is unique and is used to catch fishes of high market value in large quantities at the same time, not causing any harm to the ecosystem in the river. The bait is prepared from natural substances like fermented rice, decomposed coconut, wheat powder, mustard, oil cake, Jowar powder with some attractants such as fenugreek, cardamom, ekangi (Kaempferia galangal) bark powder, Jayatri, etc. These are mixed according to the species of fish they are targeting long with water to make a dough like component (Bose A.K. et al., 2017). This is a perfect example of using the natural state of the river.

The bait is prepared from substances found in the riverine ecosystem, which doesn't harm the river at the same time, serves the purpose for the fishermen.

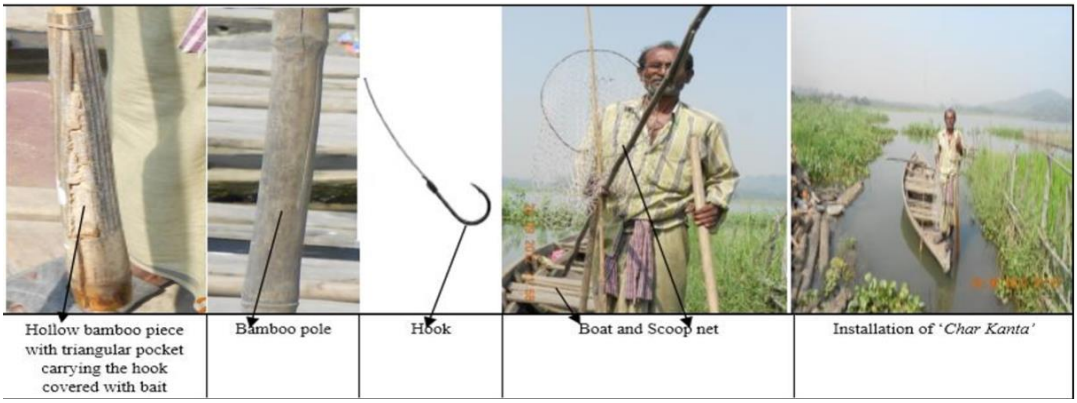


Figure 10:Char Kanta Fishing

Source: Bose A.K., et al., 2017

Another study conducted about the tribal people living in the rural parts of Rajasthan by scholars Aparna Prateek and PC Trivedi of the University of Rajasthan showed more strategies and adaptive measures with the river and ecosystem. Some of the signs used by indigenous knowledge for predicting rainfall include flowering and new leaves of Ficus species plants, the appearance of butterflies, ants, and termites. These organisms and animals exist when there is a favourable environment for them. The people help preserve the environment and the ecosystem services help them in return to cope with disasters and changes. The same community has interesting land use strategies to deal with flooding. In the flood-prone area, houses are built on silt so that water can pass underneath while in some places houses are built on raised platforms, like the Chang Ghars in Assam by the Missing community. They also traditionally made with lightweight materials which can be dismantled and removed easily in cyclone prone areas.

As we have discussed both ecological and social approach, let us see an example where the eco-social approach is followed in India. The festival brings together the complex social analysis of the pilgrims and the ecological considerations, including the change in the flow of the river and protecting the quality of the floodplain.

AN EXAMPLE OF THE ECO-SOCIAL APPROACH

KUMBHA MELA

The Kumbh Mela is one of the largest human gatherings in the world, which takes place at four different locations based on the position of stars. It is celebrated every twelve years, and the Ardh Kumbh is celebrated every six years along the banks of the river Ganga. A six-week festival is a place

for the pilgrims to take a bath in the "Sangam" or the confluence of the Ganges, Yamuna and the mythical river Saraswati, making it the most sacred pilgrimage for the Hindus. In the Hindu texts, the myths go as Jayant, the son of God Indra ran away with the pot (Kumbha) of the nectar of immortality (Amrita) and dropped it in four different places on earth: Haridwar, Ujjain, Nashik, Allahabad. The Ganges is believed to have this nectar and bathing in it washes away all the sins and attains liberation (GAP,2019).

Figure 11: The site of Kumbha Mela

Source: Rahul Mehotra & Felipe Vera, 2015

The Kumbh Mela is an ephemeral mega city with more than 100 million visitors. The city is constructed and then later deconstructed within a matter of weeks, providing safe infrastructure, electricity, fresh drinking water, and sanitation. The temporary city built can be a lesson in terms of land use, sustainability, and zoning of areas.

Unlike a more permanent city where the construction of the physical environment happens as a simultaneous aggregation of relatively stable parts that progressively materialize the space; the Kumbh Mela takes form like a choreographic process of temporal urbanization, happening in coordination with environmental dynamics. It comprises five stages: 1) planning, 2) construction, 3) assembly, 4) operation and disassembly, and 5) deconstruction. These stages are directly linked to the context and timings determined by the presence of the monsoon in the region (Rahul, 2015). While mega-events like the Olympics change the urban fabrics of the host city, the Kumbh Mela plays a vital

role in keeping the man-environment relationship. The site for Kumbh Mela is a perfect example of how urban cities can be developed in close interaction with rivers, without destroying the natural habitat. This is evident from the eco-friendly construction and innovations taking care of causing less destruction to the river beds and the aquatic system. As Mehotra describes in his book, Kumbh Mela – Mapping the ephemeral mega city, Kumbh Mela is a confluence of sacred rivers and sacred time, with an enormous number of people. People with various jobs, volunteers, pilgrims, devotees all join together with the traditional and cultural practices, all these that confluence with the river by the act of taking a bath in the river. A testimony of how much rivers are valued in Indian tradition.

Without disturbing the river system

The shifting of the river every year does not allow the Kumbha Mela to have a constant layout. The morphology of the ground varies, and the grids become a structure which adapts to an unpredictable terrain and the hydrological structure of the river delta of Ganga and Yamuna rivers changes. This shifting context is taken into consideration when planning the settlement for the gathering. The banks which are a rural landscape of seasonal crops are transferred into a city for the event. This is possible by the administrative framework which transforms the confluence of the rivers into a city without making alterations to the hydrology. This involves complex and high-level planning usually managed by the Mela Adhikari (district magistrate) where they form networks with various religious groups and forms the grid, dividing the area into 14 different sectors. The planning of the Maha Kumbha Mela started of 2001, began in 1998 and this pattern has been followed in the other events too. The area covered is 23.5 square kilometers, which also includes the rivers and is usually termed as ' Nagri.' The city holds a population of thirsty times its regular size, which shows the efficiency in planning (Rahul Malhotra, 2019).

Figure 12: The river changing its flow, Figure 13: Grids formed according to the flow

Source: Rahul Mehotra & Felipe Vera, 2015

The materials used for construction are mostly natural, organic, and decomposable in the river bed or which can be used for agriculture. Another exciting feature is the use of Geo-bag or Non-woven Geotextile bags, which is made of porous synthetic fabric that is stitched from three sides and is open on one side. This can take whatever forms necessary and helps in protecting the rivers from erosion by developing an embankment and by filtering sludge from the wastewater. These are adaptive and allows for appropriate modulation of the riparian interface.

The Grid

As the river morphology changes, the floodplain is unknown until the flood waters recede. Thus as mentioned earlier, the planning starts at a very early stage and produces various physical forms of the flood plain. Then space is divided into sectors. Again these sectors are culturally diverse and socially active, which are given to each community to organize according to their priorities making each industry unique. These are not repetitive and in between small gardens are constructed to provide aesthetic appearance and will be flooded again after the event. As Mehotra describes, the Kumbha Mela follows a soft infrastructure without majorly depending on heavy machinery which disturbs the floodplain and might cause permanent alterations to the ecosystem. As an example, the roads constructed with steel plates can be carried by people without any machines. Natural materials like bamboos are mostly preferred, which either decomposes or can be reused, easing the process of dismantling and thus allowing the area to return to the agricultural field after the event.

Figure 14:The area fully occupied during the Kumbh Mela (a) & (b)

Source: Rahul Mehotra & Felipe Vera, 2015

The Bridges

In the case of the pontoon bridges constructed which rests on pipas(massive steel structures designed to float), floating steel structures of 9.75m long and 2.5m wide are used. Bamboo tripods are sunk into the riverbed, anchored the bridges and are lowered not the water by a specially modified flatbed truck. These are connected by steel cables above the waterline and coir rope under water. These bridges are undergone 30-35 inspections during the time of festivals and hence joining the residential areas(Rahul Malhotra, 2019).

The Roads

Once the bridges are built, the construction of the roads are done which serves the Nagri or the city, for a length of 150 km. The streets define the grids of the ephemeral city. They are built such that they don't cause any harm to the river or its river bed. There are mainly two types of roads, the pucca and gattas (paths between main streets). Square metal plates are laid over the gates for the transit of vehicles. The roads are built on the stabilized ground outside the flooding area, o.6m higher than the ground level and graded on both sides to ensure drainage. With the main roads are the connected temporary roads made of poured sand, a natural material aiding drainage and would return to the river bed during the rainy season.

Sanitation is another part of the process which has mammoth planning and administration. There are twenty-two groups of sweeper, with each group having eleven and a leader who collects the trash and dispose of them in large holes outside the Kumbha Mela. People from the rural areas in India are not

used to toilets, and hence open defecation is a problem. The sweepers make sure that the area is not contaminated and waste is carried away where the antibacterial chemical is applied.

A merge of modern innovation with sustainability was seen when the Hindustan Unilever limited, a government body, introduced wheel wash-o-cycle, equipment like the washing machine which does not use electricity and uses minimal water for washing clothes. This was added to tackle the pollution caused in the river by washing clothes. The company also ensured a proper drainage system and clean water to avoid contamination from dirty water.

The National Green Tribunal of India directed the organizers to oversee the standards of the Kumbha Mela 2019. It led to spread awareness about environmental protection among people by introducing solid waste management by segregation of waste by the people. This is a great initiative since the urban rivers in the country are widely polluted by plastic wastes. The effort by the Ministry of Culture of India, to host an exhibition to make people aware on people visiting the meal by conducting an exhibition, sharing information under the Namami Gange Mission, tapping of nullahs by bioremediation, use of geo bags in the banks, etc.(Ministry of Culture, 2019). The exhibition focuses more on the pollution of Ganges, bridging the relationship between the people and the river, with the riverine environment. It is also a great sign when the authorities decide to use natural methods like bioremediation to fight the natural sewage, by releasing microbes into the sewage water.

It can be seen that as the period of gathering comes close, the Ganges river in the area becomes cleaner. The BOD level and the DO level becomes fit for regular use, and the river becomes more lively. The state government imposes restrictions over the tanneries during the period, ensures minimum flow, and the question arises on why this is not implemented throughout the year. These figures and news show how the practice of a tradition and the culture of a society has more impact on a better environment and cleaner river environment while improving the connectivity of the people with the river is essential (Banjot, 2019).

What makes the Kumbha different from the ephemeral cities or mass gatherings is the construction of infrastructure as more relational fluxes than as superimposed elements. "At some point, the river will flood the traces of the city until the following October, when the river will again reach its lowest level, and the landscape will become a productive agricultural site that endures for twelve Ganges cycles. The Paraphernalia that is not reused is typically thatch or bamboo and gets incorporated or merged with natural terrain through organic decomposition. This allows seamless conversion from a temporal space to agricultural fields" (Rahul & Vera, 2015).

Table 3: State of Ganga before Kumbha Mela

Name of the station	Distance from Sangam	Date of monitoring	BOD (mg/l)	DO (mg/l)
Sangam	0	8-1-2019	3.2	12.4
Sangam	0	15-1-2019	3.0	10.6
Rasulabadghat	10 km upstream	8-1-2019	3.8	12.5
Rasulabadghat	10 km upstream	15-1-2019	3.1	12.4
Shastri bridge	2 km upstream	8-1-2019	3.4	12.3
Saraswati ghat	2 km downstream	8-1-2019	2.7	9.8
Saraswati ghat	2 km downstream	15-1-2019	2.5	9.6
Chhatnag ghat	5 km downstream	8-1-2019	3.7	10.5
Chhatnag ghat	5 km downstream	15-1-2019	2.9	10.5

Source: UPPCB, Prayagraj

Lessons

Rahul Merhotra in the book, "Kumbh Mela, mapping the ephemeral Megacity", says, " In a time that change and the unexpected are the new normal, urban attributes like reversibility and openness seem to be critical elements for thinking about the articulation of a more sustainable form of urban development. The lessons we can extract from Kumbha Mela are aligned with these attributes." The question raised is why not new urbanists focus on ephemerality rather than permanence creating disturbance in the ecosystem. Given that cities are constantly evolving, events like Kumbha Mela can serve as a perfect example of how to bring urbanization in coherence with rivers. This does not alter the natural cycle of river flooding, at the same time, helps the people to adapt to these changes effectively. Kumbha Mela offers a new model of spatial arrangement, one which is temporal, cyclic, and in constant advancement, ready to spring into motion as environment changes and to make way for the pilgrims to connect with the geography and especially the river (Rahul Mahotra, 2019). It is a model for river cities around the world, how advancement and accommodating people can go hand in hand without breaking the connectivity with rivers. And the core element which makes it possible is the religious component.

The Kumbha Mela is related to the natural cycles of the seasons and the river. During the festival, it becomes a dense urban space while during the years in between, it becomes agricultural land.

Figure 15:Prayagraj after Kumbha Mela

Source: Rahul Mehotra & Felipe Vera, 2015

As chapter concludes, as a reader, one might be wondering why are the rivers still polluted. What could happen that took over this rich river culture? With the same question in mind, I wanted to talk to someone who has dealt with the situation in India in person. This led me to Ms. Katie Jo Walter Shoemaker, an activist who has been deeply involved in improving the conditions of Yamuna. She came to Vrindavan and Delhi in 2009-2010 on Fulbright grant from the U.S. and helped the local organizations working to stop a flyover being built in front of Vrindavan's historic Ghats. Over the years, she has met with various organizations and leaders and is currently trying to involve people who want to help, making sure their actions are practical. She is also the administrator of the Facebook group, "Save Yamuna to save Vrindavan!" which has nineteen thousand members currently. Here is an excerpt of our conversation.

1. Can you please tell me about yourself and your works in India?

My work is in international Education. I happen to care about conservation in Braj. That is what first drew my interest that the Yamuna is such a holy river, deep with devotional, philosophical benefit to so many as well as life-sustaining properties. I came to Vrindavan and Delhi in 2009-2010 on Fulbright grant from the U.S. and helped the location l organizations working to stop a flyover being built in front of Vrindavan's historic Ghats. The construction would have caused even more pollution. I have been interested/involved in Yamuna issues since then. Have met and spoken with heads of different

organizations working on trying to help the Yamuna. That is all. Further recently trying to see how we can involve people who want to help and make sure their actions are practical.

