IBN HALDUN UNIVERSITY
ALLIANCE OF CIVILIZATIONS INSTITUTE
DEPARTMENT OF CIVILIZATION STUDIES

MASTER'S THESIS

ECOLOGY, EPIDEMICS AND THE COLONIAL STATE: ENVIRONMENTAL CHANGE AND HEALTH IN EASTERN BENGAL DELTA, 1858-1947

MOHAMMAD HOSSAIN

THESIS SUPERVISOR: ASST. PROF. DR. ERCÜMENT ASIL

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by

MOHAMMAD HOSSAIN

A thesis submitted to the Alliance of Civilizations Institute in partial fulfillment of the requirements for the degree of Master of Arts in Civilization Studies

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ISTANBUL, 2020

ACADEMIC HONESTY ATTESTATION

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ABSTRACT

ECOLOGY, EPIDEMICS AND THE COLONIAL STATE: ENVIRONMENTAL CHANGE AND HEALTH IN EASTERN BENGAL DELTA, 1858-1947

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MA in Civilization Studies

Thesis Advisor: Asst. Prof. Dr. Ercüment Asil

June 2020, 98 pages

The dynamic nature of the ecological regime of eastern Bengal stems from the fact that it is home to the largest delta in the world, the Bengal Delta. Despite its importance, its history has been underrepresented in regional historiography. Iftekhar Iqbal tried to address this under-representation by incorporating the category of the ecological in his assessment of the region. An important aspect of Iqbal's scholarship includes the study of how human-induced ecological changes in the Bengal Delta spread water-borne diseases and caused famine.

The present study argues that colonial efforts to combat the epidemic disease at Dhaka in eastern Bengal failed due to two reasons. First, the colonial medical institutions and health infrastructure in the nineteenth and early twentieth century Dhaka was disproportionately distributed and remained inadequate and out of the reach of those who needed it most. Second, colonial developmental projects and attitudes leading to the loss of ecological balance in the Bengal Delta contributed to famine-like conditions and hyperendemicity of epidemic disease in the region, which together contributed to higher mortality in the region.

This study employs an ecological framework based on dynamic deltaic nature to examineepidemics in assessing the colonial history of the Bengal Delta region. It also uses the notion of the Delta as a broader 'zone of anomaly' in the history of colonial administration of the region. Employing this framework to assess the history of the region, the study concludes that colonial policies that neglected ecological concerns in the delta were directly responsible for failure in eradicating epidemics in eastern Bengal during the colonial period.

Key Words: Epidemics, Bengal Delta, colonialism, environmental history, Mitford Hospital

ÖZ

EKOLOJİ, SALGIN HASTALIKLAR VE SÖMÜRGE DURUMU: DOĞU BENGAL DELTASINDA ÇEVRESEL DEĞİŞİM VE SAĞLIK, 1858-1947

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Medeniyet Araştırmaları Yüksek Lisans Programı
Tez Danışmanı: Dr. Öğr. Üyesi Ercüment Asil
Haziran 2020, 98 Sayfa

Ekolojik olarak Doğu Bengal'ın dinamik bir yapıya sahip olması, içinde bulunduğu dünyanın en büyük deltası olan Bengal Deltası'ndan kaynaklıdır. Çok ciddi bir önem taşımasına rağmen Bengal Deltası bölgesel tarih yazımında yeterli seviyede temsil edilmemiştir. Iftekhar Iqbal, bölge üzerine yaptığı değerlendirmesinde ekolojik sınıflandırma yaparak durumu ele almaya çalışmıştır. Iqbal'ın çalışmasının önemli bir yönü ise Bengal Deltası'nda insan kaynaklı ekolojik değişikliklerin sudan geçen hastalık ve kıtlığa nasıl neden oldukları üzerine yaptığı araştırmasıdır.

Elinizdeki çalışma, Doğu Bengal'ın Dhaka bölgesindeki salgın hastalıklarla mücadelede sömürge yönetiminin çabalarının iki sebepten dolayı başarısız olduğunu ileri sürmektedir. Birincisi, 19. yüzyıl ve 20. yüzyıl başlarında Dhaka'daki sömürge yönetiminin sağlık kurumları ve altyapısının yetersizliği ve ihtiyaç duyanlar tarafından kolay ulaşılamaz olmasıdır. İkincisi ise sömürge yönetiminin yaklaşım ve kalkınma projelerinin Bengal Deltası'ndaki ekolojik dengeyi bozarak kıtlık ve hiperendemik hastalıkların ortaya çıkmasında ve dolayısıyla bölgede çok sayıda insanın ölümüne neden olmasında büyük bir rol onynamasıdır.

Bu çalışma, salgın hastalıklar üzerinden Bengal Deltası'nın sömürge dönemi tarihini incelemek için dinamik deltaik yapısına dayanarak oluşturulan bir ekolojik çerçeve/altyapı kullanmaktadır. Ayrıca bu çalışmada Delta kavramı bu bölgedeki sömürge yönetimi tarihinde büyük bir 'anomali bölgesi' olarak kullanılmıştır. Bölgenin tarihini değerlendirmede bu çerçeveyi kullanan çalışmamız, Doğu Bengal'deki salgın hastalıkları defetmek noktasında sömürge dönemi boyunca görülen başarısızlıkta bölgenin ekolojik şartlarını dikkate almayan sömürge politikalarının doğrudan sorumlu olduğu sonucuna varmaktadır.

