Bangladesh University of Engineering & Technology

PLAN 434: Regional Planning Studio

Project 04

Exploring the Factors Influencing Catchment Area of the Districts of Bangladesh: A Study on Chapai Nawabganj and Meherpur District

Level-4 Term-1

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TABLE OF CONTENTS

	PAGE NO.
ACKNOWLEGEMENT	i
TABLE OF CONTENTS	ii
LIST OF TABLE	iii
LIST OF FIGURE	iii
LIST OF ABBREVIATION	iv
ABSTRACT	v
CHAPTER 1: INTRODUCTION	1-2
1.1 Background	1
1.2 Literature Review	1
1.3 Objectives of the Study	2
1.4 Scope of the Study	2
1.5 Limitation of the Study	2
1.6 Methodology	2
CHAPTER 2: CATCHMENT OF THE STUDY AREA	3
CHAPTER 3: FACTORS INFLUENCING CATCHMENT AREA OF THE DISTRICTS	4-9
3.1 Geographical Location and Natural Resources of the Districts	4
3.2 Employment and Economic Opportunities	4-6
3.2.1 Employment Rate in Major Economic Sector	4
3.2.2 Major Non-Farm Economic Activities	5
3.2.3. Regional Shift of the Districts	6
3.3 Cultural and Heritage Sites	7
3.4 Active Non-Governmental Organizations (NGO)	7
3.5 Number of Research Centers	7
3.6 Healthcare Facilities	7
3.7 Educational Institutions	8
3.8 Growth Centers and Rural Markets	8
3.9 Transportation Network	8
3.10 International Connectivity	9
3.11 Plans and Projects Undertaken in the Study Area	9
CHAPTER 4: MAJOR FINDINGS, RECOMMENDATION AND CONCLUSION	10
4.1 Major Findings	10
4.2 Recommendations	10
4.3 Conclusion	10
REFERENCES	11-12
GLOSSARY	13

LIST OF TABLE **PAGE NO.**

Table 1	Catchment Area of the Districts	**3**
Table 2	Regional Shift of Chapai Nawabganj District	**4**
Table 3	Regional Shift of Meherpur District	**4**
Table 4	Plans and Projects Undertaken in the Districts	**9**

LIST OF FIGURE **PAGE NO.**

Figure 1	Methodological Framework of the Study	**2**
Figure 2	Catchment Area of the Selected Districts	**3**
Figure 3	Existing River and Water Bodies in the Districts	**4**
Figure 4	Employment Rate in Major Economic Sector in the Districts	**5**
Figure 5	Percentage of People Engaged in Major Economic Activities	**6**
Figure 6	Existing Transportation Network in the Districts	**8**

LIST OF ABBREVIATION

ASA-Association for Social Advancement

BANBEIS- Bangladesh Bureau of Educational Information and Statistics

BBS- Bangladesh Bureau of Statistics

BRAC-Bangladesh Rural Advancement Committee.

BWDB-Bangladesh Water Development Board

Improvement Project

IRIDP-Improvement Rural Infrastructure Development Project

MoHFW-Ministry of Health and Family Welfare

NGO-Non Government Organization

TPE-Total Person Engaged

UGIIP-Urban Governance & Infrastructure Improvement Project

ABSTRACT

Interactions between regional centers and their hinterlands occur at different hierarchical levels within a country. Defining catchment areas of the districts within a country and identifying the factors influencing the service boundary of each district is an essential component to develop regional level plan for the districts. The research aims to comprehend the extent of a district's service area and influencing factors. With a focus on Chapai Nawabganj and Meherpur districts, which are border districts located in the north-western part of Bangladesh, this research explores the factors that affect the catchment areas of the districts. The catchment areas of districts are identified and examined using Reilly's law of retail gravitation, where district headquarters serve as focal points. The study finds notable distinctions between the districts of Chapai Nawabganj and Meherpur. Favorable geographical location, adequate transportation networks, and international connectivity with India influence Chapai Nawabganj's larger catchment area, which make it a significant center for trade and commerce. Meherpur, in contrast, encounters challenges because of its unfavorable geographic location, declining rivers, poor transportation systems, and lack of international connectivity, which limits it's potential for economic expansion and reduces its catchment area. This study offers critical insights that can guide decisions regarding policy and contribute to achieve regional development that is both equitable and balanced.

CHAPTER 1: INTRODUCTION

1.1 Background

Bangladesh is divided into sixty-four districts each having distinct characteristics in terms of geographic location, availability of natural resources, service and facilities, economic viability and transportation networks. Diversity of various components among districts lead to interconnection and interdependency through the flows of human, material, capital, and information. The connection and attraction between regions are always dynamic, requiring assessment to ensure functional sustainability. The spatial interconnections between settlement centers and their surrounding areas through migratory flows, commuting movements, and transportation linkages lead to the development of the functional regions (Klapka & Tonev, 2008). Functional areas are defined by combining local units that have a high degree of dependency in terms of the intensity of flows connected to a central location (Glasson, 1978). This study aims to identify the catchment areas of the districts to understand the extent of each district's service boundary. The Reilly's law of retail gravitation was designed to model the catchment areas of a region upon the attraction by individual types of services (Reilly, 1931).In this study, Reilly's law has been applied to determine the catchment areas of the districts of Bangladesh where district headquarter has been considered as a center point. This study primarily focuses on Chapai Nawabganj and Meherpur districts, exploring their catchment areas and the factors influencing them.

1.2 Literature Review

Gravity models have been widely employed in regional planning, mostly as shopping models and in research on various spatial interactions in regions (Dennis et al., 2002; Derbali et al., n.d.). Several scientific studies have applied the Reilly's law of gravitational flow to identify the area of influence of the functional regions and understand their spatial interactions (Bozdo et al., 2013; Derbali et al., n.d.; Halás et al., n.d.; Kraft & Jan, 2012). Human's decisions on which service center to use are influenced by the center's attraction, marketing and communication facilities, location, and accessibility (Bozdo et al., 2013). Catchment areas of regions may vary due to static factors including size of areas, geographic location, availability of natural resources, and importance at the national level (Snieska & Zykiene, 2015). Significant variable factors such as physical infrastructure, demography, employment, viability of the economic sector, rate of regional economic growth, availability of educational infrastructure, the sufficiency of social and healthcare services also influence service boundary of regions (Snieska & Zykiene, 2015).

1.3 Objective of the Study

1. To identify and analyze the factors which influence the larger and smaller catchment area of the selected districts of Bangladesh.
2. To explore the interrelationship among the factors influencing the catchment area of the selected districts.

1.4 Scope of the Study

This study's findings show how far each district's services, facilities, and resources extend outside its administrative boundaries. Understanding the factors that determine catchment areas may help with regional planning while addressing the specific issues and challenges of the districts. This study provides a scope of further research in effective resource distribution, ensuring that regions with smaller catchments receive adequate focus and resources.

