



## WATERBODY NEGLIGENCE IN URBAN DEVELOPMENT AND ITS IMPACT ON CITY'S SUSTAINABILITY: GHAGRA CANAL, DINAJPUR AS A CASE

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### Abstract

Due to its geographical location, Deltaic Bangladesh is naturally enriched with more than 700 rivers. Like the rivers, their distributaries, and tributaries, large and small canals also distinguish the land whether it's naturally originated or excavated by the dwellers. Dinajpur City has such canal from city's origin named "Ghagra," which flows through the heart of the city. "Ghagra" is a 29 km long canal in which 15 km contributes to Dinajpur Urban area. Though it was excavated to maintain the water disposal network of the city, in later periods, it was also used for bathing, fishing, and boating. The absence of a proper master plan of the city considering the waterfront as a design element, rapid urbanization, and unawareness of people is causing continuous decay of the canals and the whole Dinajpur city in the near future. Unplanned development, canal encroachment, and waste dumping have blocked the flow of the canal and disconnected it from the river, resulting in waterlogging and sometimes flood in Dinajpur city. The research will focus on what are the impacts of neglecting the Ghagra canal in urban development on Dinajpur city sustainability. At first, the research will analyze Ghagra Canal's morphological transformation and impact, then it will investigate city sustainability assessment criteria, and finally, the research will assess its impacts on the city's sustainability. The research will be qualitative research guided by theoretical, mapping, and photographic analysis. This paper will show how neglecting the water body during urban development can affect a city's sustainability and as well as similar phenomena.

**Keywords:** Urban Water body, Urban Development, City sustainability and Ghagra Canal, Dinajpur

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## Introduction

Bengal is a deltaic country situated in the transition zone between Southwest and Southeast Asia. Due to its geographic location, several biggest rivers of the world with innumerable branches flow through the country. The Ganges-Brahmaputra river system forms in the Bengal Basin a delta of 25,000 square miles extent. It is therefore quite obvious that the monsoon rains, the rise and fall of river levels, floods, alluvion and diluvion and changes in river courses form the substance of both cultural and physical geography of the area. Due to its location, topography and climatic situation Bangladesh is habitable comparative to many parts of the world.

Bangladesh is a rapidly developing country, envisaging to be middle income country in 2021 (Choudhury, G. A. et al., 2012). As the country's goal shifts upward to middle income status with population growth of approx. 2 million per year, it is facing rapid urbanization. We all know the consequences of urbanization for a country is not given. Environmental degradation including deforestation, water area encroachment, water pollution and air pollution is the main of all the consequences.

Like all other cities of Bangladesh, Dinajpur is also facing the rapid urbanization and its parallel consequences. Dinajpur City is a part of Rangpur Division as well as varendra region. Varendra region is a part of the Northern Region which is Ganges-Brahmaptura paradelta, it was established on the bank of an ancient mythical river. The name of the mythical river is Punarnava. Geologically, the city's location has been established in the womb of a dead river called Ghaghra. The site of the city, the river Ghaghra-Gabura-Kachai, was once a tributary of the Punarnava River. But day by day, to adapt the development and population pressure this canal has lost its identity and now incapable of serving the city. It became isolated in many parts which hinders the natural flow and disconnected from the Dhaleshwari River. The city is growing neglecting the canal and turning back towards it. It became the waste dumping zone and crime zone of the country. Water logging became common in Dinajpur in rainy season as water can't pass through the canal. Air and water pollution is also a vital issue. While the whole world is adapting water centric development, main water resource, Ghagra canal was neglected in Dinajpur city development which is causing degradation of the whole city environment. This degradation results in reducing economic opportunities as well as social status and values. Ignoring vital natural resource and disconnecting built area and nature no habitation can sustain for long time.

The research will focus on what are the impacts of neglecting Ghagra canal in urban development on Dinajpur city sustainability. At first, the research will analyze Ghagra Canal's morphological transformation and its impact, then it will investigate city sustainability assessment criteria and finally, the research will assess the impacts on the city's sustainability.

## Literature Review

Water bodies (WBs), such as lakes, ponds, streams, canals, rivers and impoundments, provide essential ecosystem services for human society, yet their characteristics and changes over large areas remain elusive (Feng, S. 2019). Urban water bodies are important parts of the whole urban ecosystem that are of great significance for urban environmental testing, urban heat-island effects, and urban ecosystem maintenance. Urban Water bodies are important for assessing the role it plays in urban ecosystem services in the context of human survival and climate change. The changes in urban water bodies make a huge difference to human lives and may cause disasters, such as surface subsidence, urban inland inundation and health problems.

Since the second half of the twentieth century, the world has experienced its fastest rate of urbanization, particularly in developing countries (Chadchan and Shankar, 2009). urbanization is one of the most powerful and visible anthropogenic forces on Earth (Dawson et al., 2009). Rapid urbanization surely accelerated economic and social development, but it has also created numerous environmental problems ranging from the local to the global scale (Kim and Baik, 2005; Zhao et al., 2006), including increased air and water pollution and decreased water supply (Liu and Diamond, 2005; Shao et al., 2006). Moreover, urbanization affects water resources by fundamentally altering longitudinal and lateral processes that in turn alter hydrology, habitat, and water chemistry; these effects create physical and chemical stressors that in turn affect the biota (Hughes, R. M. et al

2014). To keep pace with the speed of urbanization, most cities are going through unplanned urban development. Unplanned urban development in areas consisting water resources, is causing water body encroachment, waste dumping in water bodies and water pollution in many ways. That means, the impacts of unplanned urban development on water bodies are quite threatening. The whole ecosystem is altered in this process of water body exclusion in urban development and as a result the sustainability of the city is compromised in many ways.