Anahtar kelimeler: salgın hastalıklar, Bengal Delta, sömürgecilik, cevresel tarihi, Mitford Hastanesi

DEDICATION

I dedicate this thesis first and foremost to my deceased father Abdur Rouf Talukdar, who passed away before it could be finished. He was a very simple man who loved his family deeply and had many friends. He patiently taught me the value of being a father, and predicted that I would one day write books.

Next, I also dedicate this thesis to my father-in-law *Shaheed* Mir Quasem Ali, whom I met only once before his passing away to the next world. His exemplary love and lifelong dedication towards his faith ideals, family, associates and friends, and the people of this country will be remembered for generations by the Grace of the Almighty.

I pray to the Almighty that my father and father-in-law be accorded the highest of places in Paradise.

Finally, I dedicate this thesis to my beloved mentor Dr. Abdullah al-Ahsan, who taught me the importance of learning from history and to strive towards seeking the truth. I consider it a matter of great blessing to call myself a student of his. May the Almighty grant him a long and fruitful life.

ACKNOWLEDGEMENTS

Alhamdulillah.

The idea of writing a thesis on environmental history was a result of numerous enlightening conversations with Dr. Fatih Çalışır, of the History department of Ibn Haldun University, whose course on environmental history opened up to me new and exciting prospects to explore in terms of historiography. Without his relentless encouragement, constant advice and generous support throughout the past year, this thesis would not have come to fruition.

I am deeply indebted to my thesis supervisor Dr. Ercüment Asil, of Alliance of Civilizations Institute at Ibn Haldun University, whose timely feedback, steady supervision and indomitable mentorship not just kept me on track but inspired me to go the extra mile to ensure a good standard of scholarship. I would also like to thank Dr. Önder Küçükural and Dr. İbrahim Özdemir for their valuable informed comments on my thesis. In all honesty, there is no way that I can do justice to the unceasing support and love that I received from the MEDIT and IHU family, whether from my dear friends, beloved classmates, dedicated staff or respected teachers.

With the grace of the Almighty, my family remains the bedrock which always stood beside me through thick and thin. I am deeply grateful for the generous love and support by my beloved mother Mafuza Rouf and siblings Ayesha, Khadija and Nurul Islam. I also appreciate the constant encouragement by my family-in-laws, especially my dear mother-in-law Ayesha Khandaker.

And last, but not the least, I am indebted, beyond words, to the unfailing support from my wife Tahera Tasneem, and our little one, Ayman Quasem, without which I could not have written a thesis in the first place.

I thank you all from the bottom of my heart, and acknowledge the sacrifices you make for me everyday. I sincerely hope that I can make you all proud.

Mohammad Hossain

ISTANBUL, 2020

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CHAPTER I

INTRODUCTION

The Bengal Delta is the largest delta in the world, and the region it covers today is amongst the most densely populated regions on earth.[1] Two-thirds of the delta lies in present-day Bangladesh, and the remaining part lies in the West Bengal state of India. It is estimated that 630 million people live in the region, the bulk of them in the two main cities, Kolkata (formerly Calcutta) in West Bengal, and Dhaka, the capital of Bangladesh.[2] The active part of the Bengal Delta lies in its eastern half, near the confluence of three rivers, the Ganges, the Brahmaputra, and the Meghna, which together form the GBM (Ganges-Brahmaputra-Meghna) system. The dynamic nature of the ecological regime of Eastern Bengal stems from the fact that it is centered in this active part of the Bengal Delta.

Despite the apparent ecological importance of the eastern section of the deltaic region, however, its history has been underrepresented at two levels. Firstly, in political terms, it remains neglected because much of the political history of the region during the colonial period took place in western Bengal, centered in Calcutta. Secondly, as an extension of the first one, environmental historians of South Asia have largely neglected its study, preferring to study the agrarian systems and forest management practices of western Bengal under the colonial period.

[1] Niladri Gupta et al., "One-Dimensional Modeling of a Recent Ganga Avulsion: Assessing the Potential Effect of Tectonic Subsidence on a Large River," *Geomorphology* 213 (May 2014): 10, https://doi.org/10.1016/j.geomorph.2013.12.038; Jakia Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," *Journal of Coastal Research* 321 (September 2016): 1212–26, https://doi.org/10.2112/JCOASTRES-D-14-00232.1.

[2] Ramachandran Ramesh et al., "Integrated Management of the Ganges Delta, India," in *Coasts and Estuaries* (Elsevier, 2019), 189, https://doi.org/10.1016/B978-0-12-814003-1.00011-3. To put the immense population into perspective, it is mentionable that the population of India as of 2020 is 1.38 billion, and that of Bangladesh is 164 million, "Population of India and Bangladesh 2020," Worldometers, accessed May 16, 2020, https://www.worldometers.info/population/asia/southern-asia/.