1.5 Limitation of the Study

The study endured a constraint in terms of data sources and collection. While population data were obtained from BBS report, 2022, data for other influencing factors, such as employment rate, total person engaged in economic activities, growth centers, and markets, were obtained from BBS report, 2011. Thus, the study may not reflect the most recent situation of these parameters, thereby influencing the accuracy of the analysis. In addition, catchment area computation with Reilly's law may have inherent limitations in accurately capturing the distinct spatial dynamics of districts.

1.6 Methodology

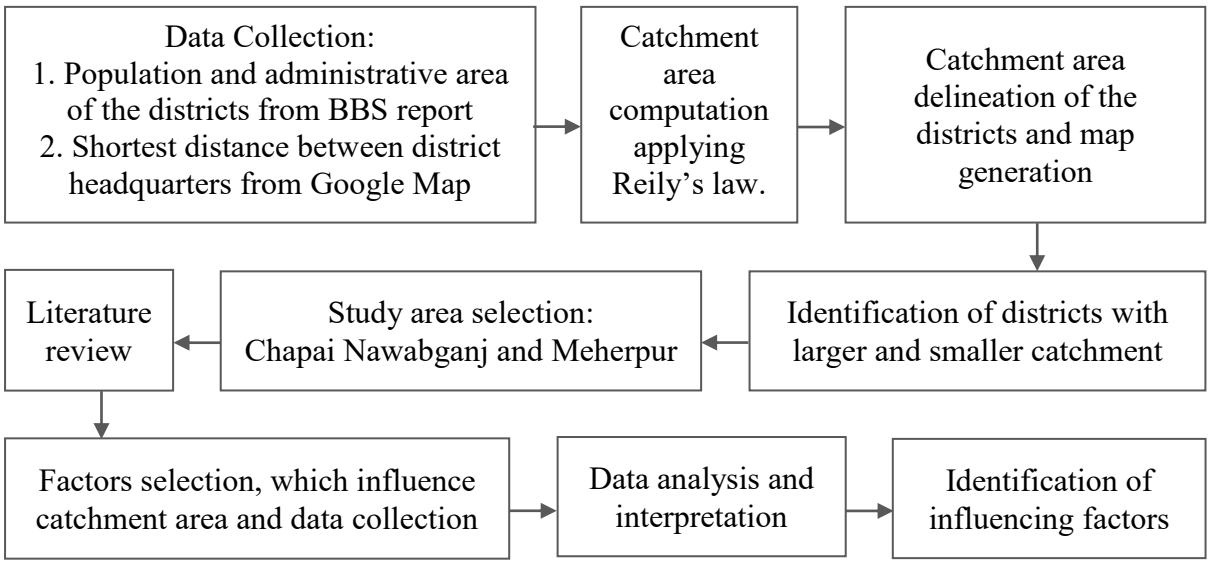


Figure 1: Methodological Framework of the Study

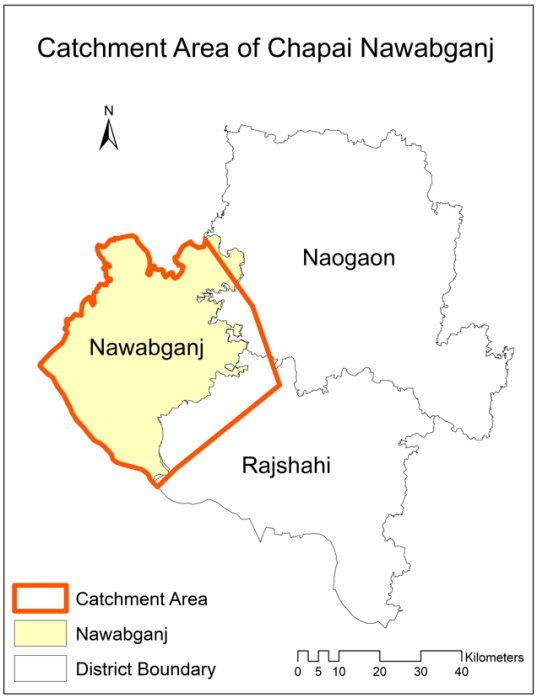
CHAPTER 2: CATCHMENT OF THE STUDY AREA

Chapai Nawabganj: Catchment area is 25.75% larger than its administrative area. 17.27% of the total catchment area lies on Rajshahi district whereas only 5.78% lies on Naogaon district, which implies that Chapai Nawabganj district has more influence on Rajshahi district than Naogaon.

Meherpur: Catchment area is 42% smaller than its administrative area. 22% of the district's total administrative area falls within the catchment of Kushtia district and 20% area falls within the catchment of Chuadanga district. This scenario indicates that both Kushtia and Chuadanga district have influence on Meherpur district.

Table 1: Catchment Area of the Districts

District	Chapai Nawabganj	Meherpur
Administrative Area	1702.55 sq. km. (BBS, 2011)	716.08 sq. km. (BBS, 2011)
Catchment Area	2140.93 sq. km.	415.37 sq. km.
Total Population	1835527 (BBS, 2022)	705356 (BBS, 2022)
Urbanization Rate	25.24% (BBS, 2022)	22.02% (BBS, 2022)
Density per sq. km.	1078 (BBS, 2022)	951 (BBS, 2022)



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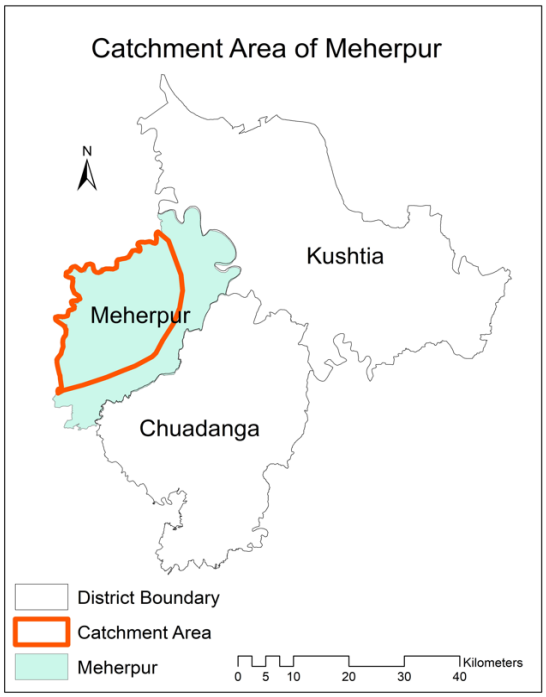