Usually, the city has been studied from the geographic perspective, by its area, boundary and population. However, to understand the concept of city, various approaches have been pursued since the origin of city concept. Different viewpoints have been shared from different perspectives. Mostly adopted viewpoints are the economic (Ratcliff, 1949), the sociological (Weber, 1921/1958; Wirth, 1938) and the cultural (Mumford, 1938; Zukin, 1995). With passing time, Ecology became an important viewpoint to define city. But focusing on the nature and functioning of the city, these approaches are not concerned with the space. Rather at the same time, a city is a geographic, ecological, cultural, an economic unit, and systematic unit for habitats. From this point of view, the city the place and the people, with all the machinery and administrative devices that go with them, as organically related; a kind of psychophysical mechanism in and through which private and political interests find not merely a collective but a corporate expression. (Robert et al., 1925).

When it comes about city development or any kind of development, sustainability must be one of the widely used among all development theories. “The concept of sustainability will always have its relevance. Sustainability has become the subject for a contemporary assessment of progress and responsibility, freedom and culture” (Bachmann, 2010). Sustainability or Sustainable development came from the urge of conserving all resources from decay while repeatedly used by habitats. Sustainability emerged as the strategy of survival and its concept is rooted in all culture (Spindler, E. A. 2013). This is also evident in the management of commons (Chasek et al., 2006), which shows commitment to sustainability, a sense of responsibility and respect for nature.

In the 18th century, sustainability was laid down first as a principle of the German forestry industry. With the birth of the contemporary environmental movement in the late 1960s and 1970s, and debates about the limits to growth, environmentalists were keen to show how environmental issues could be linked to mainstream questions of development. However, not until the 1980s that the term attained much wider currency. It became the focal point for this debate in the mid-1980s and the now classic modern definition of Sustainability or sustainable development by WCED is-

Sustainable development is the development that meets the needs and aspirations of the present without compromising the ability of future generations to meet their own needs. (WCED 1987 a: 43)

It contains two key concepts: firstly, the idea of meeting needs, and in particular the needs of the world's poor, through more equitable distribution of opportunities and resources; secondly, the concept of limitations of growth and of resource depletion imposed by the ability of the environment to meet future needs. Thus, sustainability concerns our ability to maintain a coupled human-nature system at a desirable state for multiple generations in the face of anthropogenic and environmental perturbations and uncertainties. (Wu, J., & Wu, T. 2012). As Bell and Morse (2008) argue,

“Sustainable development . . . embodies an ultimate practicality since it is literally meaningless unless we can ‘do’ it.”

But the main question is what is to be sustained, what is to be developed and how these both can be balanced or integrated (Robert, K.W. et al, 2005). That’s when the Triple bottom line concept came. This concept views sustainability works in three fundamental dimensions. Environment, Economy and society are these three pillars of sustainability. This Concept implies that the three pillars are all necessary and equally important to sustainability. Each of the three have to contribute to achieve sustainability as a whole.

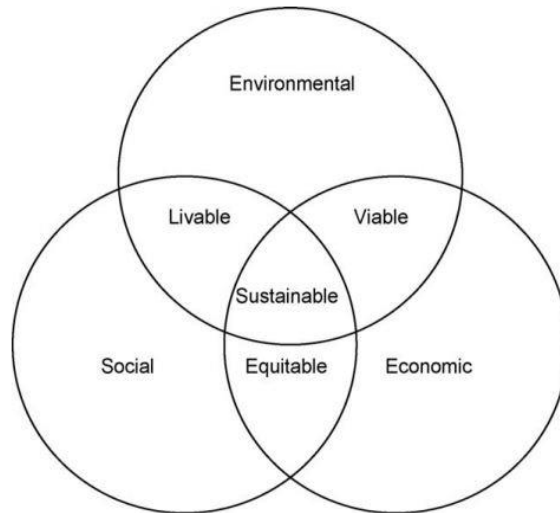


Figure 1. The triple bottom line concept, most represented as a Venn diagram.

From the triple bottom line concept it can be said that if we have to ensure sustainability we have to work in these three sectors. On the other side, if we have to measure sustainability, we have to check each of these three parameters whether they are individually sustainable or not.

However, City sustainability usually comprises the growth of economic benefits while conserving the environmental setup and social justice and equity. That means for a certain time period in future, the socio-economic development should not exceed the environmental limits. Based on this, a well-accepted concept of city sustainability and assessment criteria is explained by Mori and Yamashita. According to them,

A sustainable city is defined as a city that maximises socio-economic benefits measured by economic and social indicators under relevant constraints measured by environmental sustainability indicators and socio-economic indicators of distributional equity. The minimum requirement for sustainability is to satisfy all the constraints (Mori and Yamashita, 2015).

Based on this concept of city sustainability, they divided the indicators of the triple bottom line concept into two categories for the assessment of city sustainability: constraint and Maximisation indicators. Constraint Indicators indicate the criteria relevant to environmental sustainability and distributional equity and the maximisation indicators measure the benefits of cities in economic and social sectors. To be sustainable a city should be sustainable in both categories of indicator. If any city accelerates in economy but fail to satisfy environmental constraints it is not sustainable. Same goes when environmental constraints are served but economic growth hinders.

Usually, we focus on socio-economic development without satisfying environmental constraints. Therefore, it should be ensured that the city is going through socio-economic growth under the limit of environmental constraints and distributional equity. Since no threshold is determined yet to measure constraint indicators, city sustainability can be questioned even if a single constraint indicator is threatened by the growth of maximization indicators.