2. Haberman in his book 'Yamuna: A river of love in an age of pollution' mentions, " Indians consider a river polluted only if someone from lower caste or an undesired object touches the river. What's pollution for the rest of the world is not, in the Indian view." Do you think this mentality of people is one of the reasons why the rivers are polluted?

No, I don't think that is a primary reason, and I don't think things can be stated so broadly. I know many people in Delhi who say they will not go to Vrindavan because the city and water are so dirty. And these are people who also have some religious sentiment for the river. Further, many temples in Braj which used to use Yamuna jail for puja/Seva have stopped doing so as even they admit that the water is physically polluted. There is a difference between physical and spiritual/ritual pollution. Some people see the difference, and some people see only the physical or only the spiritual.

3. From my research, I have concluded that river communities play a vital role in conserving the river, and they have to be protected. Do you agree?

I don't think that I do. From what I have seen, most river communities have been forced to forego usual respectful practices because of mass damage from dams, industrial pollution, sand mafia, etc. The river communities are the last ones anyone thinks about as they abuse the river and make their money (see how many are forced from Riverside slums with no or unhelpful provisions - a big one is the Yamuna Pushta slum in Delhi). I think river communities get overwhelmed by this and often abuse the river as well out of a combination of convenience and hopelessness.

4. Yes. I have done my research on Yamuna Pushta too, and about the slums that developed along the riverside. So do you think, areas becoming urbanized have pressurized those people along the river banks to change their culture?

It would appear so from my side, yes. I mean reverence is still there, but misuse by others has such a great impact that older sustainable practices begin to deteriorate/fade away.

5. From your experiences and conversation with people, do you think, the mindset of people towards the rivers are changing as areas get urbanized?

So, but in complex ways. For instance, in Vrindavan, many locals wanted the flyover in front of the Ghats because they saw it as a sign of development, which translates into pride and prosperity. So not

even just areas getting urbanized but urbanization and development as a significant goal for India's town and cities are impacting mindsets too.

6. Were you successful in stopping the construction?

The coalition of people that I helped to connect the dots between was, yes. Stopped after PIL filed by one resident - That the flyover was environmentally disastrous as well as destructive toward the heritage Ghats, and different people and organizations came forward to help his case, contributing evidence, etc. In the end, it was mostly that construction firm did not get NOC from ASI and flyover was coming within 100 meters of ASI protected building.

7. So the locals were ready to sacrifice their natural surrounding for the flyover?

Many were, yes. They saw as a positive development.

8. Is it religion that drives Indians towards rivers? Like, a fear of displeasing their deity?

You can probably get many different answers to your questions depending on who you ask, but my feeling is no, not fear. More out of traditional reverence for the fact that water nourishes and cleanses. If religion, this is how I see it - that the physical and spiritual benefits align - of course, that only happens if the river is healthy, otherwise the religious and material are at odds like now, and many attributes that to Kali Yuga, and use that as reason to not be involved in a losing battle to reclaim the rivers from the greed of the world.

9. So many associates the pollution in the river as a spiritual sign?

A spiritual sign - don't know if I would call it that rather a side effect or product of the kalbi Yuga, which is characterized by greed. And lack of truth, dignity, spirituality in general populace.

Interview Analysis

The conversation with Ms. Katie portrays the changing mindset of people, as the country advances. As an activist who worked for the Yamuna, Katie says that the people are changing and are ready to give up the natural habitat for a better lifestyle. Spirituality necessarily is not the primary reason why the river is polluted but is a bond that binds the people and river. It also helps to keep the tradition alive. But it is also used as an excuse nowadays, seeing it as a side effect of Kali Yuga, and not taking necessary action. Katie believes river communities succumb under the pressure of urbanization and development, that they have to let go of their traditional practices. While progress is beneficial for the society and the economy, the harmony between humans and nature is forever lost as the traditional practices and relationship to the rivers ceases.

CONCLUSION

The flow chart below sums up the idea of the chapter. Examples from India has shown that, for river conservation and sustainability, the ecological and social approach should not be considered mutually exclusive, but as one. The ecological approach ensures that the rivers are not disturbed from their natural state while meeting the needs of humans. It preserves the vertical social connectivity, allowing people to access the banks of rivers, spend time, and carry out activities such as agriculture. This approach rewards people with ecosystem services such as indigenous knowledge, flood prediction, which are invaluable. The social approach, however, cannot be ignored, which studies people and their way of thinking. This approach maintains the lateral social connectivity so that they consider the river as their own, which ensures sustainable use of the natural feature. Indians keep this by their mythology, rituals, and traditions. Finally, we can see how practical eco-social approach by looking into the case of Kumbha Mela. Even with such a respectable and intelligent culture, rivers in India are amongst the most polluted in the world. The conversation with activist Katie showed that changing perspectives of people due to the pressure of urbanization has posed a threat to river culture practices. To understand the scenario, a case study is done in the next chapter.

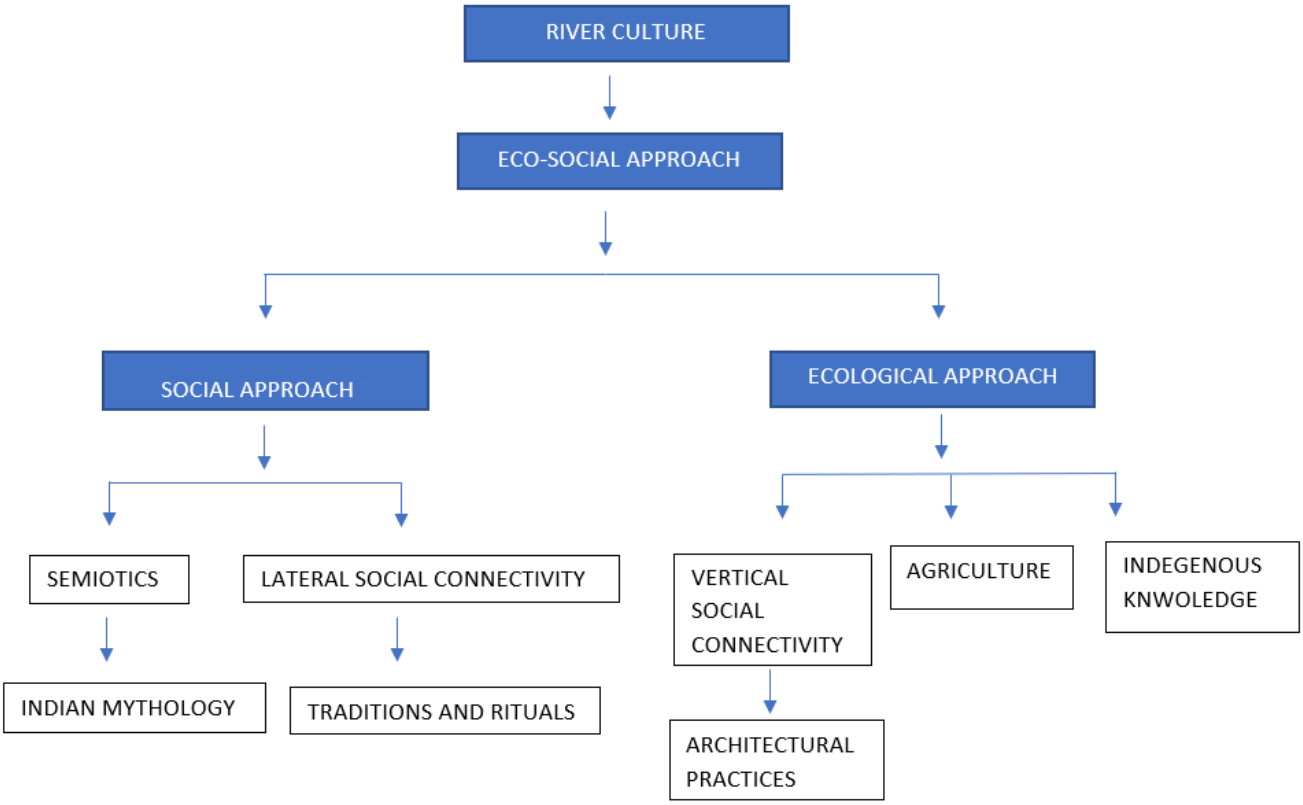


Figure 16: Schematic diagram of River Culture Approach

CHAPTER 3: WHY IS URBANISATION A THREAT TO THE RIVER CULTURE IN INDIA?

INTRODUCTION

We ended the last chapter with a question; "Why are the holiest rivers, the Ganga and Yamuna amongst the most polluted despite the rich river culture in India?" The author formed a hypothesis, considering 'Urbanisation' as a possible threat to the river culture. This chapter analyses the case of NCT of Delhi and how urbanization pressurized the native river community. We will look into how the river Yamuna has been ignored and what are the reasons behind this. To ascertain the hypothesis and findings, key interviews, analysis of policies, and masterplans of the capital city have been included.

URBANISATION

United Nations defines urbanization refers to the general movement of people from a rural area to the urban areas of a country with population growth equating to urban migration. It is also related to the amount of increase in the industrialization of a settlement. It can also be defined as the expansion of urban land cover. The process leads to the growth of cities due to industrialization and economic development, which eventually results in human behaviour, specialization, labour division, environment, etc. It is calculated that by 2050, about 64% of the developing world and 86% of the developed world will be urbanized, most of which will occur in the continents of Asia and Africa.

Before looking more into urbanization, let us look more into the terms involved, "urban," "urbanism," and "urbanize."

Urban

It refers to the demographic attributes such as the size or density or economic variables such as the commonness of non-agricultural occupation. Hence demographically it is an agglomeration of various activities in a given size, while in economic variables urban is an area where more than three-fourths of the total population is engaged in non-agricultural activities. The minimum population for urban demarcation varies in different countries, in India being 5000 persons.

Urbanism

It refers to the way of life in urban areas or how the inhabitants react to the built environment. It can be treated as a distinctive characteristic of urban life. For a farmer living in the rural area, his life is not controlled by the clock, but by the cycles of nature, whereas urban life is separated from the rule of nature as it becomes increasingly industrial. In the words of Louis Wirth, "urbanism is a way of life, is

characterized by extensive conflicts of norms and values, by rapid social change, higher levels of education, the decline in intimate communication and by an increase informal social controls. "One of the characteristics of urbanism is the decline in the significance of traditional and sacred things. Converting what is non-urban to urban is termed as urbanize.

Urbanisation and impacts on the environment

When urbanization occurs unplanned, with uncontrolled growth of urban areas, a drastic increase in urban population and lack of infrastructure, it can cause problems to the environment. The impacts of these on space, environment, and quality of life will be tremendous. The infrastructure required to support such a large concentration of population is lacking behind the pace of urbanization. As a consequence urban environment, particularly in large cities, is deteriorating very rapidly (Mohit Singh, 2017). Some of the environmental problems include overexploitation of natural resources, air and noise pollution, an unprecedented rise in temperature, management of solid waste, development of slums. "Approximately 75 percent of urban waste in India ends up in the country's rivers, and unchecked urban growth across the country combined with poor government oversight means the problem is only getting worse. This situation has arisen despite the huge investments made by subsequent governments in cleaning them up. As a result, our survival and that of rivers are at stake. According to the Centre for Science and Environment, approximately 75 to 80 percent of the river's pollution is the result of raw sewage, industrial runoff and the garbage thrown into the river and it totals over 3 billion litres of waste per day. About 20 billion rupees, or almost US $500 million, has been spent on various clean-up efforts." (Misra, 2010)

Urbanisation in India

Being the second most populous country in the world, India's urbanization has a regional as well as world-wide impact. The total population has risen from 238 million to 1.339 billion as of 2017. According to the 2011 census of India, the urban population accounts for 31.6% of the total population which had been 11.4% in 1901 census. According to the world bank, this has increased to 37% by 2017, and by 2030, 40.76% will reside in urban areas as per UN state of the world population report. The country has shown an increasing trend towards urbanization by the beginning of the present century. "In India, the process of urbanization increased with the start of the globalization and industrial revolution in the 1970s. For the urbanization, Forests were cleared, grasslands grazed, wetlands drained, and croplands encroached" (Sandeep,2017). Rapid urbanization is taking place in the country, and some of the major factors responsible for this are the natural increase in population, where the natural growth rate in urban areas is higher than that of rural areas, where the death rate is higher. Industrialization, jobs has resulted in the migration of people to urban areas. As the scholar,

Breese relates urbanization in India as pseudo-urbanization where people arrive at cities not due to urban pull but due to rural push factor. This rural push is due to economic compulsions.

The effects of urbanization in India are many like the development of slums in cities. With abysmal sanitation and sewage systems, the water bodies get contaminated in slums, and the environment problems take a toll in human development also. The other problem is the increase in garbage and solid wastes. Urban sewage does not have a proper disposal facility. As the Indian society progresses, it's trash, mainly hazardous plastics, metals, and packings are growing exponentially." In the last decade, garbage was produced at nearly twice the rate of population growth. Only eight out of 3,119 towns and cities in India have full wastewater collection and treatment facilities. A third of India's population has no access to sanitation services. It becomes worse in smaller cities and provincial towns."(Jaysawal & Saha, 2014). Another serious problem is with the sewerage. Almost every city in India does not have fully functional sewerage. It has been estimated that only 38 percent of the urban population has a sewerage system. This results in exploitation of rivers, like 40 percent of sewage in Delhi flows into the Yamuna, which has resulted in killing the river along the stretch of the city (Jayswal,2014). Environmental problems due to urbanization are rising at an alarming rate in India, with Delhi being one of the highest polluted cities in the world.

Hence the pressure of urbanization is a reason why traditional practices, beliefs are not practiced in urbanizing parts of India. The river community is becoming rare, most of them migrating due to the rural push factor, or the high pollution in rivers creating a hazardous environment for them to live. This affects the health of the rivers since the balance in the ecosystem is lost. To see if this is true, let us take a look into the case of Delhi, how urbanization affected the rural community and river culture.

THE CASE OF DELHI

"Delhi has attracted people from all over the country and its population today reflects the characteristics of almost every region. Delhi truly reflects the wealth and diversity of India, wherein diverse religions, languages, customs, and cultures co-exist in beautiful plural harmony. Religious, cultural and social functions of different socio-cultural groups have transformed Delhi into a city of festivals." (Government of Delhi)

Delhi is perfect for the case study since it has one of the most complicated political situations in the country. Also, the national capital is the most rapidly urbanizing area in the country. The prevailing trend of urbanization in the country can be understood from the case of Delhi. The fact of Yamuna through Delhi also reflects the fate of other urban rivers in the country.