Source: Author, 2023

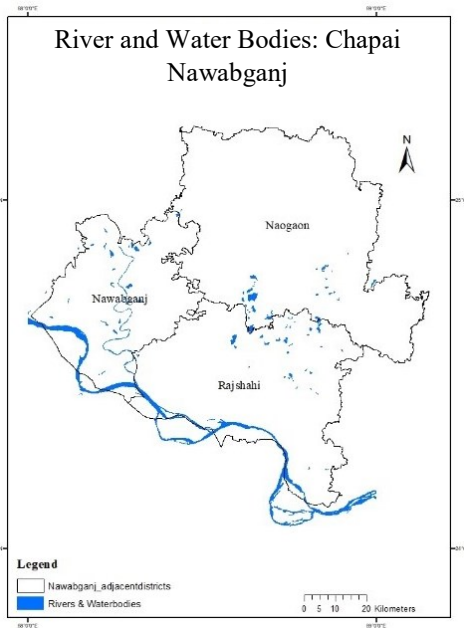
Figure 2: Catchment Area of the Selected Districts

CHAPTER 3: FACTORS INFLUENCING CATCHMENT AREA OF THE DISTRICTS

3.1 Geographical Location and Natural Resources of the Districts

Chapai Nawabganj: Chapai Nawabganj is a district in northern Bangladesh. The Ganges, Mahananda, Pagla, Moraganga and Punarbhaba are the main rivers of this district. Trade and commerce are centered on Mahananda and Padma rivers (BBS, 2011). According to BWDB, the largest rubber dam will be constructed at Chapai Nawabganj, which will provide 8000 hectares of land for effective irrigation and will produce fish worth around 22 crore takas annually (BWDB, 2023). These locational advantages might influence the catchment area of the district.

Meherpur: Meherpur district is located in western Bangladesh. There are four main rivers namely Bhairab, Ichamati, Mathabhanga, Kazla in the district and they are almost dying. Hence, there are less trading opportunities utilizing the waterways. 'Bhairab River Reconstruction Project' will be implemented in the district to facilitate trade (BWDB, 2023)



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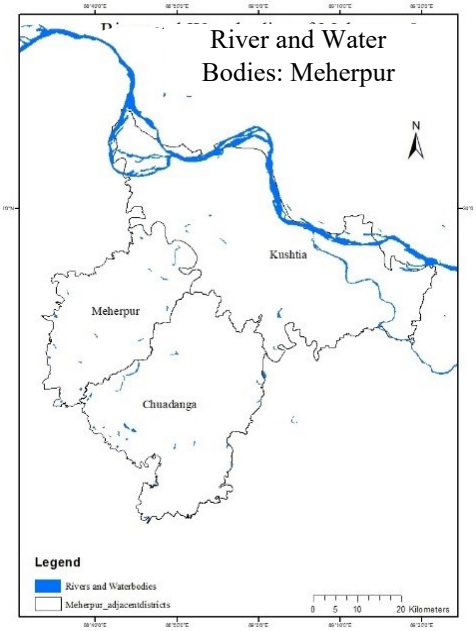


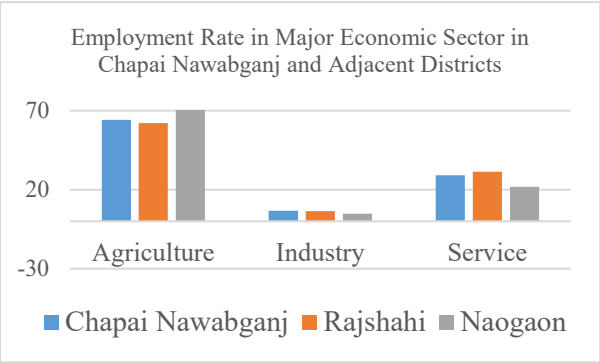
Source: Author, 2023

Figure 3: Existing River and Water Bodies in the Districts

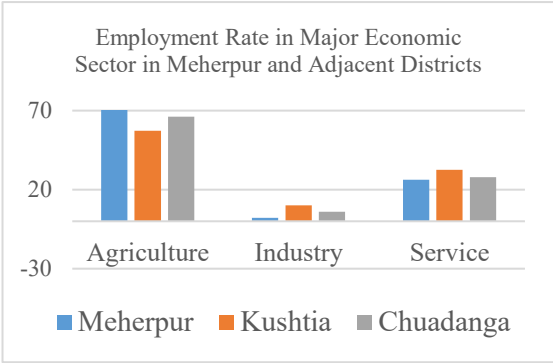
3.2 Employment and Economic Opportunities

3.2.1 Employment Rate in Major Economic Sector

Chapai Nawabganj: This district's employment rate in agriculture is 64.2%, while 6.6% in industry and 29.2% in service sector (BBS, 2011). Chapai Nawabganj has a higher employment rate in industrial sector compared to its adjacent districts, Rajshahi and Naogaon (Figure 4).



Source: BBS, 2013



Source: BBS, 2013

Figure 4: Employment Rate in Major Economic Sector in the Districts

Meherpur: Meherpur district is mostly dependent on agriculture with 71.5% employment rate in this field and this district has lower employment rate in industry (2.2%) and service field (26%) compared to its adjacent district, Kushtia and Chuadanga (BBS, 2011). This district has lower number of large, medium and small-scale industries compared to its adjacent districts (Appendix 2). There are only 3 large industries and 28 medium scale industries in the district (BBS, 2011). As a result, there is less economic opportunity in the industrial sector, which contributes to the cause of smaller catchment area of this district.

3.2.2 Major Non-Farm Economic Activities

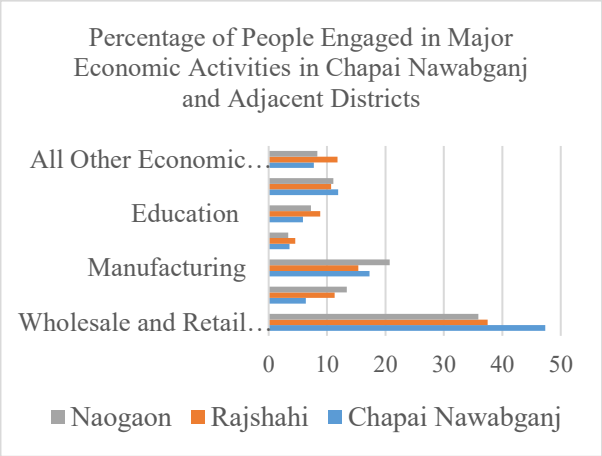
Chapai Nawabganj: Percentage of people engaged in wholesale and retail trade is 47.36%, which is higher than adjacent districts, Rajshahi and Naogaon (BBS, 2011). Percentage of engaged in manufacturing in Chapai Nawabganj is 17.28% that is higher than Rajshahi. Chapai Nawabganj has higher potential to attract more people from its adjacent districts for having higher working opportunity in manufacturing, wholesale and retail activities.