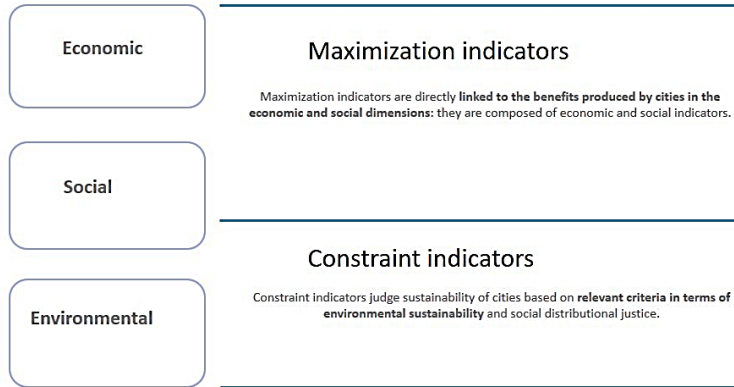


Figure 2. Maximisation Indicators and Constraint Indicators.

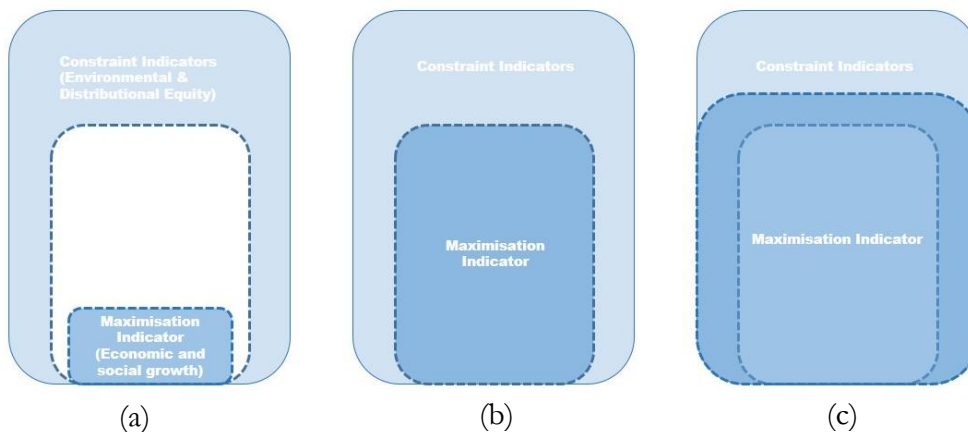


Figure 3. (a) The blue dotted line is showing the limit of constraint indicators, diagram (b) is showing a sustainable city as the growth of maximisation indicators is within the limit of constraint indicators, and (c) is questioning sustainability as the growth of maximisation indicators exceeds the limit of environmental constraints.

### Study Area

Dinajpur is a city in Bangladesh's northwest and the administrative center of the Dinajpur district. It is located in Rangpur Division. Punarhabha River borders it on the west, and some of the eastern portions are bounded by the Dhaleshawri River. In terms of history and culture, North Bengal's Dinajpur is a key city. It is one of the subcontinent's oldest towns and was made a municipality in 1869. One of the 53 district-level Municipalities in the nation is Dinajpur.

A very important waterbody flows through the heart of Dinajpur city named Ghagra canal. Which played an important role in city development and maintaining the water disposal system of the city. Also, ghagra had a great appeal for aesthetic value and recreational activities.

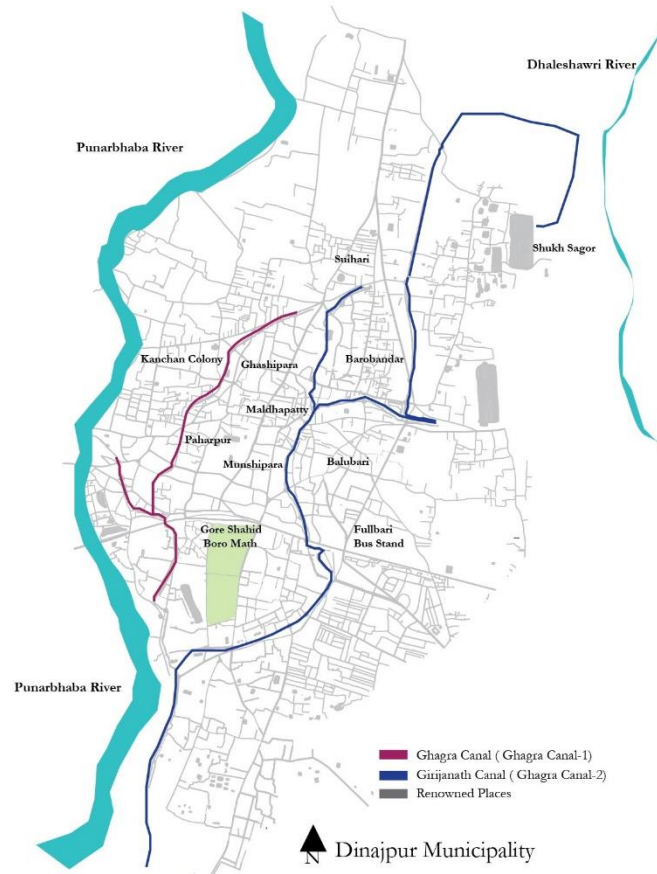


Figure 4. Dinajpur Municipality.

About mid of the 18th century, Ghagra was excavated for city dwellers. It connected the Punarbhaba River through the eastern part of the city, touching the southern part of a Baro Math through Rail Bazaar, Balubari, Khalpara, Police Lines, etc. King Girijanath re-excavated and extended the Ghagra in 1893. It was about 10-15 meters wide, depth of 10-12 meters. Overall, the river and the subsequently excavated canal have played a significant role in the existence of urban life, improving the health and environment and recreation purpose of the city. (Ali.M, 2000) (Moniruzzaman.M, 2010).