Delhi's hydrology is closely linked with the city. It has always been intertwined with the history of the town. However, major historical events and periods, and the policies have influenced the rivers more negatively than positively. The river has provided both opportunities and danger. Due to sheer ignorance in the planning of the city, the governance and people have invited more disasters from the river Yamuna. The river has been seriously ignored from Delhi's urban form. The blame is in the planning of the city, a problem which is even persistent today. Rather than encouraging rural areas and farmers along the banks of the river, unplanned urbanization and policies have pressurized them to give up their culture, which resulted in, as the Delhiites describe "The death of the river." "A large water infrastructure network constructed in the medical Delhi sultanate has fallen into disuse. An understanding of the regional system was lost in the sixteenth century through the Mughal Dynasty used isolated fragments till the late eighteenth century. Delhi's British rulers found the collapsed network a health hazard and an obstacle to their grid-iron settlements. Modern development has ever since systematically dismantled the hydraulic network. Dams have been demolished and rivulets buried and converted to sewers (Danny Cherian, 2004)."

The present demographic of Delhi shows how urbanization has affected the national capital. The official website of the government of Delhi says that the rural population of Delhi has been decreasing since 1901 when it was 48 percent to 2.7 percent in the 2011 census. And the demographic map (figure 17) shows precisely the trend in urbanization where the areas with high population density have been pushed towards the fringes of the city, near to the river. "Delhi is among the top three States/Union Territories in terms of per capita income (Rs. 38864 in 2000-01), current prices. More than 80% of the state income is from the tertiary sector. However, with the continuous inflow of laborers and unemployed persons, the number of people living in low areas is increasing" (Economic Survey of Delhi, 2001-2021). With rapid urbanization, these highly populated rural areas have been adapting to a mix of urban culture. These areas which are always looked down by the elites in the developed regions of the city has been acting as a constraint to the visual connectivity to the river. Hence we can see that most of those who are the primary benefactors from the river, for drinking and other purposes are not aware of what is happening to the river.

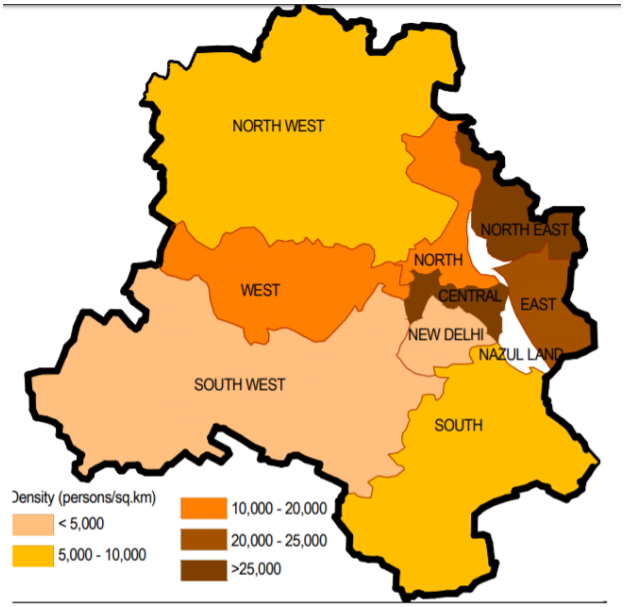


Figure 17: Demographic profile

Source – Govt. of Delhi (http://delhi.gov.in/DoIT)

Let us take a look in the history of the river and the city along with significant events in history and how this affected the river community, posed a threat to the culture, and eventually to the health of the river Yamuna. Here we discuss the 'four nails on the coffin' of the fate of the river culture and Yamuna through different timeline of NCT of Delhi.

Delhi becomes the Capital (1912-45)

In 1911, the capital of the raj was shifted from Calcutta to Delhi, and the foundation stone was laid. Large parts of New Delhi was planned by top British architects like Edwin Lutyens. The construction was completed by 1931 and inaugurated. The shift was to exercise control all over the country as Delhi is the centre of the then Hindustan, and the British motive was more political. The streams were designed establishing British legitimacy, racial and social segregation. The committee of May 12, 1912, chose Shahjahanabad which was defined by stream gullies on the North-South sides, the west by Delhi ridge and the east by Nizamuddin Nallah. Now, the Nallah has been buried under Great college street-Metcalf road axis, and the Clive-Dupleix and King Edward Roads were laid over the Kushak Nallah. To avoid connectivity between the racial and class-based neighbourhoods, the flow of streams were restricted and some redirected just like the roads (figure 18). Foe e.g., the stream originating from the Clerk's house at Gole were not allowed to flow south in the Windsor Place and Princess park quadrants (Danny Cherian, 2004).

Thus, the British ideology of continuing the caste system in India was the first nail in the coffin of the livelihood of the rural community and the river itself.

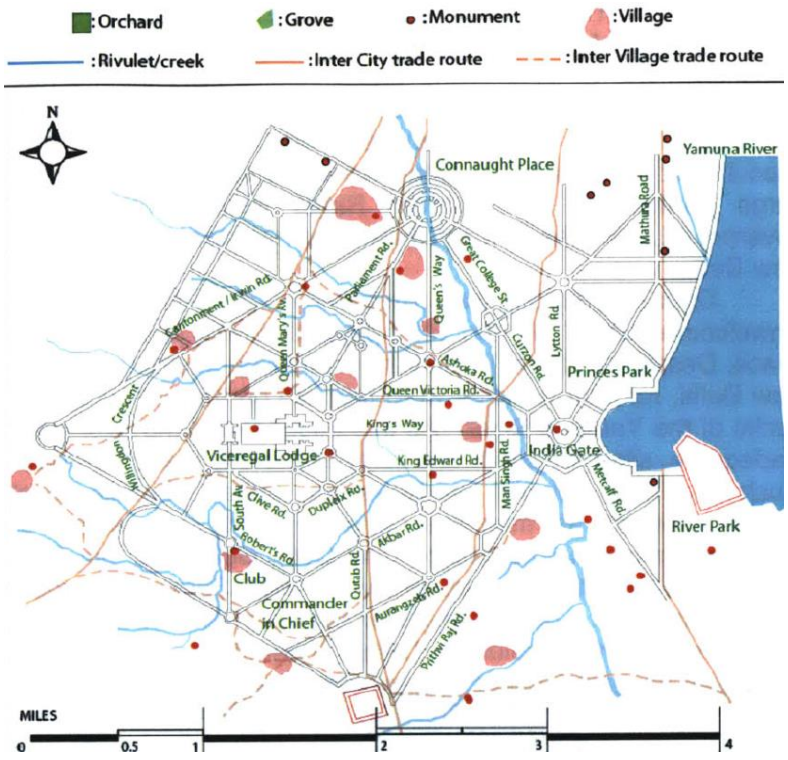


Figure 18:The 1912 New Delhi Plan

Source: Danny Cherian, 2004

Delhi after partition (1945- 1970)

The partition and inflated number of refugees in the 1947-48 period changed both the physical and socio-cultural landscape of Delhi. The second world war accelerated rapid urbanization with no concern for the environment. More migrants meant more space to accommodate them and hydrology of Delhi was extensively exploited. Here again, the effects of unplanned urbanization took place, where the Indian planners kept the refugees to the southern end, encouraging colonies in the banks of Yamuna river. The poor were kept at municipal edges, poorly connected to livelihood and civic infrastructure. This paved the way for the establishment of low-skill industries and factories in large residential areas, which was a violation of the 1962 master plan (Danny Cherian, 2004). These industries still are the major contributors to pollution in streams and the river. The British made sure that the new plan of the city again upheld the social and racial differences, which was also followed by the Indian planners. Hence the more impoverished immigrants were pushed towards the fringes, which infiltrated the cultural practices of the natives. Overpopulation in these areas with illegal

factories started polluting and exploiting the river. This laid the foundation for the gradual death of the Yamuna river passing through Delhi.

The inflow of migrants in the rural areas, near the river, infiltrated the river culture. Moreover, most of the immigrants were laborers, who did not practice agriculture or follow traditional practices of the natives. These immigrants themselves started polluting the river. The rise of illegal factories and the pollution ensured that the river and soil are unsuitable for agriculture.

Delhi in the Independent India (1975 -1990)

One of the significant events in the history of India was the National emergency declared under the Indira Gandhi Govt. in 1975. During this period, nearly seven hundred thousand people were relocated for the beautification of the city. These relocated people settled in slums in east of the Yamuna river, which were poorly drained, and started exploiting the river for various reasons including social repression, exclusion, and marginalization (Danny Cherian, 2004). Here again, with such social pressure, ignorance, and high density of population, the dwellers were to choose between preserving the river ecosystem or sustaining themselves. And after assessing the present situation, we can see that they chose the latter. And this encroachment, ignorance of the river from the urban form and exploitation had to pay the price during the 1978 flood. Again this resulted in widespread pollution of underground and surface water. More embankments and drains were constructed after the floods. Stricter rules were enforced to prevent construction in floodplain areas. The 2001 environment report state that a 201km embankment has been built along the Yamuna upstream of Delhi which has reduced the valley space and resulting in subsequent flooding. The 1982 Asian games, the biggest sporting event Delhi has hosted till then again changed the face of the floodplain, this time for worse. Hotels, auditoriums, flyovers, sports facilities were constructed on the river banks and stream valleys. For better transportation and high-speed roads, many streams were again buried, separating the poor natives and rural society from the elites. The immigrant workers who were hired for the Asiad works did not move back since they saw opportunities in the newly booming urban Delhi. These spaces gave rise to social unrest and produced riots (Mirrors of violence, Das 1990), one like the anti-Sikh riots due to the assassination of then Prime minister Indira Gandhi, a dark chapter in Nations history and one in Delhi and its hydrology also. During the riots, the nallahs were used to dispose of dead bodies, as much as 16 were found. The water bodies, the streams, and nallahs through the city were used in a political sense, so was the river, a way to separate the community based on enclave typology. This social unrest itself caused such riots or fuelled it. These settlements never helped the river again as these people were not interested in practices which helped the ecology of the river system. The area turned up to be two political constituencies in which the political parties saw opportunities, thus

providing them with necessary facilities (Mehra, 2006). We can see here that the planning department and the government were indirectly rooting for the death of the river through the national capital.

Thus during this period, the situation became worse, with no natives to care for the riverine ecosystem, creating more problems socially and ecologically. The slum dwellers risen in numbers, and so did the pollution level of the river. This trend, followed by the rise of Yamuna Pushtas, sealed the final nail on the coffin of the man-river relationship in Delhi.

The Rise of Yamuna Pushtas

The common trait in every uprising cities or urban areas in India is the inevitable development of slums or the poor section of the society who cannot afford to live in the centre. These people are neglected and pushed towards the periphery of the city, and they form colonies and slums. One prime example taken from our case study of Delhi is the Yamuna Pushtas, the slums developed by the last decades of the twentieth century along the banks of the river Yamuna. The history of the slums again starts with the British. The mutiny of 1857, a rebellion against the East India Company's power made the British to exercise more control, who was in the beginning blended to the Indian culture. "'Native' culture was now admonished for its inferiority, its propensity for dirt, filth, dampness, and congestion, and an effort was made to introduce European ideas of city order and planning to improve the poor condition of the city and its inhabitants. In the period that followed, a series of measures were introduced to intervene, perhaps for the first time, into issues of urban form - of how the city's citizenry lived, and in what type of housing. This change in emphasis provided the government a pretext to direct many areas of local life. Such colonial and hence, 'superior' improvements were also held up as justifications for continuing British domination" (Mehra, 2006). The company started deciding the price of the land and increased privatization of the area. And by 1936, the entire old Delhi was designated as a slum. The problem worsened when the British started collecting tax and spending it on New Delhi to improve their areas. This has to be assessed, keeping in mind the inflow of migrants into Delhi after partition, which led to congestion and economic breakdown in the area. As can be seen in the map, old Delhi which is home to the Yamuna Pushtas were located near to the river and acted as a source of pollution.

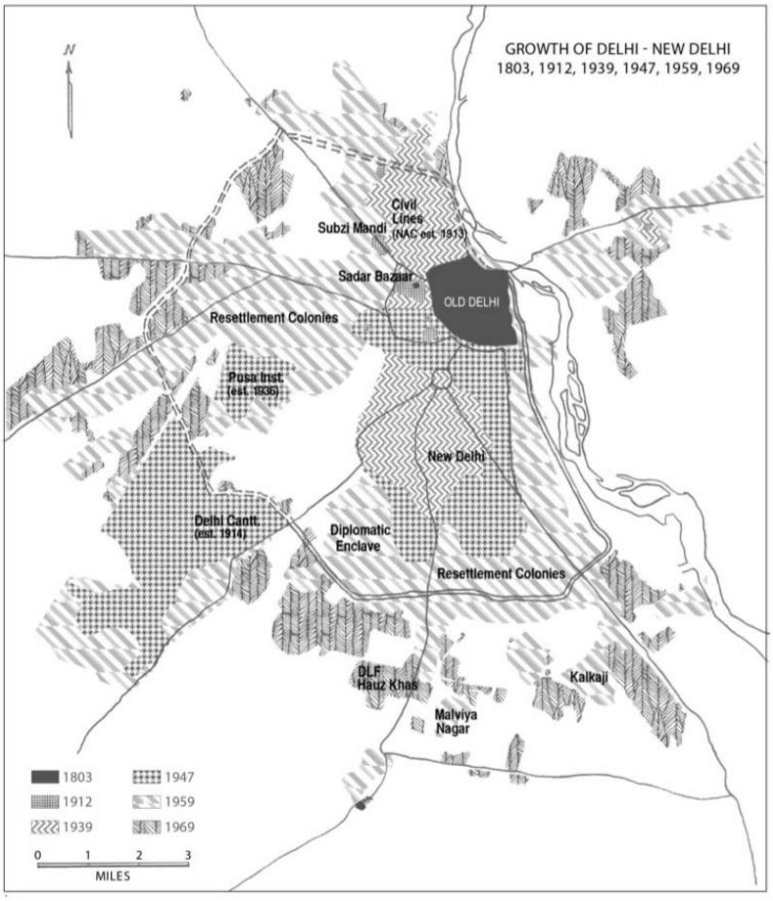


Figure 19:Growth of Delhi (1803-1969)

Source : Divya Mehra, 2013

After the independence, the act of 1956 defined slums as "Any area (where) buildings…(a) are in any respect unfit for human habitation, or (b) are by reason of dilapidation, overcrowding, faulty arrangement and design of such buildings, narrowness or faulty arrangement of streets, lack of ventilation, light or sanitation, or any combination of these factors, are detrimental, to safety, health or morals" (Birdi, 1995). "They were promised to be relocated and given houses, but even during three decades after this, the vacant land allocated for the slum dwellers to be relocated decreased from 80 sq. Yards in the 1960s to 15 sq. yards 2000s" (Mehra, 2006). And the changing governments never took initiatives to improve the lives of the slum dwellers, instead used it as a political weapon. The community was left vulnerable, and this exclusion from the society and is considered illegal after many policies declared for them, forced them to give up their culture. The inflow of immigrants and poor workers who also settled in these areas also influenced the natives. There are no official records about the natives, but as the master plan also denotes, the area has been used for agriculture, and the farmers paid tax in return of using the land. After the forming of the master plan of 1962 (figure 20), construction activities started in these areas, and many immigrant workers from Rajasthan,

Haryana, and UP started settling. Many farmers who cultivated either sold their land or had to give up some of it, thus the floodplain area being more as built-up land. Which eventually meant that those who had traditional river culture were displaced and hence, this is when the depletion of the ecology might have accelerated. With no one to take care of the river, negligence from the governing bodies, no apt policies to protect the Yamuna, thriving of illegal small scale factories and the nallahs that has been constructed by the British to enhance the social separation led the river to its present state.