Special Trading Opportunity in Chapai Nawaganj

Mango is the main cash crop in Chapai Nawabganj district. According to the district's Department of Agriculture Extension, there are 37,588 hectares of mango orchards and the government has set a target to produce 440,956 tons of mango this year. A special 'Mango Train' has been introduced on Dhaka-Chapai Nawabganj route to facilitate the distribution of mango (BR, 2023). This will enhance the trading opportunities in Chapai Nawabganj.

Meherpur: Percentage of people engaged in manufacturing is only 12%, which is lower than its adjacent district, Kushtia and Chuadanga. Majority of the people in Meherpur are engaged in small-scale economic activities. People might move from Meherpur to its adjacent districts for large-scale employment opportunities. Thus, lack of employment opportunities has an influence on the smaller catchment area of the district. Out migration of females has increased

in Meherpur district due to scarcity of income generating opportunities, educational and health facilities (Rokib et al., 2011).



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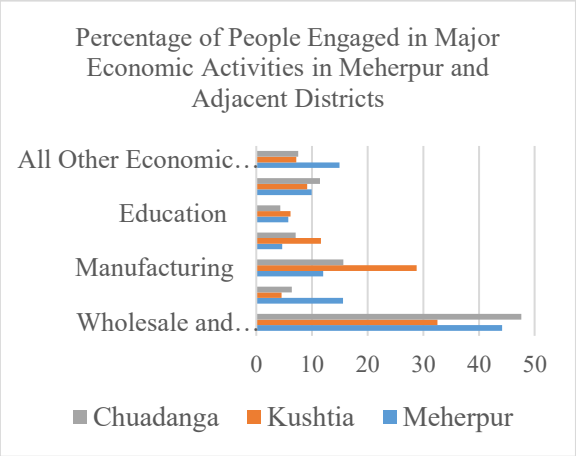


Source: BBS, 2013

Figure 5: Percentage of People Engaged in Major Economic Activities in the Districts

3.2.3. Regional Shift of the Districts

Chapai Nawabganj: There is a positive regional shift in employment in mining and quarrying, manufacturing and water supply, sewerage and waste management. Regional growth in these sectors has led to increased economic activities and job creation in the district. Thus, this district has the potential to attract skilled labor from adjacent districts. The rate of migration to Chapai Nawabganj city has increased due to the growth of economy (Islam et al., 2013).

Table 2: Regional Shift of Chapai Nawabganj

	Total Person Engaged		Growth Rate		
Sub-Sector	**2000-09**	**2010-13**	**Chapai Nawabganj**	**National**	**Regional Shift**
Mining and Quarrying	95	141	0.48	0.21	25.64
Manufacturing	34963	45901	0.31	0.26	1766.56
Electricity, Gas Supply	480	525	0.09	0.17	-38.18
Water Supply, Sewerage, Waste Manageme	193	325	0.68	0.20	93.40
Construction	182	251	0.38	0.44	-10.25

Source: BBS, 2013

Meherpur: There is no mining and quarrying sector in this district. It has negative regional shift in employment in electricity and gas supply, which indicate contraction on energy supply industry. There is also negative regional shift in construction activities indicating slowdown in infrastructural development and opportunity for employment generation.

Table 3: Regional Shift of Meherpur

	Total Person Engaged		Growth Rate		
Sub-Sector	**2000-09**	**2010-13**	**Meherpur**	**National**	**Regional Shift**
Mining and Quarrying	0	0	0.00	0.21	0.00
Manufacturing	9495	12232	0.29	0.26	246.29
Electricity, Gas Supply	141	144	0.02	0.17	-21.44
Water Supply, Sewerage, Waste Management	8	11	0.38	0.20	1.40
Construction	128	149	0.16	0.44	-34.73

Source: BBS, 2013

3.3 Cultural and Heritage Sites

Chapai Nawabganj: The district is endowed with some significant religious centers, which include historical ali shahpur mosque, khanjan dighi mosque, choto shona mosque, three domed mosque, darsbari mosque, shah neyamatullah's majar. These religious sites enhance the district's cultural and historical importance. There is potential to propagate new services, facilities and economic opportunity focusing on the tourist spots.

Meherpur: Important cultural and historical sites of Meherpur district include temples and liberation war memorial. Compared to Meherpur, the adjacent district Kushtia has more significant cultural sites such as Rabindranath Tagore's residence in Kuthibari, majar of Baul Saint Lalon Shah (Appendix 3). Thus, there is less potential in Meherpur to grow tourism as an economic opportunity.

3.4 Active Non-Governmental Organizations (NGO)

Chapai Nawabganj has 19 active NGOs providing various social services in the district, which include BRAC, Proshika, ASA, Manobic Unnayan Society, Swanirvar Artha-Samajik Unnayan Sangstha, Kolyani Mohila Sangsad (Appendix). On contray, Meherpur district has only 9 active NGOs working within the district.

3.5 Number of Research Centers

In Chapai Nawabganj, 3 research centers are located in the district which are mango research institute and two horticulture research centers. No research center exists in Meherpur district.

3.6 Healthcare Facilities

Chapai Nawabganj district has 365 total healthcare facilities and Meherpur district has 192 total healthcare facilities (MoHFW, 2022). Both Chapai Nawabganj and Meherpur districts have lower number of healthcare facilities compared to their adjacent districts (Appendix 5). Though Chapai Nawabganj district has larger catchment area, it has less healthcare facilities than Rajshahi and Chuadanga. This scenario implies that catchment area of this district does not necessarily depend on total healthcare facilities, other factors might contribute more. In Meherpur district, majority of the women are deprived of receiving modern healthcare facilities(Hossain et al., 2011). Thus, people from Meherpur may move to adjacent districts to receive health services,

3.7 Educational Institutions

In spite of having larger catchment area, number of educational institutions is lower in Chapai Nawabganj district (Appendix 6). Thus, availability of educational institutions might not be an

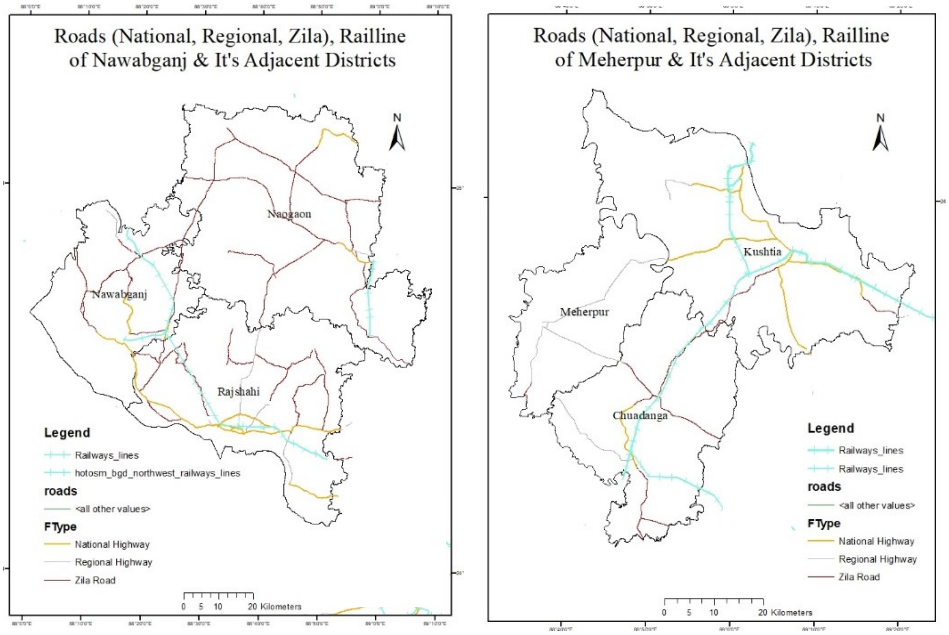
influential factor for larger catchment area of Chapai Nawabganj district. Number of educational institutions is lower in Meherpur district compared to its adjacent districts, Kushtia and Chuadanga (Appendix 6). There is no university in this district. As a result, people of Meherpur might go to adjacent districts to get better educational facilities