Although the name of the entire canal is Ghagra, the locally western part of the canal is called the Ghagra canal, and the eastern part of the canal is called the Girijanath canal. In this paper, the western part of the canal is referred to as Ghagra-1 and the other part is referred to as Ghagra-2. According to the Ministry of Water Resources and the Bangladesh Water Development Board, the length of the entire Ghagra canal is 29 km, compared to 15 km in the urban part. Of these 15 km, Ghagra-1 is 4.92 km and Ghagra-2 is 10.54 km.

However, this study will focus on the detrimental effects of the city's neglecting the canal and how it interferes with the sustainability of the metropolis. Therefore, the study area for this research is the canal and the city of Dinajpur, which is connected to the canal.

## Methodology

After studying the background of Dinajpur city, Ghagra canal and their relation it's clear that ignoring Canal as an important part of city in urban development is causing continuous decay of the canal. That's why this research will first measure the morphological transformation of Ghagra canal and its impact on city and then investigate whether these impacts are threatening city sustainability or not.

To conduct this research, at first an initial is taken to analyze the canal's morphological transformation and it's impact on Dinajpur city. Historical information has been collected from literature about Dinajpur city and the Ghagra canal's origin. Information about canal-oriented previous activities has been collected by interviewing senior citizens as key informants. To analyze the morphological transformation of the canal, depth and width at selective points of the canal have been measured and analyzed comparatively with the past measurements. Access road networks and the encroached area are analyzed to understand the relationship of the canal with the city development. To understand these changes, CS maps, RS maps, and current maps are collected and in-depth surveys of the canal are conducted. The Digital measuring system, Photographic analysis, Map analysis and KII is used to measure the transformation. After that, an intense survey and interview session has been conducted to find out the impacts on Dinajpur city. Impacts are categorized in three sector environmental, social and economic. Interview data, photographic analysis, spot section analysis and maps are used to analyze the impacts.

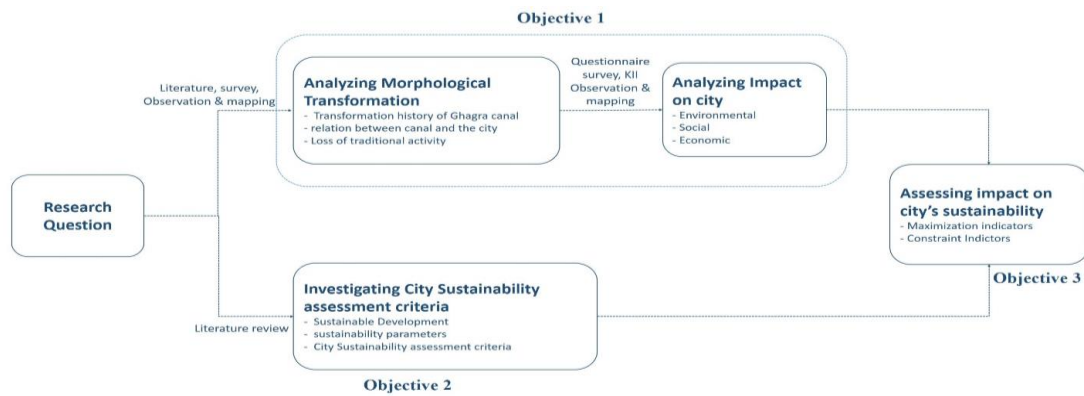


Figure 5. Analytical Framework of the research.

Second, this research has investigated about the concept of city sustainability, city sustainability indicator and similar case studies to find out the assessment criteria of city sustainability. There are lots of theories and methods to city sustainability but without solving contextual issues, meeting contextual needs Sustainability can't be ensured. As no case is similar due to contextual variety, no framework to assess sustainability will work exactly. That's why this research has focused only on whether these impacts threaten city sustainability or not. From the concept of constraint and maximisation indicator it's clear that to be sustainable Dinajpur city has to ensure constraint indicator sustainability. If sustainability of any single constraint indicator is threatened it can be said that the whole city sustainability is threatened. Therefore this study will provide a framework to connect these impacts to city sustainability and finally check whether it's sustainable or not.

## Impact Assessment and Evaluation

### *Morphological analysis*

Extensive changes have been observed in the canal and its surrounding land-use patterns from the time of Ghagra excavation to the present time. Significant morphological changes include the width and depth of the

canal, the disruption of the canal connection, and the relationship of the built form to the canal. This morphological analysis has been done through secondary data, CS (Cadastral Survey 1888-1940) map, RS (Revisonal Survey 1997-2000) map, Google Earth, and physical survey and observation.

*Width and depth:* From the historical background it is known that the canal 30 feet to 45 feet wide was dug, with a depth of 30 feet to 36 feet. Besides, from the CS map, it can be seen that the canal is 25 to 30 feet wide. In present, according to the survey (Figure 07), the current width and depth at different points of the canal are Mirzapur 25'6", 15'6", Choto Gurgola 28'4", 9'10", Fakir Para 23', 8', Maldahpatti 22'3", 13', Jorabridge 20', 14', Shipahipara 22'5", 13'8" Enayatpur 6'10", 4', Paharpur 16', 7'6", Baluadanga 6'8", 8', Mission road 8'3", 12'5", Kosba 15', 10'5" and Aliapur 24', 18'. However, at present it is reduced from a minimum of 6 feet to a maximum of 28 feet wide and the depth is found to be 4 feet to 18 feet. One of the reasons is the development of the city without considering the canal and also an awareness of the people. As a result, it is easily affected by canal encroachment and garbage dumping. In Ghaghra-2 alone, at a distance of 8 km, there are 558 illegal installations including pucca, semi-pucca and raw (Anar, 2020). In addition, even if silt accumulates over time, it is not dredged.