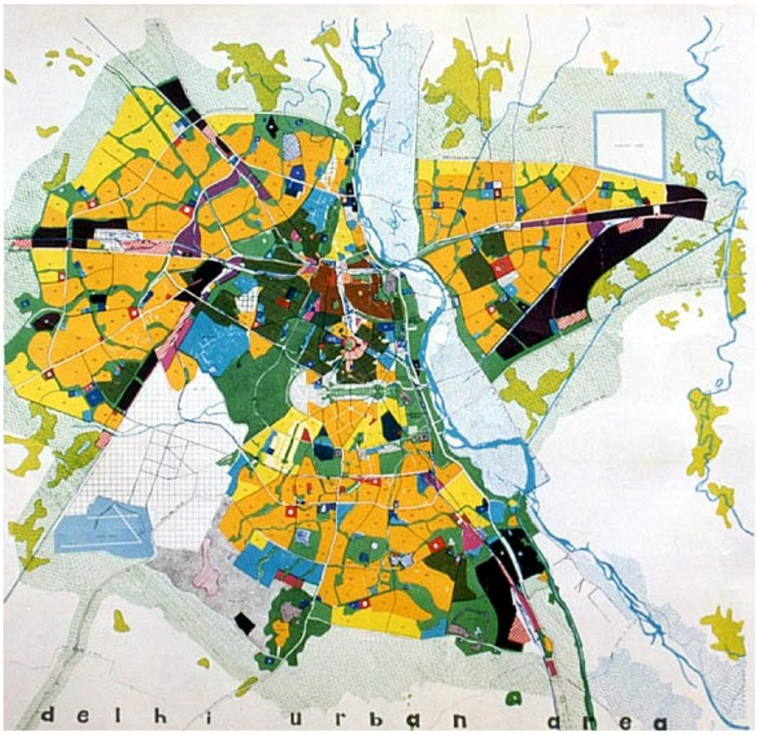


Figure 20:Delhi master plan 1962

Source : DDA

By 1999, over three million people were living in slum clusters all over Delhi (Almitra Patel vs. Union of India). Now the second eviction was in the 1990s, this time more legally, recognizing the dwellers are encroachers and polluters. In the Pushta settlement in the Wazirpur Bartan Nirmata Sangh versus Union of India, the court found out that it was the slums which were significant contributors to the pollution of the river. The government wanted to make the city with the likeness of Paris or London. But it was pretty evident that the now the river ecology will never be restored, no steps will be taken. The lateral connectivity was lost when the river was heavily polluted; now with future policies, the river would be reduced to just another point of attraction. "Mr. Jagmohan, the union minister of culture and tourism, unveiled the plan for a 220- acre national tourist and cultural complex on the riverbanks that would become one of the greatest hubs of cultural tourism and attract hundreds of thousands of domestic and foreign tourists." (The Hindu, 10 January 2004).

And finally, the new river community became a barrier between the city dwellers and the government. The structure of life in the slums distanced the middle and upper-class people from these areas and the river. The authorities found it difficult to implement any river revival works. And the political parties saw them as an opportunity for votes. Hence, once a group of people who preserved the river now became villains of the story. And the reason behind this, Unplanned urbanization.

The Contemporary Delhi

Delhi is the National Capital Territory, which is a city and a union territory having the national capital New Delhi. Bordered by Haryana and Uttar Pradesh, the city covers an area of 1,484 square kilometres; it has a population of 16 million according to the 2011 census, of which 97.5 percent of the total population share is in the urban areas. The city has been ranked the second-most productive metro area in the country by the metro economy. The metropolitan areas of the union territory are considered to expand beyond the NCT boundaries to the neighbouring satellite cities, making it the second largest urban area according to the United Nations. The city has played a significant role in the history of the country, serving as a capital for various kingdoms and empires. It has hence been captured, destroyed and rebuilt several times and presently is a cluster of several cities spread across the metropolitan region. The capital is also the centre of the National Capital Region, which is a unique interstate regional planning area created by the National Capital Region Planning Board Act of 1985.

YAMUNA FLOWING THROUGH DELHI – PRESENT THREATS

The Yamuna is originating from the Yamunotri glacier at Bandar Punch in the Shimla region. It flows for a length of 200km in the Himalayan region and joins several tributaries in its journey. Flowing south-west for 275km, it enters the national capital Delhi at 215msl. River. The river flows through Delhi for 30 km to Okhla (figure 22), flows 272 km to Agra and turns southeast to the confluence with the River Ganges in Allahabad. The slope of the river bed keeps decreasing in its flow through Delhi, from 0.56m/km between Tajewala and Delhi to less than 20cm/km between Delhi and Agra. In the official website of the Planning Department of Delhi, it has been mentioned that the Yamuna river and the final part of the Aravalli hill ranges are the two main geographical features of the city. Delhi is the dividing line between two significant river plains of the country, the Ganga-Yamuna plains in the east and the Sutlej-Ravi plains in the north. While the Aravalli hills are covered with forests and act as lunges to the city, the river Yamuna in Delhi is the source of drinking water and sacred to many of the inhabitants. One of the prominent features of Delhi is the river Yamuna flowing through the region. Then the River [Yamuna] flows south-west and southwards for 275 km to enter the National Capital Territory of Delhi at 215 m above MSL (Birj Gopal, 1993). In the 166th century, the first Mughal

Emperor, Babar described the Yamuna as "better than Nectar" and one of the World wonders, the Taj Mahal has been built on the banks of Yamuna.

SECTION	STATE	LENGTH (km)	TRIBUTARIES / DRAINS	DAM/BARRAGE	CANAL
Hills (Jamunotri – Hathnikund Barrage)	UK, UP, HP	172	Kamal, Giri, Tons, Asan	Dak Patthar Barrage, Asan Barrage	Dakpatthar Canal, Asan Canal
Upstream Delhi (Plains) (Hathnikund Barrage – Wazirabad Barrage)	Haryana, UP	224	Som nadi / Choti Yamuna Drain no. 2 and 8	Hathnikund Barrage	WYC and EYC
Delhi (Wazirabad Barrage – Yamuna Barrage – Okhla Barrage)	Delhi	22	22 drains, Hindon Cut	Wazirabad Barrage, Yamuna Barrage	Agra canal
Downstream Delhi (Okhla Barrage-Confluence with Chambal)	UP, Haryana	490	Hindon, Bhuria Nala, Mathura – Vrindavan drain, Agra Drain	Okhla Barrage	Agra Canal, Gurgaon Canal
Revived Yamuna (Confluence with Chambal – Confluence with Ganga	UP	468	Chambal, Ken, Kali Sindh, Betwa	—	—
Total		1376			

Figure 21:Barrages in the river Yamuna

Source: CPCB, 2000

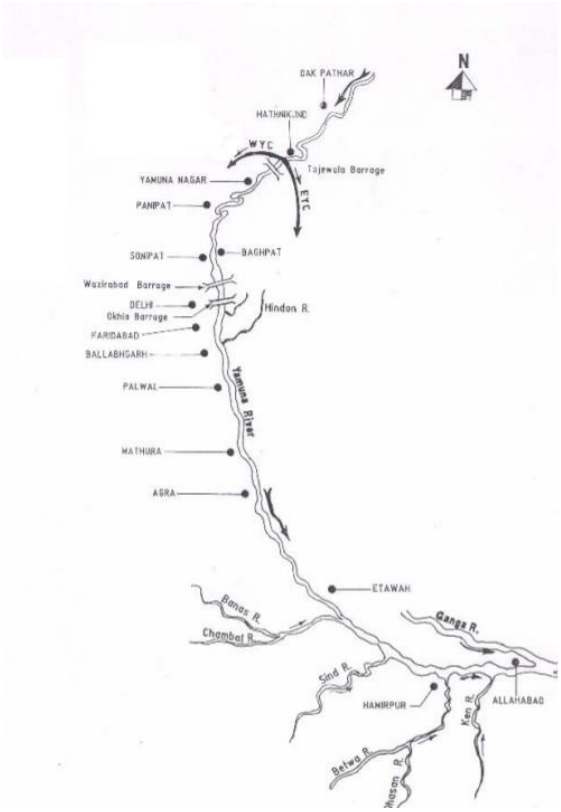


Figure 22:The Yamuna river basin

Source - Deepshikha Sharma and Arun Kansal, TERI University

A study done by TERI university mentions in its report that the river is polluted by both point and non-point sources, in which the National Capital of Delhi is the major contributor, followed by Agra and Mathura. The maximum pollution is recorded between the Wazirabad Barrage and Okhla, a 22 km stretch of the river. The river is tapped at the Wazirabad barrage, and no water is allowed to flow beyond during the dry season to meet the needs of the population. The flow that occurs beyond the barrage is just untreated sewage and wastewater. Same is the case of Okhla Barrage, where the water is tapped for irrigation purposes. As can be seen in the fig. 21, the river is dissected by five major barrages, and the water for various use is abstracted from here.

In the book River of Love, Habberman writes about two interviews he had with the residents of Delhi about their experiences on the river Yamuna. " Things were not this bad; many long-time residents of Delhi have fond memories of a river that no longer exists, says Mohan Sharma, a shop owner in Delhi. With a twinkle in his eyes, he told me about swimming in the Yamuna in Delhi in the early 1950s. He told about bicycling along the river banks. My grandchildren will never have this experience. Another person was Krishna Dutt, who used to take baths in the river, had leisurely swims in the river says with sadness. It's all gone." So does commander Sureshwar Sinha, founder of Paani Morcha, an NGO to

improve the condition of Yamuna says that Delhiites used to come for picnics on the banks of the river and enjoy its beauty even in the 1970s. One of the common factor each of them point out is, none of their grandchildren enjoy the river as it had been like they did. In the report by Central Inland Fisheries Research Institute (CIFRI), it is observed that the lateral and longitudinal connectivity has been disrupted with barrages which have altered the flow characteristics altering the natural habitat of the river. In an excerpt from a report by Climatechange.org, "There is hardly any fish in the Yamuna. The pollution has made the river into a drain. We don't eat the fish that we catch; it is not good for health, replied a fisherman. Many of the fishermen are forced to take up part-time jobs like pulling rikshaws." The people who were once dependant on the river is forced to move away, both due to pollution and loss of their means of livelihood. If this continues, the river Yamuna will be long forgotten very soon, ironically from where it has been considered as a Goddess.

What are present threats to the riverine community along the banks of the Yamuna and their culture? Let us take a look.

Urbanisation

Urbanization had increased rapidly since 1911 when the capital of India was shifted from Calcutta to Delhi. The pace of Urbanisation was enhanced during 1941-51 when the country was divided into two parts, and most migrant people settled in Delhi (Sandeep, 2017). The city of Delhi is overwhelmingly urban, with 75 % of its total area (1483 sq. km) falling in civil jurisdiction and the population density in the metropolitan area is as high as 14698 persons per sq. Km as per 2011 Census. 16.37 million Population, i.e., 98 % of the total population (16.79 million) of Delhi is residing in urban areas(Economic Survey of Delhi, 2017-18). The Indian state of Forest report states that Delhi has the highest rate of population density in the country with 11,297 people living per km2. Delhi is undergoing rapid urbanization, and the increase in urban population has led to environmental deterioration. Lack of planning is a significant issue that the growing metropolitan city is facing. There has been an unplanned development of industries and factories. "Studies have revealed that only 20 percent of industries are located in the approved industrial areas "(Sandeep, 2017). According to WHO, Delhi has been ranked the fourth most polluted city in the world. Due to the high movement of people into the town, the number of vehicles increased drastically, which is now the primary source of pollution. Delhi has a total area of 1483 square kilometre. The rural population and space have been in a continuous decrease with the rapid pace of urbanization, from 9.49 lakh in 1991 to 4.91 lakh in 2011. This also has decreased 300 villages in 1961 to 112 in 2011. The number of villages urbanized has increased from 20 in 1961 to 135 in 2011 and number of census tows has risen from 2 in 1971 to 110 in 2011. More than 97 percent of the population was in urban areas in 2011 census compared to

53 percent in 1901 (Economic Survey of Delhi, 2017-18). Cities in their life go through four stages of development marked by urbanization, sub-urbanization, des-urbanisation, and re-urbanization in a cyclical process (Jain et al., 2011). After the first stage of urbanization, the centre becomes congested, leading to a deterioration in living conditions, and as transportation facilities improve, people move out to live in a healthier lifestyle in the suburbs, leading to suburbanization which is currently happening in the case of Delhi. "With urbanization and industrialization, the primary source of environmental degradation had emerged. The main problems of environments had arisen due to urbanization and human activities that are water pollution, air quality degradation, global warming, etc. " (Sandeep, 2017). From the land survey by the GOI, in table 4, we can note that the area of forests and cultivable land is negligible compared to urbanized land. The surprising fact is that urbanization is taking place without improving the existing infrastructure and destroying natural features, which places an extra burden on the river Yamuna. The failure of the government to provide public housing to the poor resulted in illegal settlements in agricultural lands.

Table 4: Land Use Statistics in Delhi

Land Use	Area (in thousands) (ha)	Percentage
Total geographical area	148	NA
Reporting area for land utilization	147	100.00
Forests	1	0.68
Not available for cultivation	92	62.59
Permanent pastures and other grazing lands	0	0.00
Land under misc. tree crops and groves	1	0.68
Culturable wasteland	10	6.80
Fallow lands other than current fallows	8	5.44
Current fallows	12	8.16
Net area sown	23	15.65

Source : Source: Ministry of Agriculture, GOI

Also, even when 97 percent of the population is urban in the city, they are not exactly enjoying the benefits of the urbanization. From the pie chart, 19 percent lives in designated slums, 5% in unauthorized areas, and 13% in resettlement colonies, most of these areas which are located in the river banks. It is well known in Delhi that the loss of floodplain due to urbanization has resulted in a fall of groundwater table (Gopal & Sah, 1993).