3.8 Growth Centers and Markets

Chapai Nawabganj district has 21 growth centers and 196 rural markets (BBS, 2011). Growth centers are well distributed across the district facilitating economic activities (Appendix 7). Growth centers with adequate infrastructural facilities play a vital role in boosting rural development and economic growth (Das & Mondal, 2010). Meherpur district has 11 growth centers and 76 rural markets (BBS, 2011). Distribution of growth centers in Meherpur district is dispersed compared to its adjacent district, which may hinder trading facilities (Appendix 7). Growth Centers are an important aspect of Bangladesh's rural-urban connectivity and must be properly located in prominent rural places (Barua et al., 2015).

3.9 Transportation Network

Chapai Nawabganj district has well developed transportation network in terms of road, rail and water connectivity (Appendix 8). National and regional highway cross through the district ensuring connectivity with its adjacent districts, Rajshahi and Naogaon. Meherpur district is connected with adjacent districts only through regional highway. This district is not connected with national highway. Also, there is no rail connectivity in the district. The nearest rail station is located in Chuandanga, which is about 30 kilometers away.



Source: Author, 2023 Source: Author, 2023

Figure 6: Existing Transportation Network in the Districts

3.10 International Connectivity

Chapai Nawabganj is connected with India through N6 national highway at border (Appendix 9). In Chapai-nawabganj, there is a check post (passport checking and entry hall) locating on the national highway facilitating easy access for trade and commerce to the West Bengal of India. Chapai Nawabganj has become the attraction of investors for its international connectivity. On contrary, Meherpur district does not have border connectivity with India through national highway. The adjacent district, Kushtia is connected with India by waterways. Therefore, the Meherpur does not have the locational advantage for trade and commerce with India. It can be stated that well connectivity through transportation network provides economic opportunities and affects significantly the catchment area of Chapai Nawabganj.

3.11 Plans and Projects in the Study Area

Several plans and projects have been undertaken in the districts as showed in the table. In Chapai Nawabganj, industrial development has been given priority in terms of promoting solar energy, encouraging small and large-scale industries. These interventions will help to boost economic viability of the district increasing its attractiveness to skilled labor force. In contrast, there is no such plans taken for boosting industry and economy in Meherpur district. As a result, the district is unable to attract potential human forces that is one of the reason of its smaller catchment area. Rural infrastructural development projects have been undertaken in both districts, which will help to increase its potential as a service center in the future.

Table 4: Plans and Projects Undertaken in the Districts

Districts	Three Year Work Plan	Ongoing Projects
	Industry	Road and Infrastructure
Chapai Nawabganj	1.Promotion of solar energy 2.Establishments of small- and large-scale industries 3.Generation of employments	1.Improvement Rural Infrastructure Development Project-3 (IRIDP-3) 2.Urban Governance & Infrastructure Improvement Project
Meherpur	No Plan	1.Third Urban Governance & Infrastructure Improvement Project (UGIIP-III) 2. Improvement Rural Infrastructure Development Project-3 (IRIDP-3)

Source: BBS, 2022

CHAPTER 4: MAJOR FINDINGS, RECOMMENDATION AND CONCLUSION

4.1 Major Findings

- For Chapai Nawabganj, geographical location, rivers, well-developed transportation networks, international connectivity with India facilitate better trade and commerce. Chapai Nawabganj is important at national level for mango production and distribution throughout the country. The larger catchment area of the district depends more on economic opportunities rather than the availability of physical and social amenities.
- In Meherpur district, there is absence of locational advantages as the rivers of this district are dying. Absence of well-developed transportation network, rail and waterway connectivity hinders the economic growth of this district. In spite of being a border district, it does not have international connectivity. In addition, there is lack of physical and social amenities. All these factors influence the smaller catchment area of this district.

4.2 Recommendations

- River restoration programs should be undertaken in the districts to facilitate economic activities by utilizing waterways.
- Railway network and border connectivity should be established in Meherpur district.
- Tourism industry could be promoted in Chapai Nawabganj district focusing on its historical and cultural sites.
- Adequate distribution of resources and infrastructural development should be ensured for increasing the attraction of the districts and economic opportunities.
- Sustainable regional planning requires cooperation between governmental institutions, non-governmental organizations, and local communities.

4.3 Conclusion

With a focus on Chapai Nawabganj and Meherpur, this research highlights the crucial factors affecting catchment areas of Bangladesh's districts. Chapai Nawabganj boasts from favorable geographic location, national and international connectivity, which promotes commerce and economic growth. In contrast, Meherpur experiences in terms of geographic location, national and international connectivity that hinder its ability to grow economically and expand its catchment area. The main conclusion from this study is the significance of economic opportunities in defining district catchment areas. The research emphasizes the need of balanced growth, equitable resource allocation, and the development of basic infrastructure and services.

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GLOSSARY

Catchment area A catchment area is a service area which refers to a geographical region from which a specific facility or service draws its users.

Functional region A functional region, also known as a nodal region, is a geographic area characterized by a central point or node and the surrounding areas that are connected to that central point through various interactions, activities, or flows.

Regional shift Regional shift refers to the significant change or movement of economic, demographic, or cultural activities from one geographical region to another.

Reilly's law Reilly's Law is a concept in geography that predicts the likelihood of consumers traveling to a particular retail center based on its size and the distance from their location.