*Connectivity:* The Ghaghara canal, which was connected to the river and the city, is now isolated in many places. Prior to its closure, the Ghagra served as a navigable route through the Dhaleshwari river (a tributary of the Atrai) to Punarbhaha and flowed all year round. Now not only is the canal disconnected from the river but disconnection is also seen in the course of the canal itself (Figure 06). Ghagra-1 is disconnected from Ghagar-2, so the flow of water is not continuous as before. Besides, the depth of the canal is decreasing due to siltation and waste.

Accessibility of canal with the city is very poor now form before. In the past, there were many activities in the canal such as fishing, boating, bathing etc. As a result, people had access to the canal. One of the reasons for the loss of activities is that the buildings along the canal are constructed without any setback and the environment is unhygienic. Loss of ac accessibility means that the canal is gradually lost. Although it is a bit,

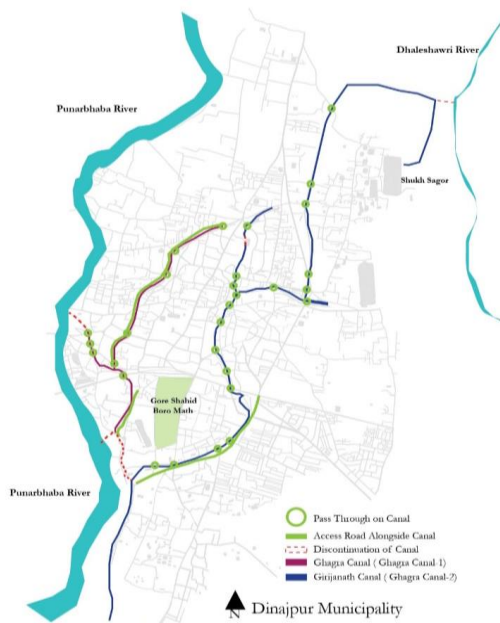


Figure 6. Road Access around the Canal.

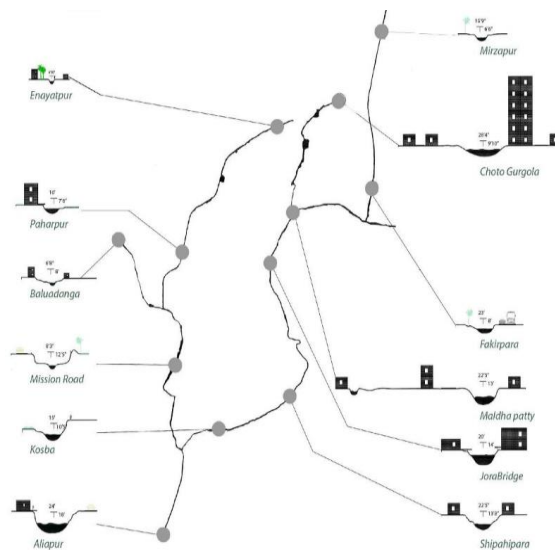


Figure 7. Width and Depth of Ghagra (Survey Data).

Ghagra-1 and Ghagra-2 can be understood. Although there is accessibility on one side of the Ghagra-1 canal, both sides of the Ghagra-2 canal are full of buildings. As a result, the condition of Ghagra-1 is comparatively better than that of Ghagra-2. Although dirt is dumped opposite side by on the same canal, but a somewhat better environment than Ghagra-2.

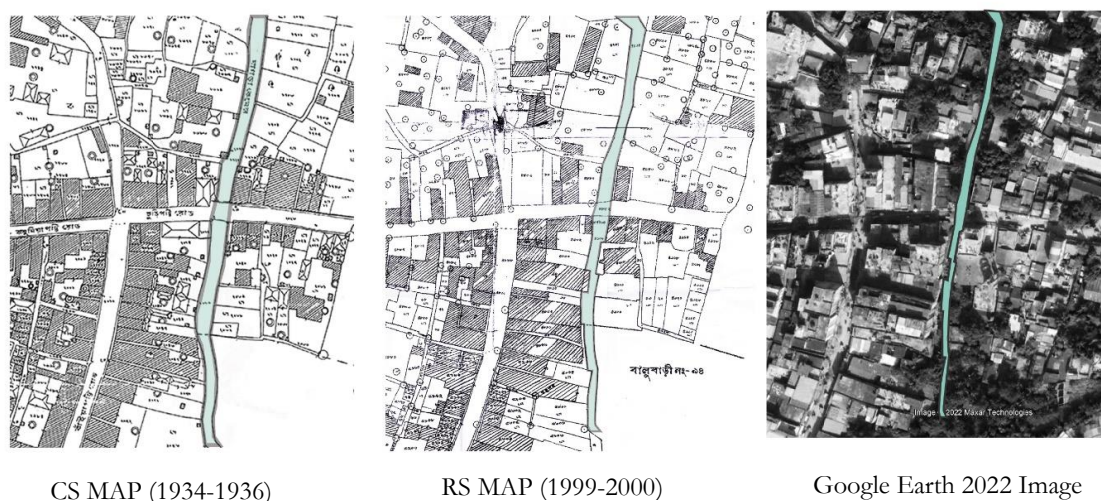


Figure 8. Relationship of Built form with Canal Analysis (Maldapatti).