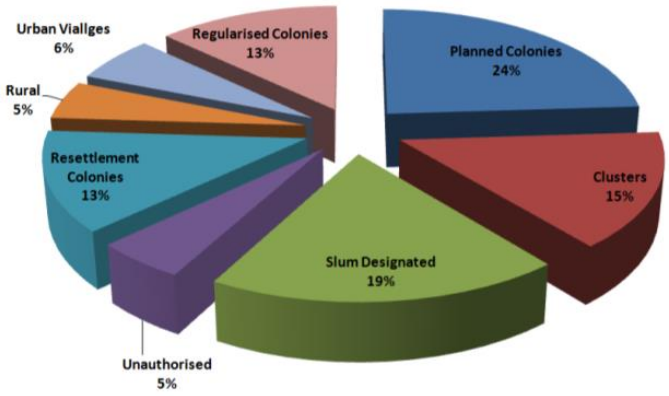


Figure 23:Types of settlements, Source: Delhi Urban an infrastructure improvement Project

Source: (DUEIIP,2001)

Why has there been a high number of uncontrolled settlements? It is mainly due to the increased gap between demand for and supply for land, housing, and allied infrastructure. This was due to high population growth and accelerated urbanization. Also, political and institutional failure is a reason, along with the failure to implement the policies that benefit the poor (Ahmad & Choi, 2011).

The sewage system and wastewater discharge

"There is no major urban or industrial centre along the Yamuna in its Himalayan stretch. At Delhi, after the Najafgarh Drain which brings in the partly treated domestic sewage and industrial waste immediately below the Wazirabad Barrage, 17 other drains add wastewater from diverse other sources (figure 24)." Several other drains have caused siltation and accumulation of heavy metals in the river basin. However, the sewerage system is not provided in the unplanned areas, and the wastewater is directly discharged into drains. "The existing sewerage conveyance system is a large network of branch peripheral and trunk sewers. There are 28 main Trunk Sewers with sizes ranging from 700mm Dia to 2400 mm Dia, with a total length of 130 km. The balance length of sewage conveyance system comprises of peripheral sewers and internal sewers of small sizes and a total length of approximately 6000 km. The Trunk Sewers have been laid over the years at different stages. Some of these are as old as 40-60 years old. The condition of Trunk Sewers, especially the older one, has deteriorated as a result of silting and settlements." (MPD2021 report)

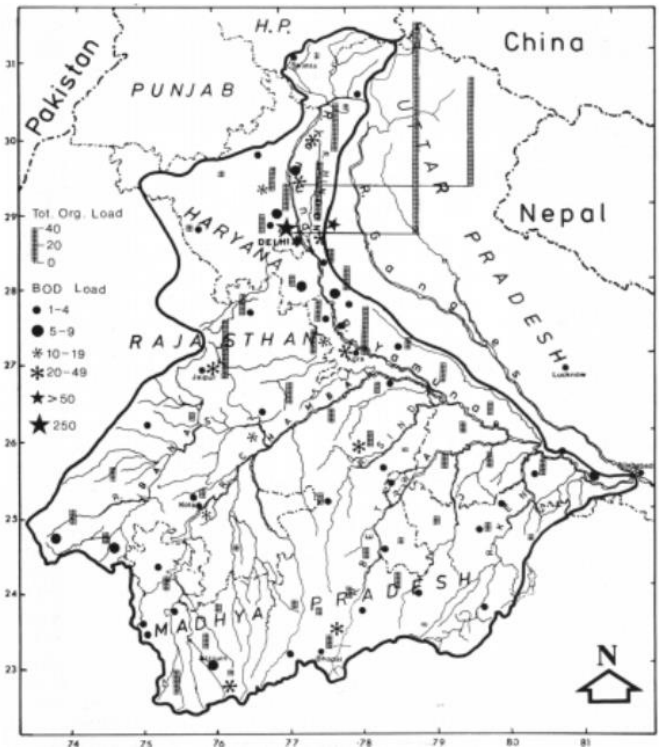


Figure 24: Mean total organic and BOD loads (x 103 kg/ day) entering the Yamuna river Basin

Source: Birj Gopal

Built up areas in the floodplains

To control the growth of the capital and immigration of people, the government of India came up with new policies, out of which was the Master plan of Delhi in 1962, the first ever in the nation. Land controls, housing programs were launched, but still, these couldn't stop the illegal activities, squatter settlements, and unauthorized colonies. Even though the Delhi Development Authority (DDA) introduced public housing, it failed to meet the demands of the massive rise in population and the weaker part of the society had to resort to unauthorized colonies in the urban fringes, near to the Yamuna river. These areas are not recognized by the municipality and therefore does not enjoy any benefits. The number of unauthorized slums shot up to 1300 by 1996. The informal urbanization has allowed private builders to acquire the land, since they are not under legal surveillance, hence converting the cultivable land into built-up areas. Thus the high-income earners of the capital are attracted towards the 'green' nature of the fringe areas, usually taking up properties for construction in the floodplain areas too. In the early stage of development of the city, the discontinuity between the built-up area and rural fringes were more pronounced than it is now. The increasing density of construction changed the urban fabric of the Delhi and altered the habitat of the Yamuna river

floodplain. Recently the authorities decided to legitimize the buildings and construction already present in the floodplain area. According to the Hindustan time's report, "The DDA has issued a public notice to re-define the river zone, proposing to reduce the area from the current 9,700 hectares to 4,961 hectares, thus allowing more construction in the floodplain of the river." This will allow more private builders to take up the land, even government agencies thus posing severe threats among others on the river.

Figure 25: Map showing geographic expanse of River Yamuna and its floodplain along with river bottlenecks in the NCT of Delhi.

Source: Urban Metabolism of River Yamuna in the National Capital Territory of Delhi, India. Govind Singh , Mihir Deb and Chirashree Ghosh .

The total urban floodplain of Delhi has reduced from 97 sq. Km to 83 sq. Km and a minimum width of 1 km were seen downstream Wazirabad barrage where it is severely bottlenecked. The locations are Wazirabad barrage, Shastri Park Metro station, Yamuna Bank Metro Station, CWG village and Okhla barrage. The presence of concretized urban infrastructure near the bottlenecked areas increases the vulnerability of flood hazard — the flood warning level of the river 204.0m, which has been crossed 14 times in 15 years. Thus due to failure in planning and inability to control urban sprawl, the urban

floodplain transformation leads to a reduction in the active floodplain area of the river, which not only affected the flow, but also the floodplain area around it (Govind Singh et al., 2016).

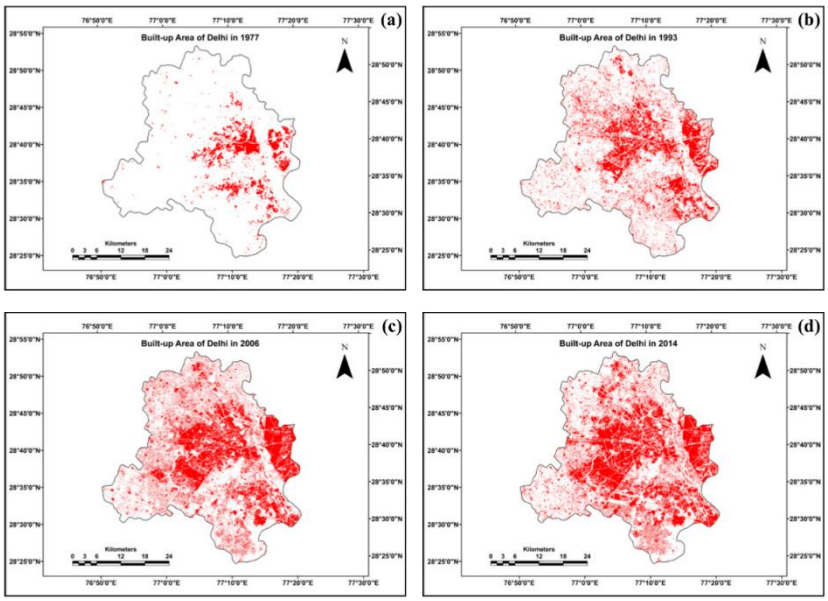


Figure 26: Built up area maps for the years 1977,1993,2006 and 2014

Source : Madhavi Jain, 2016

Peri-Urban Agriculture in Delhi

Even though 35-40 percent of India's population lives in urban areas, India's agricultural policies have focused mainly on rural areas, aimed at achieving self-sufficiency in food production, and to reduce rural poverty. Hence, urban food needs are expected to be met by production in rural areas. With such emphasis given on rural agriculture, the contribution from the urban and peri-urban agriculture is rarely acknowledged (Dolf de lintel et al., 2002). From the land use pattern in Delhi, in 1996-97 the agriculture lands including permeant pastures, cultivable wastelands, fallow land, and the net sown area were 41.7 percent while non-agricultural land contributed to 56.9 percent. The non-cultivable land has again risen to 62.59 percent of the total land area in the 2011 census. The economic survey report of 2017-18 suggests that rapid urbanization has affected the agricultural sector in Delhi. This is due to the number of rural villages in Delhi reduced from 214 in 1981 to 112 in 2011. The total cropped area was at 52816 hectares in 2000-01 to 34750 in 2017-18. The reduction in crop area was at 1.90 percent per annum (Economic survey of Delhi, 2017-18). The decline in forest and agricultural land is a result of pressure from rapid urbanization. These lands have been taken up by prominent real estate players building a more concrete structure on the floodplains. From figure 26, it can be seen that the majority of the agricultural lands are located in the floodplains of the river Yamuna. From mentioned

above, due to disregard in policies concerned to urban agriculture and informal urbanization in the fringes of the city, unauthorized construction and encroachment of floodplain is happening.

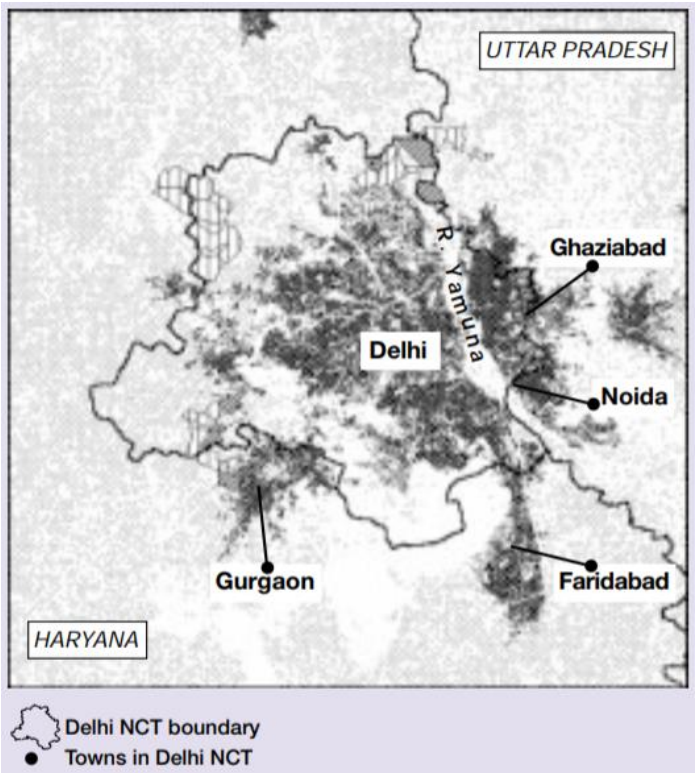


Figure 27: Agriculture in Delhi

Source : Dolf le Lintelo et. Al, 2002

In the latest agricultural census of India in 2010-11, it was seen that agricultural land holdings in Delhi is reducing at an alarming are due to rapid urbanisation. Nearly about three fifth of operational holding size was less than one hectare, commonly called marginal size (table 5). In 2011 census, marginal size holdings in Delhi increased to 55 percent. Only 0.76 percent had large land holdings which are more than 10 hectares (Census of India, 2011). With majority being in the marginal land holding sector, land fragmentation is very high. Many of them cultivate in leased lands paying cash at fixed annual rates. In the study scholar *Dolf*, about peri-urban agriculture, it is observed that leasing to and from farmers is fairly popular. With a reduction in agricultural areas, as of 2011 only 0.74 percent of the population is involved in agriculture. This can be due to the negligence and lack of support from the government for urban farmers.

Table 5: Agricultural land holdings in Delhi

DELHI	2005-06 CENSUS	2010-11 CENSUS
MARGINAL	55.5	55.17
SMALL	22.48	22.04
SEMI-MEDIUM	13.61	14.53
MEDIUM	7.63	7.53
LARGE	0.77	0.73

Source: GOI

What is the effect of such a situation on the river Yamuna? As per the 2011 census, 25 percent of the area was rural and the rest urban. The pressure of urbanization while carving up the fringes and the rural regions, the weak sector which depends on agriculture are threatened. This might be a reason for them to use pesticides for farming to yield more. Since the agriculture practiced are on the banks of Yamuna in Delhi, this affects the floodplains, the water retention capacity in the floodplains and the river directly, converting into a poisonous body. " From the present study conducted, the river Yamuna and its canals are contaminated with HCH and DDT residues. All the studied water samples were within the maximum permissible limit (MPL) of 3,000 ng/l for ΣHCH residues while 03 samples had crossed the MPL of 1,000 ng/l of ΣDDT in drinking water (WHO 1971). However, on comparing with European Commission (1998) only 37% were within MPL of 100 ng/l of ΣHCH while all the samples crossed 100 ng/l of ΣDDT. " (Kaushik et al., 2008). The authors conclude by saying awareness among farmers is needed so that illegal use can be reduced. We can understand that urbanization has forced the farmers to choose livelihood over the ecology of the river due to the pressure of urbanization. These are the same community of people who holds onto their beliefs and myths of rivers, considers the river as their mother. In a study, conducted by the University of Delhi, on two villages, Madanpur Kadhar and Jagatpur, it was found these villages who depend on agriculture and worship the river like their deity, have been ignored by the government and has been used just for political gain. This view is in contrast to that seen in various master plans of Delhi that the river can be channelized. " The socio-economic survey of the villages Jagatpur and Madanpur Khadar reveal a varied dynamic vis-à-vis the city. The survival of common property in Jagatpur in the face of rising land prices, and flagrant construction on the Yamuna flood plains, both by the government as well as private operators, is surprising, to say the least"(Bhatia & Kumar, 2016). The study concludes by saying that there is a striking distance between the villagers and the river. The river is completely missing from their rituals and songs today. When asked, most of the women don't even remember the songs of Yamuna. This is unlikely in the villages of India, especially in an area where the Yamuna flows.