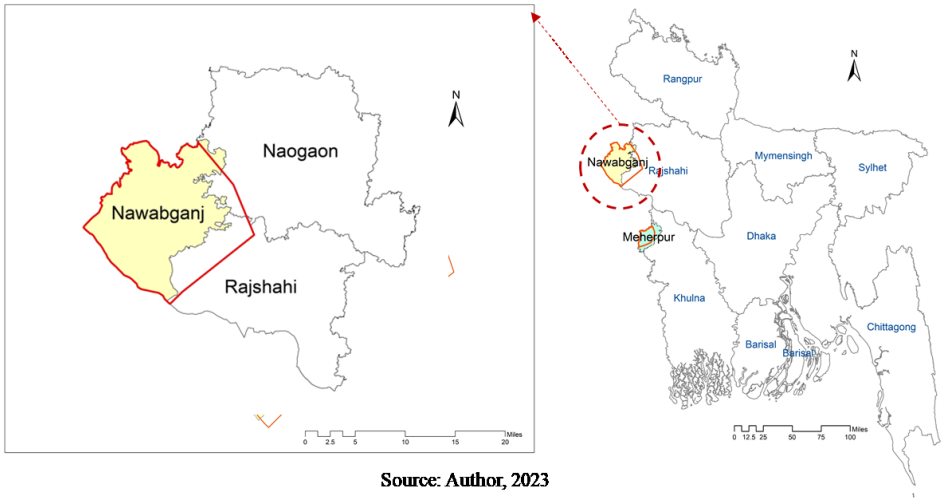
Social Amenities Educational institutions, healthcare facilities, parks and recreation area, libraries, community centers etc.

Physical Amenities Natural landscape, infrastructure, architectural features, recreational facilities, public space.

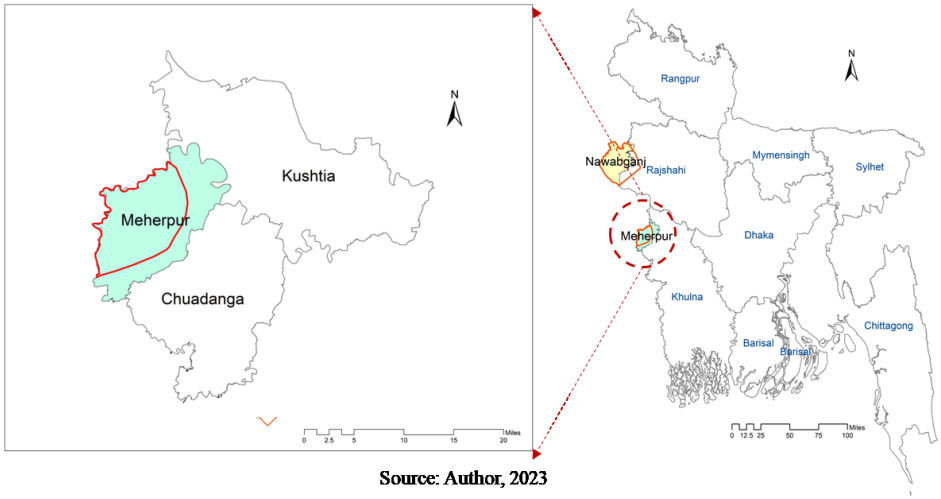
Spatial Interaction Spatial interaction is the movement, exchange, or flow of people, goods, information, or ideas between different locations, influenced by factors like distance, connectivity, and socio-economic conditions.

APPENDICES

Appendix 01: Study Area Profile

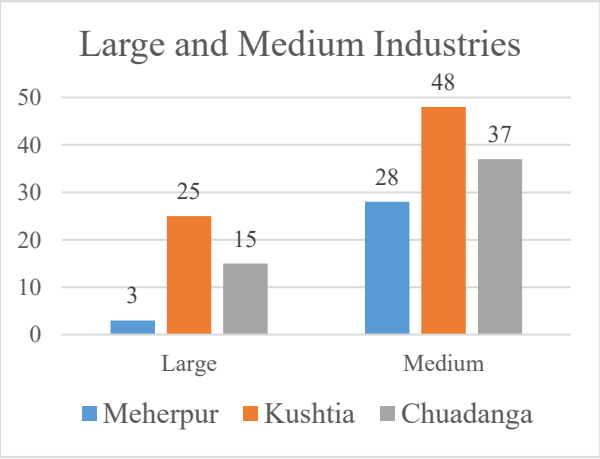


Source: Author, 2023

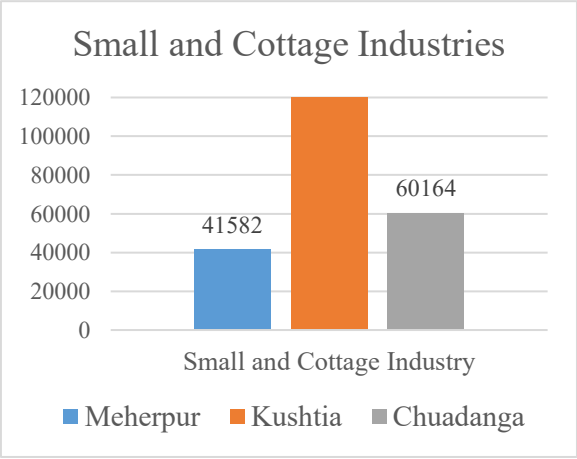


Source: Author, 2023

Appendix 02: Number of Industries in Meherpur District



Source: BBS, 2011



Source: BBS, 2011

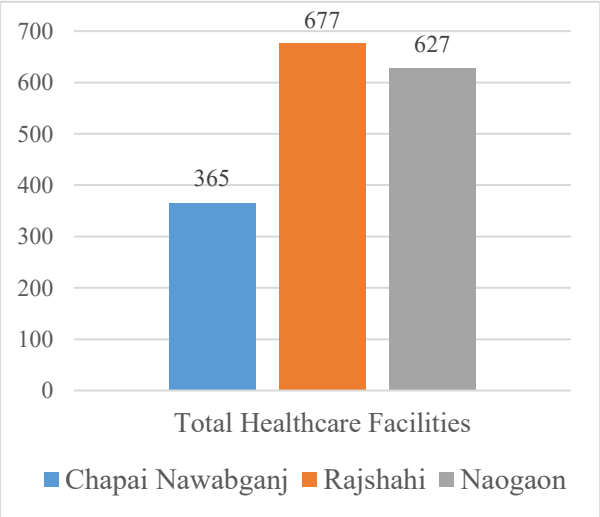
Appendix 3: Cultural and Heritage Sites in the Districts

Chapai Nawabganj	Rajshahi	Naogaon
1. Historical Ali Shahpur Mosque 2. Kotwali Gate 3. Khanjan Dighi Mosque 4. Chamchika Mosque 5. Choto Shona Mosque 6. Three Domed Mosque 7. Darsbari Mosque 8. Shah Neyamatullah's Majar 9. Tomb of Bir Shreshtho Mohiuddin	1. Barendra Research Museum 2. Puthia Rajbari 3. Shah Makhdum Majar 4. Rajshahi University Campus 5. Shaheed Sriti Museum 6. Bagha Masjid	1. Paharpur Buddhist Bihar 2. Alta Dighi 3. Kusumba Mosque 4. Jagaddal Vihara 5. Bolihar Rajbari
Meherpur	**Kushtia**	**Chuadanga**
1. Bhabanandapur Temple 2. Siddheshwari Kali Temple 3. Meherpur Martyrs' Memorial 4. Mujibnagar Liberation War Memorial Complex	1. Gopinath Jiur Temple 2. Rabindranath Tagore's Residence in Kuthibari 3. Majar of Baul Saint Lalon Shah 4. Jhaudiyar Shahi Mosque	1. Liberation War Memorial Monument