**Built Form:** Ghagra canal has historically played an important role in the spatial development, life, and livelihood of Dinajpur. Morphological analysis reveals a very good relationship between both the canal and the city. It is easily replicated by the built form. The CS map shows the space between the built form and the canal, which usually formed a buffer of the built form with the canal. Where a relationship was formed between the people and the canal. Activities like ghats, bathing, fishing, etc. entertained the community as well as kept the canal alive. However, with the passage of time, the space between the built form and the canal has become extinct and even the width of the canal has been reduced by encroachment. As a result, the building and human relationship with the canal is deteriorating. Generally in rules, a building should be in a minimum setback from any water edge. In the past, it was a bit like that but now it is the opposite. The canal is falling at the back of the built form, causing the canal to lose its accessibility and at the same time become a dumping ground. A morphological analysis of the canal with Maldapatti (Figure 08), the oldest area of Dinajpur, shows that there was some space between the built form and the canal on the CS map. Subsequently, the amount of RS map decreases, and some encroachments are observed. And the current map of 2021 shows that the build forms have overwhelmed the canal and as a result the existence of the canal is under threat.

### **Environmental impact**

#### *Natural Environmental*

**Loss of Surface Water Resource:** In an urban area, surface water is a very essential element and valuable asset. The preservation of surface water helps to reduce urban flooding, keep a cool environment and make our cities sustainable in the future (Kafy, 2018). Surface water like Ghagra Canal is a very important feature of the Dinajpur urban landscape. But when the canal is excluded from urban development, abuse is acknowledged by the city and at some point, it loses its own identity. As a result, the flow of the canal decreases. Water becomes polluted due to various reasons like open sewer pipes, high volume of discharge wastewater, garbage dumping, destruction of the water ecosystem, surface runoff of katcha bazars, medical waste dumping, and industrial

effluents, etc. As a result, on the one hand, we are losing such an important asset, on the other hand, the canal will appear as a burden without being conducive to a sustainable city. A respondent's comment about the water of Ghagra canal

*"At one time the water of this canal was very fresh. At that time there were not so many people, no one would even throw dirt. Now the color of the water has changed." (a 77-year-old man)*

**Unplanned Waste Dumping Zone around Canal:** The master plan 2010-2030 shows that city planning has been done without considering the canal. As a result, the people and the authorities are not aware of the relationship between the canal and the community, infrastructure, and building form of the city.

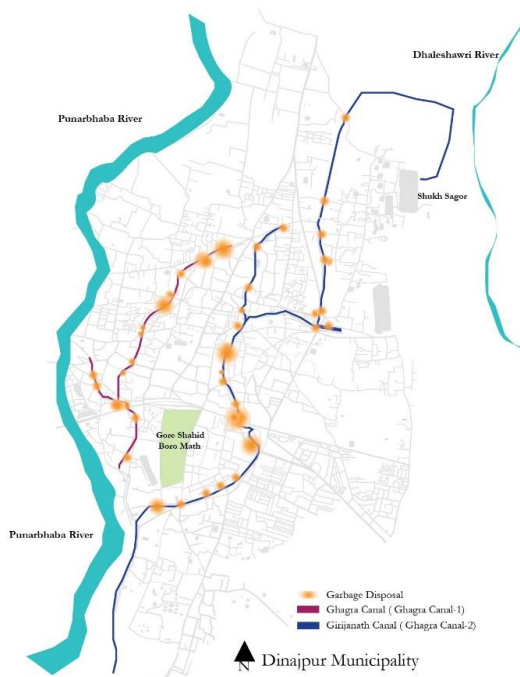


Figure 9. Garbage Disposal Map.

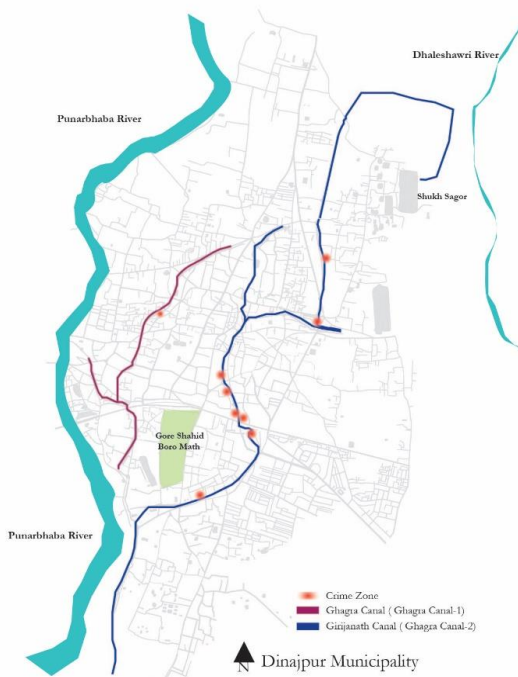


Figure 10. Crime Zone Map.

The current scenario shows that the edges of the canal have crossed this built form and somewhere encroached and facing the backside of the built form toward the canal. Besides, as there is no accessibility everywhere along the banks of the canal, the houses are being easily dumped the dirty into the canal. The accessibility of Ghagra-1 is a bit better, so the amount of garbage dumped directly in the canal is a bit less, but the people of the houses adjacent to the canal keep piles of the garbage next to the canal. Ghagra-1, a pile of garbage is found in about 16 places (Figure 9). Also, small scale dump zone found in every node. The accessibility of Ghagra-2 is very poor and as a result, the amount of garbage dumped directly in the canal is much higher. There are also bridges at the road junction with the canal, all of which have been turned into garbage disposal areas (Figure 10). As a result, the canal is turning into a garbage dump. As well as the canal water is getting polluted and obstructing the flow of the canal. Also, 95% of the residents of Ghagra-2 canal have their toilet pipeline directly connected to the canal and 35% of the residents of Ghagra-1 canal have connected the toilet pipeline directly to the canal. As a result, the canal water is getting polluted, and germs are contaminating the environment.

**Disturbed Urban Ecosystem:** Canals serve as ecological corridors and hybrid zones, having the ability to affect native and introduced species' genetic resources (Guivier et al., 2019). Canals can play an important role in ecological diversification and ecological balance in urban setup if water-centric urban planning can be done. The canals are losing depth due to the dumping of waste and the aquatic habitat is being lost due to loss of depth. Many beneficial organisms live in the water, microorganisms are dying, and the ecosystem is being destroyed.