The other agricultural group affected by pollution is the fishermen, who use the ecosystem services from the river. The fishing occupation also took a serious hit due to urbanisation. From 2,300 tonnes in 2002-03, the production has reduced to 740 tonnes in 2015-16, which is a 68 percent decline. Figure 28 shows the abundance biomass relationship, which shows the reduction of many species of fish due to heavy pollution. The study conducted by the Central Inland Fisheries Research Institute in India found out that the fish species in the Yamuna, especially in the 22Km stretch between Wazirabad and Okhla is under threat. As shown in figure 28, in Delhi and Panipat, where the river is relatively polluted, the biomass curve passes over the abundance curve indicating the dominance of opportunistic species to the large-sized species due to environmental degradation. This is due to the reduced level of dissolved oxygen content in these parts of the river, that fishes which can adapt to these conditions thrive while others migrate or become extinct. Thus the livelihood of the fishermen are in grave danger such that they are forced to move away from the river and do alternative jobs in the town. The suggestions made by CIFRI about the protection of livelihood of fishermen and conservation of fishes were to stop the deforestation in the floodplains of Yamuna to stop the soil erosion. It also urged the government of Delhi to stop the exploitation of the river bed for extraction of stones and pebbles in upper segment of the river, the extraction of which prevents the breeding ground and food web of the prized Mahseer fishery.

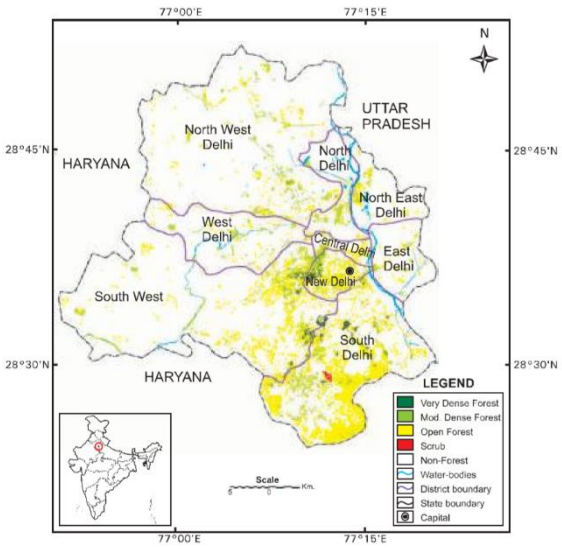


Figure 28: Forest cover in Delhi

Source: Indian state of forest report 2011

Fortunately, the forest cover on Delhi has increased to 305.41 sq km, nearly 279 sq km has been added by 2017. Delhi has the second highest tree cover among states, and the green cover has increased by 20.6% during 2017. This has been evidence of the state's policies to fight high pollution. However, the lowest forest cover has been in East Delhi at 3.70 sq km, where the river flows through the NCT (Economic Survey of Delhi, 2017-18). The type of cover found in this area is open forests, lands with forest cover with canopy forests of 10-40 percent (FRA report, 2010). This is proof how urbanization, especially the illegal settlements, has altered the ecology of the floodplain (figure 27).

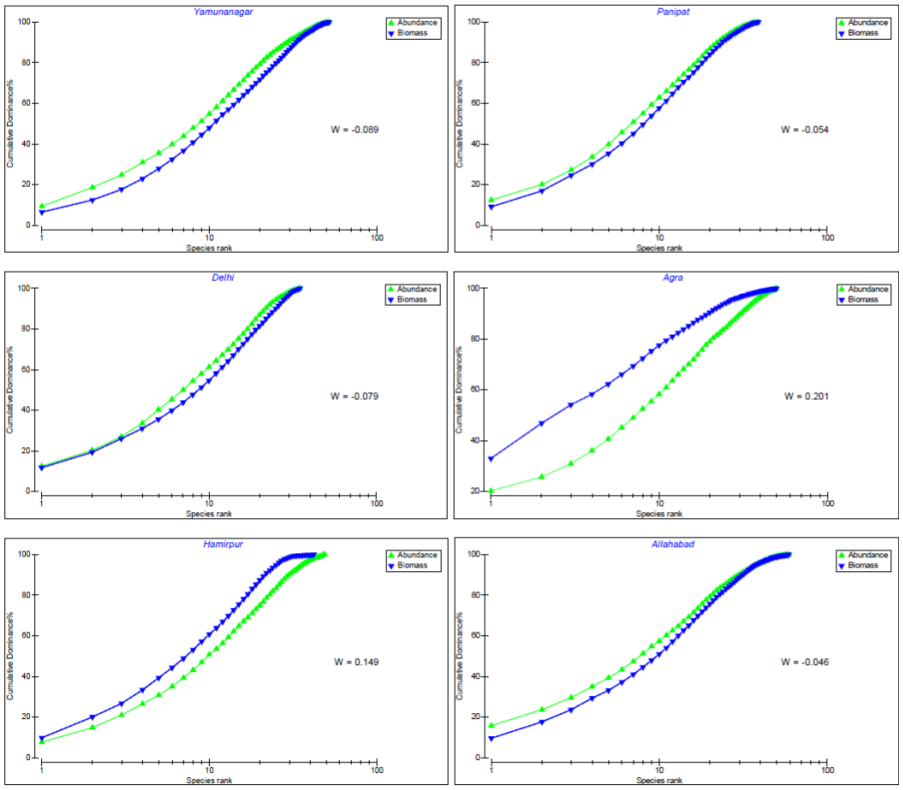


Figure 29: Species abundance-biomass relationship at various stages of river Yamuna

Source: CIFRI report

Pollution of Yamuna in Delhi

"The discharge of untreated domestic and industrial effluents have severely affected the quality of Yamuna River, and now it falls under the category E, which makes it fit only for recreation and industrial cooling, completely ruling out the possibility for underwater life and domestic supply. Almost every year, the mass death of fishes is reported. The Yamuna has been reduced to a small stream, draining industrial effluents, sewage, dirt, and other toxic substances. There is an urgent need to take stringent measures to alleviate these pollution loads and save an ailing river." (MIsra,2010)

Delhi can be termed as a river city, and the reason for the existence of the city is the river Yamuna. But in the last few decades, due to unplanned urbanization, industrialization and over exploitation, the river has been heavily polluted. India Today report says that the 20km stretch of the river in the capital is one of the highest levels of river pollution in the country and as per reports, the level of industrial pollution is nearly 13 times than that of the permissible limit. The point where the river Yamuna enters the capital, Wazirabad, the DO content is 7.5 milligrams per liter, and when it exits, it is 1.3mg/l. The Central Water Commission found out that the Yamuna through Delhi has the highest level of Biochemical Oxygen Demand (BOD) in the country. The stretch of the river in Delhi from Wazirabad to Okhla is highly polluted. Something more interesting to note is that, after leaving Delhi and joined by other rivers, the pollution levels start dropping. It was reported that nearly half of the sewage in the city was disposed of straight into the river without treatment. It is evident that the river Yamuna has been widely affected by human activities on the river. Are urbanization and unplanned growth of the city with overpopulation a reason for the exploitation of the river? Due to the high increase of population from 7 million in 1991 to 19 million in 2012, demand for land and water for human settlements, industry, and agriculture, grazing has resulted in wastewater discharge into the river. The river is used for various purposes like navigation, fisheries, growing aquatic plants, cattle bathing and washing, of which 70 percent of the total cattle population use the Yamuna which is a major source of pollution (CPCB, 2006-07). The BOD and DO levels which are under permissible limits before entering NCT of Delhi change drastically. While the DO level drops to nil, the BOD level goes up as high as 25 mg/l. From the data collected from CPCB and compiled, it can be seen that the BOD level in NCT of Delhi after certain points have always been on the increase through the years. Increase in BOD level means plants and animals cannot survive in water, which makes it unsuitable for irrigation. And it is higher than the recommended levels for bathing. This makes people stay away from the river.

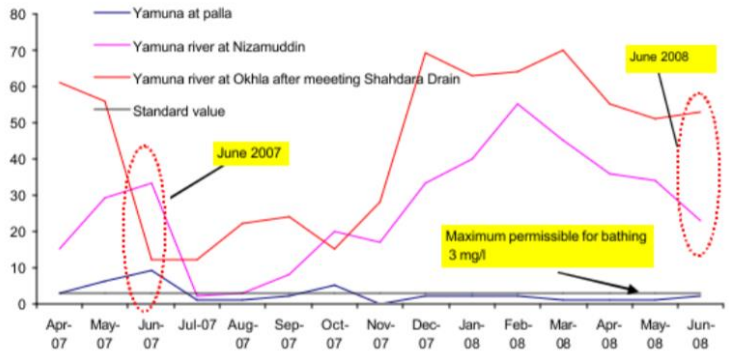


Figure 30: BOD in the river 2007-08

Source: Compiled by Sharma and Kansal from CPCB monitoring reports 2002-08

The Yamuna River Project (YRP) report says, "For centuries, the river existed not just defining the axis, but also the ecological and agricultural lifeline of the many settlements, preceding the present day Delhi. In New Delhi, Yamuna has been reduced to a poorly managed sewage drain, absent both from the urban landscape and the public imagination. The fight for citizens survival inflicts even more damage to an already fragile ecological circumstance. Urban development justified in the name of civic prosperity is often misleadingly defined opposition to environmental security. In the hardscrabble urbanity of the present Indian megacity, there is only little room for ecologically sacred. Delhi's public is now completely detached from the river, only a part sharing the consciousness of public space. This detachment is the underlying cause of Delhi's dilemma." This statement of the report summarises what we have discussed until now in this chapter.

The stakeholders

The stakeholders involved for the protection of the rivers and the ecology of the area are Delhi Development Authority (DDA). They are responsible for removing the J.J. clusters and unauthorized slums and riverfront development. Delhi State Industrial and Infrastructure Development Corporation (DSIIDC) which ensures all industrial effluents are treated before entering CETPs. The Upper River Yamuna Board, another stakeholder, has to release adequate water for dilution to ensure minimum environmental flow to reduce the pollution in the river bed. The Delhi Jal Board was established on 1998 under an Act of the Delhi Legislative Assembly and are responsible for capturing entire sewage and conveying it through STPs. The Municipal corporation of Delhi prevents dumping, desilting, closing unauthorized industries, slaughtering and Dobi Ghats in unauthorized areas. Irrigation and flooding control department – desilting, channelization of drains including fencing.

POLICIES AND STEPS

From the 1970s wildlife protection and air and protection laws were enacted in the parliament. Also, significant changes were made in the Indian constitution, the right to life was also included to enjoy a healthy environment as a fundamental right. The court also included international environment laws which provides for polluter pays principle, the precautionary principle, the principle of inter-generational equity, the principle of sustainable development and the notion of the state as a trustee of all natural resources. Thus the court had the jurisdiction to order and control the activities in the riverfront, thus redefining the relationship of the city with the river (Sharan, 2016). A public Interest Litigation (PIL) was filed in the supreme court in 1994 in concern with the pollution of the Yamuna, in which the court observed that setting up of sewage treatment plants was required due to the increase of population. This however required the evacuation of settlements, especially the slums in the area

which created a complicated situation. However, in august 2003, CPCB reported that 30 STPs were setup. This wasn't efficient, with more people settled to illegal habitation who wasn't connected to the STPs and thus increasing the sewage into the river ironically.

As of March 2015, the sewage treatment capacity of STPs in Delhi is 613.7 MGD. This is insufficient to treat the sewage generated by the city, and even this is under-utilized (CPCB,2006). The court in 2003 also observed that electroplating units, dye units, dairies in the Yamuna Pushtas, the most massive slum clusters in Delhi were contributors to the pollution of the river. However, a study done by NGOs showed that out of 3600 million liters of wastewater flowing into the river, less than 1 percent is from the slums. Between 1993 and 2003, more than 51,461 houses were cleared under the slum demolition scheme (Sharan,2016). If they weren't the major contributors to the pollution of the river, why were they displaced hastily? The poorer section was termed as encroachers and was sacrificed to host the commonwealth games, and also for the beautification of the city rather than finding a better shelter for them to improve their lifestyle. Hence, what we see here is not an attempt to revive the river, but just using it as a political agenda for real estate giants and the elites in the city. The only people that see the state of the river are those who live alongside the river. Those living in the centre aren't aware of what is happening in the river and unfortunately not much polices are made to connect them with the river. Due to fast urbanization taking place in the rural areas of Delhi, cultivable land under irrigation is getting reduced day by day. In Master Plan of 2021 for Delhi, Delhi Development Authority has also proposed complete urbanization of Delhi. Hence any increase in the command area in the future is not possible (Economic Survey of Delhi, 2017-18). For the development of Yamuna in a speedy and sustained manner, the trans-Yamuna Area Development Board was setup in 1994. Since its inception, all the activities related to the Yamuna is organized by the board. In 2017, the High court of Uttarakhand, passed a historic judgment of declaring the rivers the Yamuna and the Ganga as a living entity to implant the idea of the responsibility of saving the river.

MPD 2021

The master plan of 1962 was more focused on land use and accommodating the migrants. Very less focus was given to the river Yamuna. However, in the MPD2021, the river Yamuna became one of the primary consideration. Significant highlights of the plan for the river included rejuvenation of the river through several measures, including ensuring minimum environmental flow, treatment of drains, sewerage of un-sewered areas, treatment of industrial effluent and removal of coliforms at STPs. To encourage social connectivity, provision of lung spaces/ recreational area and green belt to the extent of 15-20% of land use, and multipurpose grounds for public functions. These steps can reduce the

pollution of the river, to an extent, which can improve the life of the community along the rivers and also encourage the general public to connect with the river.

Another highlight of MPD2021 is the regularising of unauthorized colonies and incorporating into mainstream urban development. This will help to reduce the gap between the public living in the cities and the weaker section of the society. A better social situation means an improvement in the ecology too.

Hence, it is good to see the government giving importance to connectivity between the public and the river. Also, steps taken to reduce the social gap provides hope for a sustainable future of the river. This might encourage the people in the city to socially connect with the river, while an economic boost for the rural community means, they can practice organic agriculture. Thus an eco-social approach can be established.

INTERVIEWS

To get a close view on the situation and compare the past and present state of the river, an interview was conducted, with Mr. Dias Mario Antony. He was a resident of Delhi for the past five years, a professor in History and also teaches postgraduate papers on social theory, environmental history, Human rights movements in India, History of Agriculture and crafts in medieval India. Following is an excerpt from the interview.