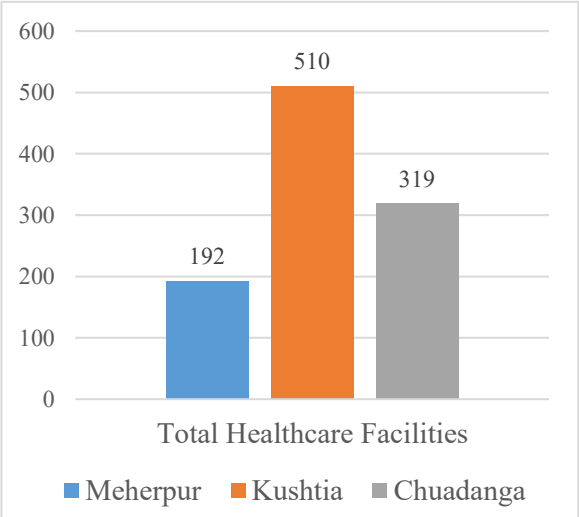
Appendix 04: Active Non-Governmental Organization (NGO)

Chapai Nawabganj	Meherpur
19 Active NGOs: BRAC, Proshika, ASA, Nijera Kari, IDE, Dasco, CARE, Thengamara Mahila Sabuj Sangha (TMSS), Trinamul, Vision, Proyash, Manobic Unnayan Society, Swanirvar Artha-Samajik Unnayan Sangstha, Kolyani Mohila Sangsad, Amnura Santal Mission, BIKE, BISE, BIDOS, BARIO	7 Active NGOs: BRAC, Proshika, ASA, Nijera Kari, Palasheepara Samity, Kumaridanga Palli Unnayan Sangstha, Child and Mother Welfare Foundation and Sandhani.