**Poor Air Quality:** Dirt around the canal spreads a bad odor which is one of the causes of air pollution. However, when the water level in the canal decreases in summer, the polluted water of the canal spreads bad smells in the air. This is deteriorating the air quality around the canal.

#### *Built Environmental*

**Inaccessible Canalside:** Dinajpur has always lagged in taking advantage of the Ghaghra canal flowing through the heart of the city. It can play an important role in improving the connectivity of the town. Along the main road, pedestrians along the canals could be strengthened the city's connectivity. But the accessibility of the canal side has decreased a lot from the past due to the dilapidated trench. Not only this, the two banks of the channel have now turned into garbage dumping sites due to lack of accessibility. Without considering the canal in the city master plan, the city dwellers are deprived of some beautiful link access.

**Reduced Life Span of Buildings and Infrastructures:** About 15 km of Ghagra canal flowing through the heart of Dinajpur city covers almost all types of land use in Dinajpur city. But over time, as the canal has been devalued and city plans have been drawn up without considering the canal, the canal is encroached, lost depth width, and is under threat today. Therefore, during the monsoon season, the excessive runoff water could not contain the canal like in the past, and different areas have faced waterlogging. The water level of canal has been overflowed its bank more than 8.2% in last 7 years. At that time different types of buildings like residential, commercial, and mixed-use, many buildings are underwater for several days. The corrosive action of saline reduces the lifetime of brick foundations, and moisture is the aftereffect. Besides slums and low-income areas (like the middle balubari sweeper colony, the eidgahbasti, etc) most of the people live in temporary and vulnerable buildings. These buildings become badly damaged during the period of waterlogging (Figure 11).

#### **Social impact**

*Increase of unsafe and insecure area:* Lack of transparency in most places due to not ensuring accessibility of canal banks everywhere. Most of the building's back facade faces the canal and, in some places, dead ends exist the canal banks' access. Due to these, immoral activities took place in some places along the canal. However, most of the canal banks do not have accessibility yet where there is accessibility, it is not always safe. Safety and security problems are less as one side of Ghagra-1 is accessible. Where the amount of insecure area is more in Ghagra-2 (Figure 10). The sense of safety and security alongside the canal (Ghagra-2) was mentioned by the respondent.

*Now there is not much going on the canal bank, I used to play there when I was young. Now it is very dirty and after dusk various immoral acts take place. So, it is not safe to go. (a 57-year-old woman)*

*Degradation of living environment quality:* Due to the polluted water of the canal, various kinds of harmful microorganisms live in it. Which is later mixed with drinking water as a result of flooding, and various waterborne diseases occur. In addition, contaminated water serves as a breeding ground for various harmful insects. Infestation of mosquitoes and flies in large numbers. Besides, open sewage disposal into the canal, is an increasing threat for the health of Dinajpur city people.

*Decreasing community gathering space:* The water body in urban areas is very precious for various aspects. it could be a great place for a recreation zone for the city as well as a social gathering space. But the negligence of city dwellers could be the opposite. The Ghaghra canal happened the same. In past, the ghagra has own flow, and city dwellers used it for various purposes like community gathering space, recreational space, social interaction

space, etc. But many times we can't find the canal, the crowd of unplanned buildings next to the canal. In addition, the lack of water-sensitive urban design has led to the extinction of these community spaces.

*Loss of traditional activities:* Canals have played a crucial role in connecting cultures and facilitating commerce. (Rahana.H, 2020). Ghagra had the same appeal to the city dwellers. Different types of activity had occurred basis of the canal-like bathing, fishing, boating, etc. Which culture has been hampered day by day by the negligence of the city people and the Dinajpur authorities. Authorities' master plan could not address the canal which could be a great asset for the city and its dwellers. For this reason, the city has lost many of its heritage activities. But looking at most cities today, they are trying to reintegrate canals with the fabric of the city.

### **Economic**

*Loss of income opportunity:* The development of the waterfront creates jobs, and will create employment as it opens up a lot of commercial activities in the area and creates indirect employment related to the set of activities (Rahana.H, 2020). However, at present some mixed commercial activities are taking place around the canal. Such as tea shops, grocery stores, food shops, etc. which is very negligible. However, if the city is planned with the canal in mind, commercial activity will increase impressively. As a result, diversifying income opportunities for the people of the city would increase.

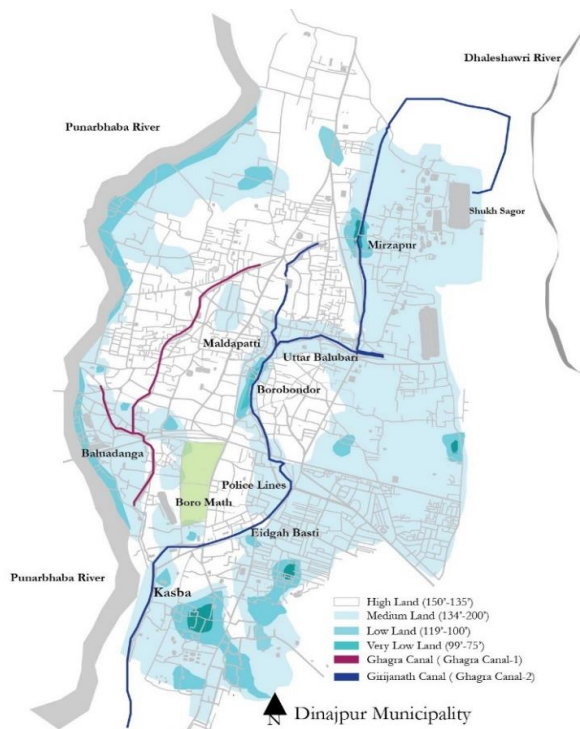


Figure 11. Water Logging area Map.