1. How long have you lived in Delhi?

I lived in Delhi for five years. It was from 2012-2017.

2. As a historian, do you think the Yamuna is no more considered as an Integral part of the city as it had been in the previous centuries?

People still do consider the Yamuna as an integral part of Delhi. But the difference is that the river has become less a part of everyday life of Delhi Citizens. This can be partly because the city has expanded so much that not everyone sees the Yamuna anymore. This was, however not the case before the colonial period, when most of the town was located right on the banks of the river and people directly depended on it for water and subsistence — talking about sustenance from the river. Remember that it is not just agriculture but fishing also. In short, even though people still consider the Yamuna to be an integral part of Delhi, there is no longer a personal connection with the river.

A hypothetical example will make this more understandable. Imagine you are living on the banks of Yamuna in the medieval period. You would take care not to pollute the river because you know that your source of drinking water and agriculture comes from the river itself. So, there is a personal

incentive to protect the river. Imagine the same situation in the present day. Almost everyone has alternate sources of water, and virtually no one relies on agriculture on the flood plains. So it much more impersonal.

3. Was there are river community along the banks of river Yamuna who protected the river through their culture and beliefs?

I am not personally aware of any specific communities, but the river is a reason for the civilization of the capital. The river has been worshipped for centuries, and as I said, the main occupation being agriculture, people connected with the river daily. So, yes, even if there wasn't a particular community, everyone saw it as a responsibility to conserve the river, and had the understanding that it is crucial for their survival.

4. Do you think the British policies towards Indians during the 20th century has resulted in the conversion of these rural areas along the river into slums?

Slums arise mostly due to rapid urbanization and development, which is not inclusive. It happens primarily due to unequal growth and opportunity to people. So, blaming the British for the growth of slums along the banks of the river does not seem appropriate. Slums usually arise in the outskirts of cities where there is free land and where the people from slums have easy accessibility to serve the more gentrified sections of the city. In the North Indian case like that of Delhi, even caste plays a role in where slums may be set up. Individual slum pockets usually house only people belonging to one particular caste.

I agree with your Point of view. However, in my readings, I found out that the British always made sure that the caste system was kept intact in the Indian community. This approach was followed by the Indian planners after independence when they made the master plan for Delhi in 1962. So can we say that the British had a role in ignoring the natives to the outskirts of the city?

I am not sure I can conclusively say about this. But it is a fact that the British used the caste system for discrimination. So it must be a reason for the development of slums along the banks of the river and outskirts of the city.

5. Has the migration of different people from various states infiltrated the river culture of the native community? Can this be one of the reasons why the river Yamuna is criminally ignored in the present?

Yes, definitely. A large percentage or Delhi's population is first, second, or generation migrants in the city. These people will never have the attachment that the natives may have towards the land and rivers of Delhi. These are people who have never relied on the Yamuna for their survival. For most people, Yamuna is just another massive drain which carries most of the cities effluents.

6. In the National Green Tribunal Report, it was mentioned that the DDAs plan to create new recreational areas and parks along the river Yamuna should be discouraged and more importance should be given to ecology. Do you agree rehabilitation of natives and indigenous people is a better option for the river revival?

The problem with this is that. Who are the natives? Who are the indigenous people? It is too difficult to identify such a native population now. Even if one can rehabilitate such a community, there are several other problems this will pose:

The river has to be clean in the first place for these people to earn a subsistence and for them to be willing to move towards these places. Will they be able to make a livelihood from agriculture and fishing in an expensive city like Delhi. What happens of all the other constructions and industries on the river banks. This includes one of Delhi largest hydel power stations and also the Yamuna Bank Metro Station. What are the alternative arrangements which can be made for the disposal of industrial waste which currently flows into the Yamuna from the Delhi NCR region particularly from industrial areas like Okhla?

7. One of the major occupations in Delhi even in the past centuries was agriculture. But less importance is given presently, the Delhi govt. Providing only eight crores of its annual budget for agriculture. If agriculture is encouraged, the main occupation of the people in rural areas, can this help the improvement of the current state of the river?

I am not so sure. There are many problems:

1. Like I mentioned, people are moving away from agriculture now. How much ever the govt subsidizes the farmers, the income will not be able to sustain a decent standard of living in an expensive city like Delhi.

2. The first problem is also linked with the size of the holdings. There are no large plots of land which can support commercialized farming. The land holdings are only significant enough to support subsistence farming.

3. Even if commercial farming can be supported by consolidating land holdings, it poses the next problem. Use of fertilizers and pesticides which can cause leaching and add to the problem. If there is technology (which I am not aware of) which can solve these issues, then maybe.

4. It is true that in the medieval period the banks of Yamuna supported farming and fishing-based society, but then again that was subsistence-based farming, and that too during a period when the cost of living was nothing compared to what it is now.

8. So maybe, if the govt. Takes action against these lobbies and protect the farmers, perhaps agriculture can still emerge as a profitable sector in Delhi?

It could. Maybe if it can create a niche market for itself, for example, let us say it creates a cooperative society and then grow only organic vegetables. Then I pretty sure they will be able to market well to a customer base which consists of the health-conscious upper-middle-class population of Delhi at a premium price. It will require a right amount of cooperation and a highly innovative marketing network. This can solve multiple issues of income, use of pesticides, and small landholding issues.

The second interview was with Mr. Birj Gopal, Chairman of SIL Working group on Inland Waters of Tropical Asia; Adviser, water Conservation Programme, WWF-India; President of National Institute of Ecology (2018-2020). He was also the part committee formed by the National Green Tribunal, to study about the case of Manoj Misra Vs. The Union, on the river Yamuna. The questions were based on the recommendations in the report, settlement along the Yamuna and government policies and approaches.

1. You were part of the committee formed by the NGT to study the case of Manoj Misra Vs. Union. Are you suggesting that the DDA's plan to build recreational areas is a bad idea?

One has first to understand recreation itself. What kind of recreation, for whom? Does recreation mean going to nature and enjoying it OR doing a business out of it? Is walking through a forest or along a lake, not recreation? Do only Parks, lawns, golf courses, amusement parks, eateries, malls, children, sports, etc. constitute recreational areas?

The report suggested recreation through access to restored/constructed wetlands – walkways and trails. Floodplains close to the river are not to be converted to commercial recreation areas.

2. One of the recommendations in the report was to develop a mosaic of wetlands and floodplain vegetation having native biodiversity. Do you believe, encouraging rural community that follows

river culture will be able to play an integral part rather than just an official authority from the government?

There is no rural community left within Delhi despite some areas in the north and south are classified by the govt as rural (but should be called suburban). We have even urban villages embedded within Urban Delhi, and in these villages, the municipal laws of land use are not applicable. "Traditional" river culture does not exist in Delhi part of Yamuna, and in most of the other areas, urban culture has taken over to a great extent.

3. Agricultural activities in the banks of Yamuna poses a threat to the river in recent years. According to the 2011 census, 55.17% of agricultural land is marginal holdings, i.e., under 2 hectares of land. To reap more harvest from small farms, farmers are forced to use pesticides and chemicals. Can urbanization be termed as the main reason behind this? Is India's and Delhi Govt.'s ignorance of peri-urban agriculture a reason for this?

Agriculture has been practiced on floodplains historically. Now the floodplains have become urban areas, and riparian fringes and even the river bed are brought under cultivation. The city, after all, needs vegetables and other crops. Pesticides are used now because the lands and water are polluted. We recommended organic farming (no agrochemicals). What is peri-urban today, become urban next year – not after five years. Urbanization is not linked to the use of agrochemicals.

4. How significant a role has religious activities played in Yamuna's pollution?

They contribute to pollution but tiny, because the river is already heavily polluted with sewage drains. Religious activities are also turned into commercial ventures, and hence more pollution.

5. An additional recommendation in the report was a separate program for spreading awareness among the public for the conservation of river to encourage public participation. Why do you think the people in the city are not much concerned with the current state of the river?

People in the city are not concerned with the river because it has no relation with their daily life, not even the water they get at their doorsteps – whether from the river or elsewhere or groundwater. Even the people living in high rise buildings along the river are not concerned except that they want the govt to remove the stink (foul smell). Those responsible for Akshardham temple on the river floodplain are not concerned with the river. Awareness programs are always supporting activities – aimed more at publicizing the efforts.

6. Do you think the development of slums near the banks of the rivers, pollution, etc. has acted as a social barrier in connecting the people in the city with the river?

To a great extent, YES. But slums have also been allowed to develop by the Govt itself. which a separate department for taking care of slums. These are often referred to as illegal encroachments and are removed from time to time.

7. Do you think the inflow of migrants after Independence and migrant workers settling after Asian games, in the rural areas along the banks of the river, infiltrated the river culture of the natives? Is this a reason why there is complete ignorance for the river?

Yes, migrants have been asked to settle along the river – not only after independence or Asian games but on several other occasions (e.g., Tibetan refugees). But it is the govt that has occupied and converted the floodplains most and ignored sewage treatment, and even the development of sewerage.

Analysis of Interviews

In both the interviews, Mr. Dias and Mr. Birj pointed out the loss of the relationship between people and the river. Today, the relationship has become more impersonal, as the dependence of agriculture is very less, and the public has access to water for their daily needs from elsewhere. Mr. Birj says that traditional culture does not exist in the Delhi part of the Yamuna and has been overtaken by urban culture. We saw this when the banks of Yamuna were converted to slums, and immigrant workers were less concerned about the river. This situation was also mentioned in both the interviews. Both of them expressed their concern over the threat to agriculture, and how the existing agriculture poses a threat to the river. From both the meetings, we can see that the river community in Delhi no more exists. Both of them agrees that migration played a significant part in the loss of river culture. And, it is difficult to nurture such a community again. Urbanization and the expensive lifestyle makes it impossible for communities to settle and follow traditions.

Moreover, the public, in general, does not have a social relationship with the river. The relationship was further worsened by the rise of slums, which was agreed by Mr. Birj. Hence, today, any rituals performed are turning out to be gimmicks, which are blindly followed.

CONCLUSION

The chapter began by asking the question of 'why urbanization is a threat to river culture in India?' We examined the case of Delhi and Yamuna flowing through the city. Delhi was chosen because it is one of the fastest growing urban areas in the country, with a complex governmental system and over population. These are some of the traits which are typical for all metropolitan areas in the country.

After examining the history of the capital, we saw how urbanization affected the river communities, how the mentality of the public changed about people living along the river banks, and how caste based planning by the British, migration led to the rise of slums which eventually resulted in the loss of river culture in the Yamuna. Even when the present scenario was examined, we saw that also when steps are taken to revive the river, the river communities were not addressed. Moreover, issues such as rapid urbanisation, poor sewerage system, encroachment, no support for agriculture by the govt. and high level of pollution makes it impossible for following traditions along the river (figure 31). More focus is given to follow modern riverscape architecture from Europe or elsewhere, rather than encouraging traditions and culture, which can ensure a sustainable river ecosystem cost effectively.

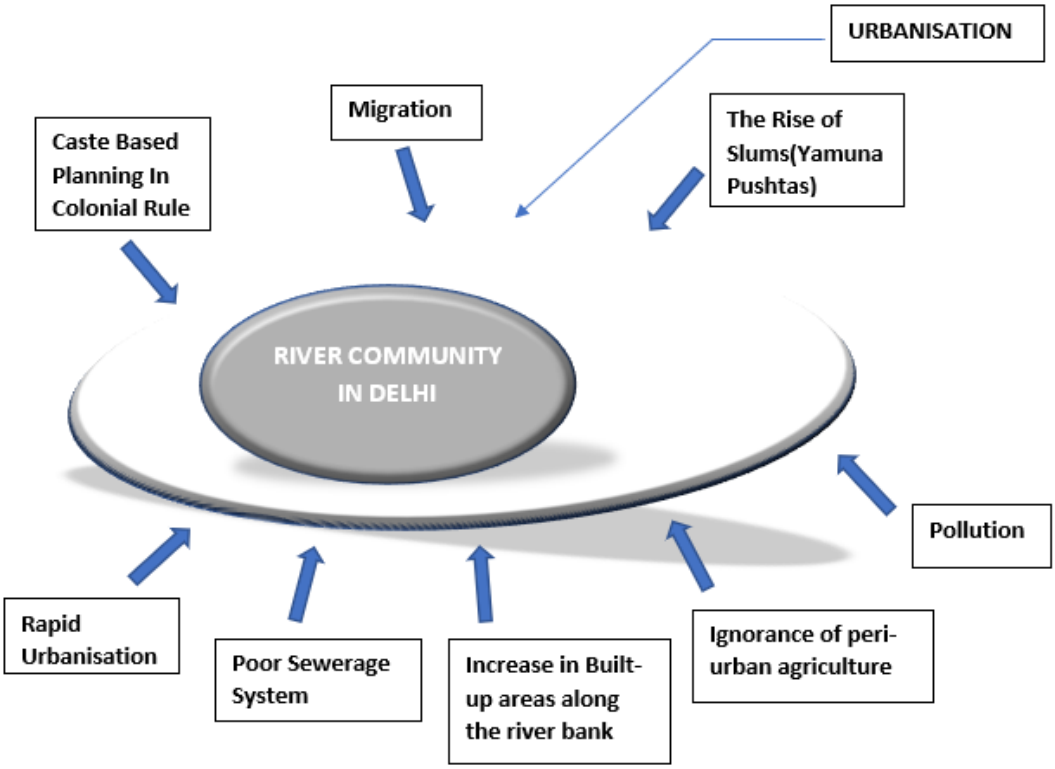


Figure 31: Analysis of Threats of Urbanisation to River Culture in Delhi

SUMMARY

The research thesis analyses to integrate River culture in River management. The Indian river culture is taken into context and various examples are discussed. The report is divided into three sections, answering three significant questions – How, What and Why?

The first chapter tries to answer the question, "How is cultural diversity linked with biocultural diversity". The section explains that culture is not only crucial for human civilizations, but also for our surroundings. Cultures evolved to conserve the nature around us and is susceptible to change as humans advances. However, culture is easily sacrificed as human species progresses. A general idea was provided in the chapter, on how culture is vital in sustainable development for the future. The section ended with an introduction to river culture.

The second chapter tried to answer 'What are the various river cultures in India?'. The section was divided into two, namely, the ecological approach and social approach. Various examples and cases from India were given under both, including Indian mythology on rivers, agricultural practices, rituals and traditions, and architecture. The chapter ended with an a successful example of an eco-social approach, the Kumbha Mela.