Appendix 05: Total Healthcare Facilities in the Districts

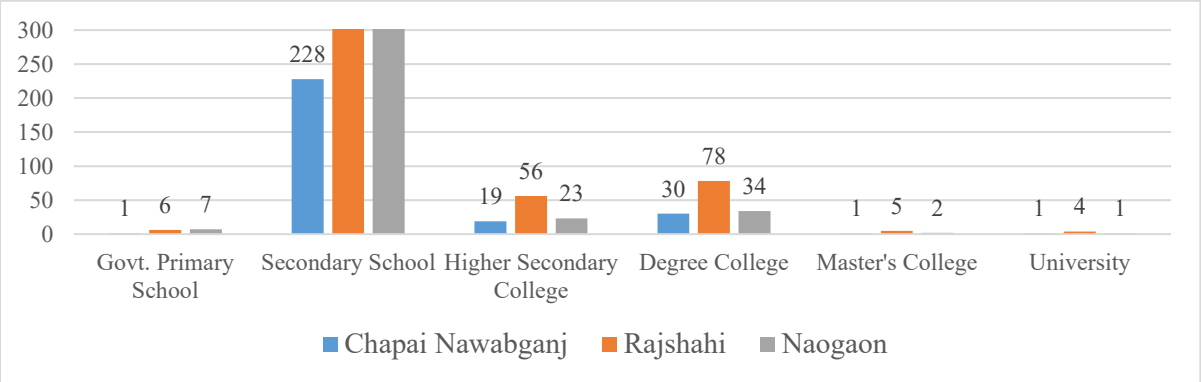


Source: MoHFW, 2022

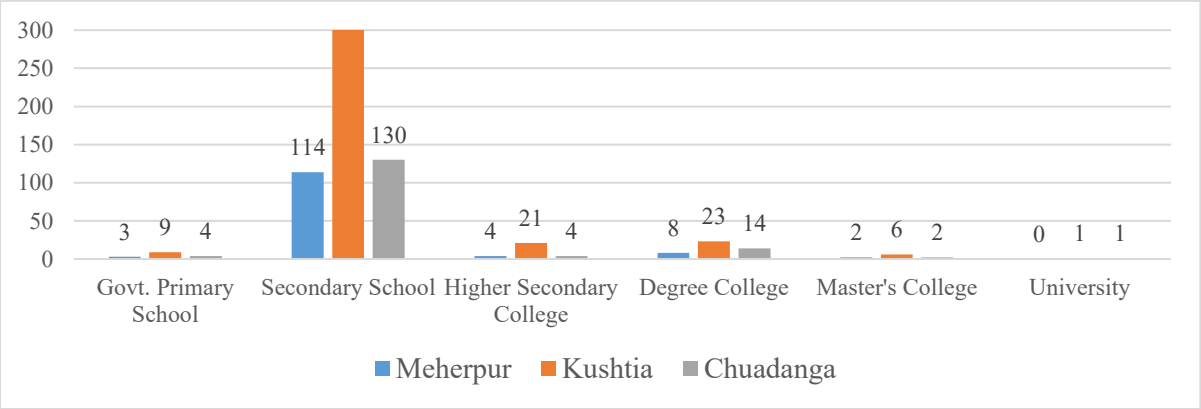


Source: MoHFW, 2022

Appendix 06: Educational Institutions in the Districts

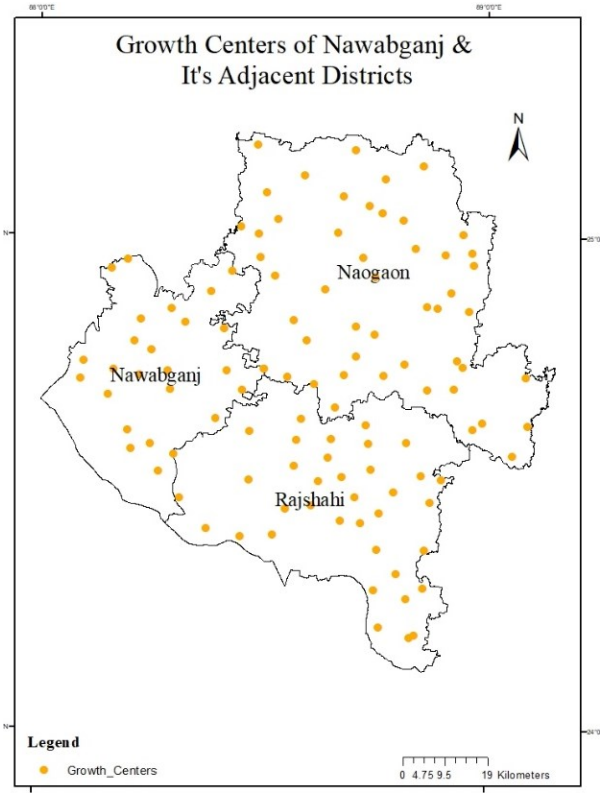


Source: BANBEIS,2021

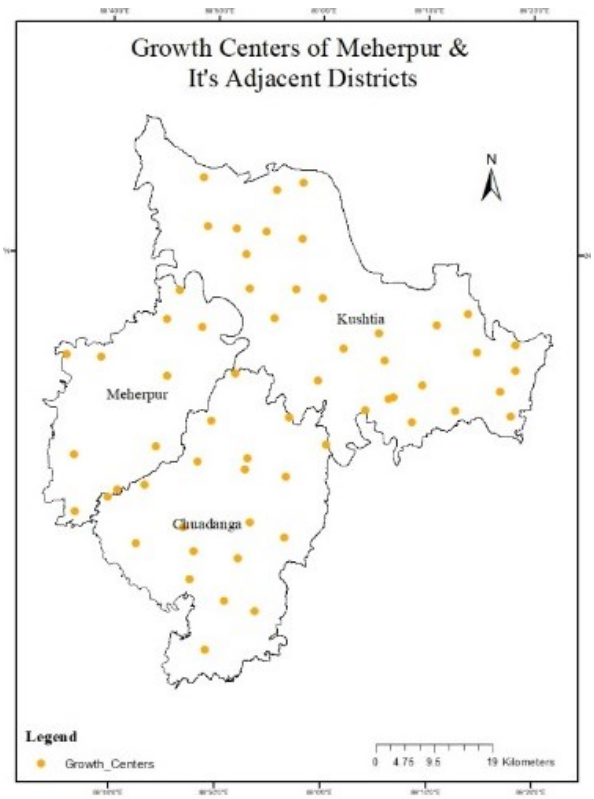


Source: BANBEIS,2021

Appendix 07: Distribution of Growth Centers in the District

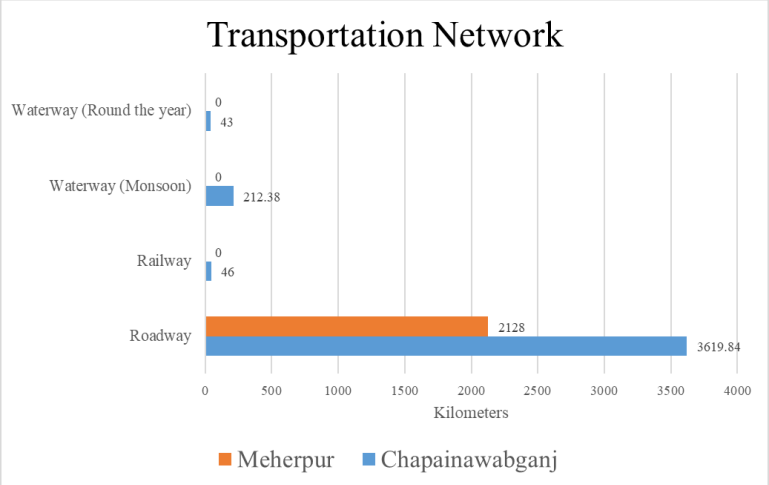


Source: Author, 2023



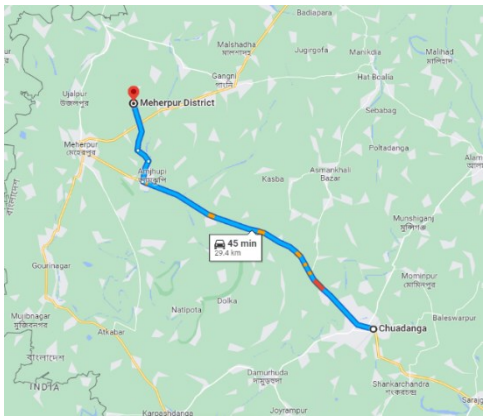
Source: Author, 2023

Appendix 08: Transportation Network in the District



Source: BBS, 2011

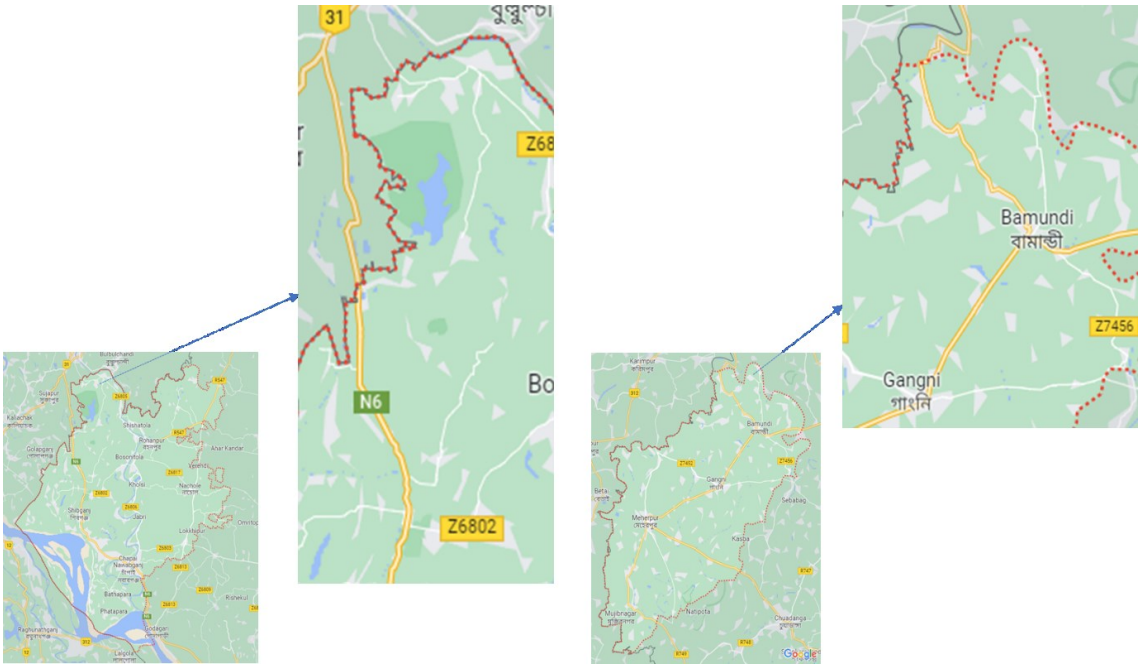
Appendix 09: Connectivity



Distance from Meherpur to nearest rail station: 30km

Bangladesh and India are connected by National Highway at border in Chapainawabganj

No international connectivity through national highway in Meherpur



Source: Google Map, 2023