Figure 12. Garbage Disposal in Canal side.



Figure 13. Flood in Maldapatti, 2017.

*High construction and maintenance cost:* Due to rapid urbanization and ignorance of water-sensitive urban design, the dilapidated Ghagra canal has lost its depth and width resulting in the rainy season occurring water logging in different areas of the city (Figure 11), and sometimes occurs flooded in several areas of the city (Figure 13). Waterlogging raises construction and maintenance costs by reducing the life span of infrastructure and causing

damage. Canalside roads and built form have been affected most. Furthermore, logged water has damaged metalloid pipes of numerous subsurface utility services such as water, telephone, and sewage. The expense of replacing these infrastructures is enormous, and the cost of upkeep is also higher.

### Result and Discussion

Due to negligence, continuous decay of Ghagra canal is affecting the city and the life of city people in every aspect. Social aspect of the city has degraded due to lack of public gathering space and community space, lack of open green space, increased crime zone, loss of tradition, compromised safety and security. Economic aspect has also affected since income opportunities are decreasing day by day and annual flooding and waterlogging has damaged the infrastructure and building structure as well. However worst scenario can be seen in environmental aspect. Air pollution, water pollution, unplanned waste management system, traffic congestion and finally the damaged infrastructure and building structure and many more. It's giving the reminder that the ecosystem of the city will fully collapse in near future.

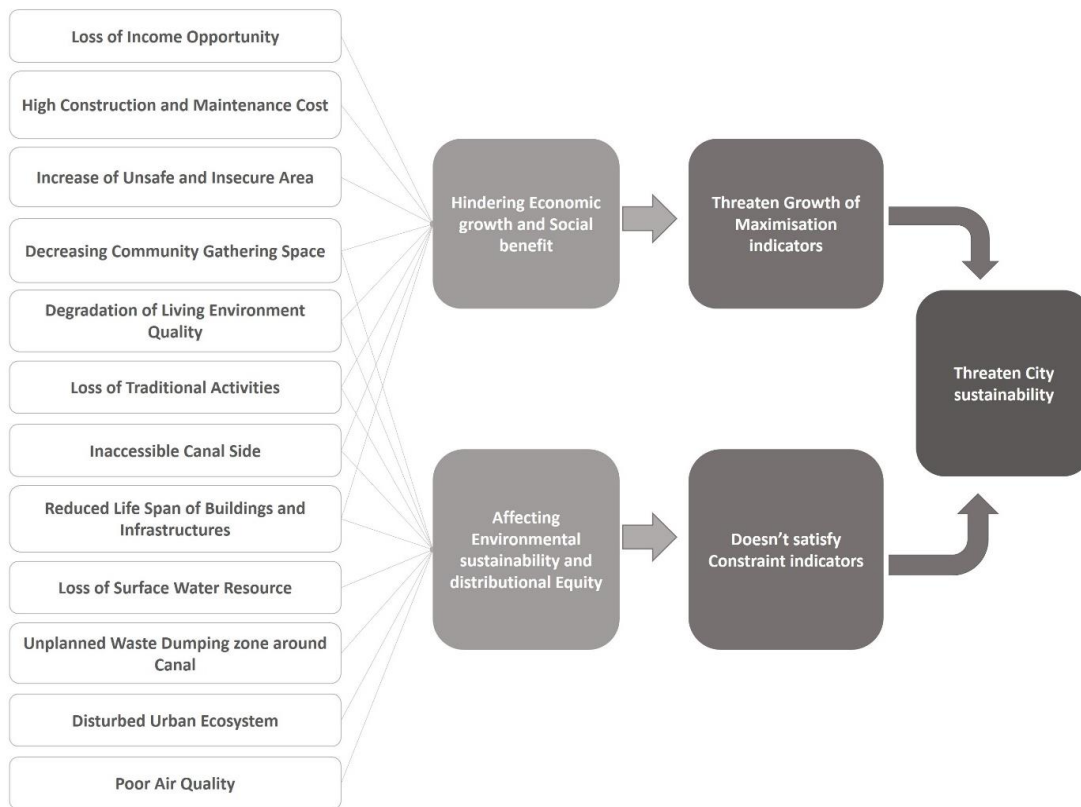


Figure 14. Impacts of canal negligence in urban development on constraint and maximization indicators of Dinajpur city sustainability.

From figure 14 it can be clearly seen that the impacts of neglecting canal in urban development directly hinders socio-economic growth and affects environmental sustainability as well as distributional equity. That means the impacts are threatening directly the maximisation and constraint indicators sustainability.

## Conclusion

Where it was clear from the constraint and maximisation indicator concept of assessing city sustainability that both indicators should be satisfied to be a sustainable city, it can be said that Dinajpur city sustainability is already in threat. Precautions should be taken to sustain the harmony of the whole city's ecosystem. However, we have to keep pace with the speedy urbanization. Avoiding development isn't any solution. There are many theories that can maintain urban development and ecosystem both in parallel. After this whole research, it can be said that the researcher, planner, designer or policy maker whoever is responsible for Dinajpur city as well as any other city development should find a way to integrate nature and development so that the city can run sustainably in future. For this, they should first study city history to find out its strength resources, issues and threats. After that they can adapt an integrated approach of development which will enhance the potentiality of natural resources while taking the benefit of it. In this case Ghagra Canal can be the strength of Dinajpur city to start an integrated approach. Development, integrating the canal can change the whole environment of the city and ensure economic prosperity as well.

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