The final chapter answered the question of "Why is Urbanisation a threat to river culture in India?". Here, the case of Delhi and the river Yamuna was considered. The history of the river communities since the formation of the capital city was studied, under the colonial rule and after independence. The chapter focused more on the rather ignored factor of loss of social connectivity with people and the river. As the river gets more polluted day by day, the public moves away from the river. This situation is worsened when the river communities fall to the pressure of urbanization and usually give up their traditions. Two interviews were conducted to understand the situation more precisely. The responses cemented the findings about the case study.

CONCLUSION

The research aimed to integrate cultural, social, and religious elements in river management. One of the widely discussed topics is conserving rivers and stopping river pollution. Even when almost all the aspects of this area is covered, the man-river relationship is not yet widely considered.

Many countries in Europe have strict laws on interacting with the river and activities around it. When Paris developed, the social connectivity (Lateral & Vertical) of the public with the river Seine was sacrificed for better longitudinal connectivity of the river. However, recently, the authorities had to plan events like the *"Paris Plage"* to bring the people to the river since it was not a part of their lives anymore. Any natural feature without the interaction of humans is just another showcase material. The purpose of nature is to serve its species, and it is our responsibility to respect and not exploit it. The perfect example of this is the case of India. The Indian culture taught its generations how to stay as one with nature, to find the true meaning of life from nature. People approached the river bodies ecologically, for practicing agriculture, meeting their daily needs, transportation, etc. At the same time, they maintained the social connectivity, celebrating rivers as their gods, offering flowers for them, coming together as a community to protect them. This balanced approach maintained social harmony between people and with nature.

However, today, this approach is disappearing from the country. This is mainly because of the loss of river communities as areas get urbanized. People always need inclusiveness into society. Moreover, the rural push happens in these areas, forcing people to give up their traditions, moving to cities in search of a better lifestyle. As people move, there ends a river culture which was practiced for generations. This severely affects urban rivers, as the river will be completely ignored. Many of the traditional techniques followed helps to recharge the groundwater table, keep the floodplain active, and more importantly, preserve the river ecosystem. As Mr. Birj Gopal states, for the case of Delhi, the river community has been lost forever. A culture followed by a community takes generations to evolve as we see it today, with lots of amendments, adaptation. All of these are destroyed within a matter of a few years.

Why are river communities relevant? They are the existing link between culture and rivers. If there is no river culture, our actions and progress will be linear, ignoring the relationship between humans and nature, forgetting sustainable development. When the contact is lost, our concern for the natural bodies is lost. Conserving the river becomes the responsibility of government authorities, and the general public will be detached from waterbodies. When there is no participation from the public, it will be a nearly impossible task to sustain rivers in their natural state.

India should learn from the case of Delhi. As urbanization is rapidly increasing all over India, planners and authorities should take care that river communities are protected; they are encouraged to follow their traditions; they are included in society because communities as such are the link between culture and nature. It is vital, we preserve the connection between culture and river, not just to conserve it, but for a sustainable future.

BIBLIOGRAPHY

1. Akira Shimada (2010) 'Buddhism in the Krishna River Valley of Andhra by Shree Padma and A. W. Barber', *International Journal of Hindu Studies,* 14(2-3), pp. 332-334.
2. Balasubramanian, A. (2007) *River Systems of India*, Mysore, India: ResearchGate.
3. Binay Singh (2009) 'Wake up sons of Ganga', *Times of India, Varanasi,* 16th December, p. 2.
4. Banjot Kaur, Sushmita Sengupta (28th January 2019) *Kumbh is fine but why not clean the Ganga all the time?,* Available at: www.downtoearth.org.in (Accessed: 23rd March 2019).
5. Brij Gopal, Malavika Sah (1993) 'Conservation and Management of Rivers in India: Case-study of the River Yamuna', *Environmental Conservation,* 20(3), pp. 243-253 [Online]. Available at: www.cambridge.org (Accessed: 16th November 2018).
6. Bose, A.K., Ridhi, Gupta, S., Suresh V.R., and Das, A.K. (2017) 'Indigenous fishing (Char Kanta): A traditional fisheries in River Tawa, Madhya Pradesh, India', *International Journal of Fisheries and Aquatic Studies,* 5(3), pp. 265-268.
7. Central Water Commission (8th february 2012) *Major River Systems In India,* Available at: http://www.india-wris.nrsc.gov.in (Accessed: 5th March 2019).
8. Cynthia Ann Humes (2012) 'Hindutva, Mythistory, and Pseudoarchaeology', *Numen International Review for the History of Religions,* 59(1), pp. 178-201 [Online]. Available at: www.brill.com (Accessed: 10th November 2018).
9. Daniel Rubin, Cody Poplin (10th April 2013) *Lessons from India's Pop-Up Megacity: The Kumbh Mela,* Available at: www.asiafoundation.org (Accessed: 22nd March 2019)
10. David Laconangelo (7th April 2017) *An Indian court says glaciers and rivers are 'living entities.' Could the same approach work in the US?,* Available at: www.csmonitor.com (Accessed: 16th November 2018).
11. David L. Haberman (2006) *River of Love in an Age of Pollution: The Yamuna River of Northern India*, I edn., USA: University of California Press.
12. Dilip Kumar (2017) 'River Ganges – Historical, cultural and socioeconomic attributes', *Aquatic Ecosystem Health & Management,,* 20(1–2), pp. 8-20 [Online]. Available at: www.tandfonline.com (Accessed: 18th November 2018).
13. Divy Ninad Koul, Swati Singh, Ganesh Neelam & Gopal Shukla (2012) 'Traditional water management systems - An overview of Ahar-pyne system in South Bihar plains of India and need for its revival ', *Indian Journal of Traditional Knowledge ,* 11(2), pp. 266-272.
14. Ganga Action Parivar(GAP), *Spiritual and Cultural Heritage,* Available at: www.gangaaction.org (Accessed: 22nd March 2019).
15. Gaurav Shah (2014) 'Ganga Aarti: A Case Study of an Initiative to Disseminate Message of Environmental Peace building', *Peaceworks,* 4(1), pp. 101-116.
16. Gokhale Yogesh (2001) 'Biodiversity as a Sacred Space', *The Hindu,* 20th May

17. Govindasamy Agoramoorthy (2014) 'Sacred Rivers: Their Spiritual Significance in Hindu Religion', *Relig Health,* 54(1), pp. 1080–1090.
18. Hawkes, H.A. (1975) 'River zonation and classification', *River ecology,* 1(1), pp. 312-374.
19. Irene Klaver, J. (2012) 'Placing water & Culture', in Barbara Rose Johnston (ed.) *Water, Cultural Diversity, and Global Environmental Change.* France: UNESCO, pp. 9-29.
20. Jack Stanford, A., Laurie Alexander, C., Diane Whited, C. (2017) 'Chapter 1 - Riverscapes', *Elsevier,* 1(3), pp. 3-19 [Online]. Available at: *www.sciencedirect.com* (Accessed: 16th November 2018).
21. Jean-Philippe Venot, Luna Bharati, Mark Giordano, Francois Molle (2011) 'Beyond water, beyond boundaries: spaces of water management in the Krishna river basin, South India', *The Geographical Journal,* 177(2), pp. 160-170 [Online]. Available at: *www.jstor.org* (Accessed: 18th November 2018).
22. Jahren, P., Sui, T. (2017) 'Water and Culture', *How Water Influences Our Lives,* VIII(1), pp. 19-37 [Online]. Available at: *www.springer.com* (Accessed: 26th February 2019).
23. Kama Maclean (2008) *Pilgrimage and Power : The Kumbh Mela in Allahabad 1765-1954. google books* [Online]. Available at: *www.books.google.com* (Accessed: 12th November 2018).
24. Karl Matthias Wantzen, et. al (2016) 'River Culture: an eco-social approach to mitigate the biological and cultural diversity crisis in riverscapes', *Elsevier,* 16(1), pp. 7-18 [Online]. Available at: *www.sciencedirect.com* (Accessed: 8th November 2018).
25. Kelly Alley, D. (2012) 'The Paradigm Shift in India's River Policies: From Sacred to Transferable Waters ', in Barbara Rose Johnston (ed.) *Water, Cultural Diversity, and Global Environmental Change.* France: UNESCO, pp. 31-47.
26. Lance Nelson, E. (1998) *Purifying the Earthly Body of God: Religion and Ecology in Hindu India. google books* [Online]. Available at: *www.books.google.com* (Accessed: 12th November 2018).
27. Lily Jamaluddin (22nd January 2019) *The Women of the Yamuna River ,* Available at: *http://climatetracker.org* (Accessed: 14th March 2019)
28. Mathias Kondolf, G., Pedro Pinto, J. (2017) 'The social connectivity of urban rivers', *Elsevier,* 277(), pp. 182-196 [Online]. Available at: *www.sciencedirect.com* (Accessed: 16th November 2018).
29. Ministry of Culture, GOI (19th January 2019) *An Exhibition on National Mission for Clean Ganga organised at Prayagraj Kumbh Mela ,* Available at: *www.pib.nic.in* (Accessed: 23rd March 2019).
30. Misra, Anil Kumar (2010) 'A River about to Die: Yamuna', *Water Resource and Protection,* 2(1), pp. 489-500.
31. M S SWAMINATHAN RESEARCH FOUNDATION (2013) *Kuttanad Below Sea Level Farming System (KBSFS)*, India, Kerala: Government of Kerala.
32. Mohit Singh Rai (2017) 'Impact of Urbanization on Environment ', *International Journal on Emerging Technologies,* 8(1), pp. 127-129.
33. Nachiket Kelkar, Jagdish Krishnaswamy, Sunil Choudhary, Dipani Sutaria (2010) 'Coexistence of Fisheries with River Dolphin Conservation', *Conservation Biology ,* 24(4), pp. 1130-1140 [Online]. Available at: *www.jstor.org* (Accessed: 18th November 2018).

34. Natalie C Ban, Morena Mills, Jordan Tam, Christina C Hicks, Sarah Klain, Natalie Stoeckl, Madeleine C Bottrill, Jordan Levine, Robert L Pressey, Terre Satterfield and Kai MA Chan (2013) 'A social—ecological approach to conservation planning: embedding social considerations', *Frontiers in Ecology and the Environment,* 11(4), pp. 194-202 [Online]. Available at: www.jstor.org/stable/23470948 (Accessed: 26th May 2019).
35. Naveeda Khan (2011) 'Geddes in India: town planning, plant sentience, and cooperative evolution', *Environment and Planning D: Society and Space,* 29(1), pp. 840-856.
36. Neelmani Jaysawal, Sudeshna Saha (2014) 'Urbanization in India: An Impact Assessment', *International Journal of Applied Sociology,* 4(2), pp. 60-65.
37. Pallabi Borah, Bhagabati, A., K. (2015) 'Effect of river environment on the land use of Guwahati city: perspectives from nature-culture relationship', *International Multidisciplinary Journal,* 4(1), pp. 27-33 [Online]. Available at: http://www.theclarion.in (Accessed: 18th November 2018).
38. Ptrick McCully, *A Short History of Rivers,* Available at: www.internationalrivers.org (Accessed: 6th March 2019)
39. Pratyusha Basu (2007) 'River of Love in an Age of Pollution: The Yamuna River of Northern India', *Journal of Ecological Anthropology,* 11(1), pp. 74-76.
40. Rahul Mehrotra, *Constructing the World's Biggest (Disassemblable) City ,* Available at: www.worksthatwork.com (Accessed: 23rd March 2019)
41. Rahul Mehrotra , Felipe Vera (28th April 2015) *Kumbh Mela: Designing the World's Largest Gathering Of People,* Available at: www.archdaily.com (Accessed: 23rd March 2019).
42. Ramakrishnan, P. S. (2003) 'The Sacred Ganga River-based Cultural Landscape', *Museum International,* 55(2), pp. 7-17 [Online]. Available at: www.onlinelibrary.wiley.com (Accessed: 10th November 2018).
43. Rebecca Kraft Rector (2017) 'Early River Valley Civilizations, 3500 B.C. - 450 B.C.', in Rebecca Kraft Rector (ed.) *The Early River Valley Civilizations (The First Humans and Early Civilizations).* : Rosen: Rosen Young Adult, pp. 26-57.
44. Sanchari Pai (July 15th 2016) *Modern India Can Learn a Lot from These 20 Traditional Water Conservation Systems,* Available at: www.thebetterindia.com (Accessed: 23rd May 2019).
45. SANDRP (15th November 2014) *Know our rivers: A beginners guide to river classification,* Available at: www.sandrp.in (Accessed: 4th March 2019).
46. Sandeep Kaur (2017) 'The Effect of Urbanization on Environment in India', *International Journal on Emerging Technologies,* 8(1), pp. 122-126.
47. Sharan, Awadhendra (2016) 'A river and the riverfront: Delhi's Yamuna as an in-between space', *City, Culture and Society,* 7(1), pp. 267-273.
48. Som Prasad Khatiwada (2014) 'River culture and water issue: an overview of Sapta-Koshi high dam project of Nepal', *International Journal Of Core Engineering & Management,* 1(3), pp. 101-113 (Accessed: 10th November 2018).
49. UCLG (2016) *Why must culture be at the heart of sustainable urban development?*, Paris: UCLG

50. Vandana Tomar (2015) 'Indus Valley Civilization', *International Journal of Social Science and Humanities Research,* 3(3), pp. 423-427 [Online]. Available at: www.researchpublish.com (Accessed: 16th November 2018).
51. Vasudha Narayanan (2001) 'Water, Wood, and Wisdom: Ecological Perspectives from the Hindu Tradition', *International Journal of Hindu Studies,* 130(4), pp. 179-206.

Integrating Cultural, Religious & Social Elements in River Management- Examples from India

Abstract :

The research thesis aims to integrate river culture into modern river management. The river culture in India is a perfect example; having an eco-social approach, maintaining the relationship with the river. Integrating this approach will help in sustainable conservation of the rivers. However, the river cultures are under threat due to urbanization. The case of Delhi sheds light on how urbanization and various events in its history affected the river community of the capital and eventually deteriorated the river culture; leading to ignorance of the river Yamuna itself by the public.

Keywords :

River Culture, Biocultural Diversity, Ecosystem services, Eco-Social approach, Urbanisation

Student Name:
Alvin Manuel Vazhayil

Email:
alvinvmanuel@gmail.com

Supervisor: Prof. :
Karl M. Wantzen

Date of Submission:
18th June, 2019

POLYTECH TOURS
Département
Aménagement et Environnement

citeres UMR 7324

35 allée Ferdinand de Lesseps

37200 Tours

FRANCE

Tél. +33 (0)247 361 452

http://polytech.univ-tours.fr/m2ri-planning-sustainability