1.1. Eastern Bengal in light of the socio-political history of Bengal

The eastern regions of Bengal, before the age of colonialism, were important centers of trade and administration. The urban center of eastern Bengal was situated in Dhaka, which was an important seat of administration in pre-colonial Mughal Bengal. It was established as a provincial capital of Bengal *subah* (province) of the Mughal Empire in 1610 and became the seat of the Mughal *subhadars* (provincial governor). When the seat of the *subhadar* was moved to Murshidabad in the north in the early eighteenth century, Dhaka continued to function as the seat of the deputy *subhadar*. Several scholars have discussed the changing fortunes of eastern Bengal from the pre-colonial to the colonial era. Richard Eaton chronicled the rise in prosperity and relative political stability of urban centers such as Dhaka and Murshidabad under Muslim rule from the thirteenth to the mid-eighteenth centuries.[3] In connection with rising ambitions of European colonial powers in the region, Radhakamal Mukherjee traced the challenges posed by the colonial powers to eastern Bengal. The predatory and sometimes ruthless practices of the French and English East India trade companies gradually led to a decline of trade and other indigenous economic practices in eastern Bengal throughout the seventeenth and eighteenth centuries.[4]

The biggest of the European trading companies, the British East India Company, successfully defeated its other European rivals, and eventually attained an unrivaled monopoly of the trade in the region. The British East India Company, apart from representing the financial interests of its body of governors and shareholders, also represented the interests of the British Crown in the region, which enabled the trading corporation to carry out both military and state administration activities. As part of this, Bengal was the first province to fall under the clutches of the East India Company rule. The accounts of political and military history accompanying this takeover are numerous and do not form the focus of this study. What is essential for our consideration is that the British colonial takeover was against Nawab Siraj-ud-Dawla (1756-1757), who was the last independent nawab of Bengal, ruling from the centers of Dhaka and Murshidabad in eastern Bengal. This came in the aftermath of the British East India Company victory in the Battle of Palashi (or Plassey as it is known in English scholarship) in 1757, where

[3] Richard M. Eaton, *The Rise of Islam and the Bengal Frontier, 1204-1760* (Berkeley: University of California Press, 1993).

[4] Radhakamal Mukherjee, *The Economic History of India: 1600-1800*, Memoirs of the United Provinces Historical Society (London: Longmans, Green & Co., Ltd., 1945), https://archive.org/details/in.ernet.dli.2015.278306.

the young nawab was betrayed by his army commander Mir Jafar.[5] Despite the colonial takeover, the Company administration officials continued to maintain the seat of the nawab on a hereditary basis, even though there was no real power or authority associated with it. In line with this, Dhaka remained the seat of the deputy *subhadar* in eastern Bengal owing to its former administrative and economic importance. However, this process was only maintained until 1843, till after the last hereditary deputy subhadar passed away without a successor. The title of the *nawab* has later revived again and conferred onto a new elite family by the British authorities, but by then, it had lost all its former meaning and importance. However, because the capital of the British colonial power was situated in Calcutta, the status of the previously significant administrative, cultural and economic centers such as Murshidabad and Dhaka was gradually delegated to that of less important municipal town centers after 1757. The eastern regions of Bengal, previously housing chief political and economic centers under Muslim rulers, thus declined in political importance after the British conquest of Bengal, and eventually became a hinterland to imperial Calcutta under British colonial administration. Trade and urban development declined as a result, and the region was converted to a food and cash crop producing province.[6]

The fertility of the land in eastern Bengal, the population boom, and accompanying economic activity such as plantation farming led to a perceptive rise of the administrative and economic importance of eastern Bengal through the latter part of the nineteenth century. The introduction of the railways enabled improved communications of the rural countryside in eastern Bengal with the urban centers in the region. The rising importance of eastern Bengal can be seen manifested in the designation of Dhaka as the provincial capital of the new province of Eastern Bengal and Assam in 1905. However, strong opposition fueled by partisan interests of the Calcutta based Hindu landed class, the *bhadrolok*,[7] led to the reunification of Bengal

[5] The British East India Company rewarded Mir Jafar for his treachery against the Nawab Siraj-ud-Dawla by designating him as the next Nawab of Bengal. A puppet for the East India Company, Mir Jafar was Nawab for two periods, from 1757-1760 till he was forced to abdicate in favor of his son-in-law Mir Qasim, and again after being reinstated by the company from 1763 till his death in 1765.

[6] Some sources for further reading to understand the decline of eastern Bengal and the impact of this decline on culture, economy and identity can be listed as follows - Sirajul Islam, *History of Bangladesh 1704-1971*, 2nd ed., 3 vols. (Dhaka, 2000); Rafiuddin Ahmed, *The Bengal Muslims, 1871 - 1906: A Quest for Identity*, 2. ed, Oxford India Paperbacks (Delhi: Oxford Univ. Press, 1996); Muhammad Mohar Ali, *History of the Muslims of Bengal: Bengal Muslims during the First Century of British Rule*, vol. II A (Riyadh: Department of Culture and Publications, Imam Muhammad Bin Sa'ud Islamic University, 1988), https://archive.org/details/HistoryOfMuslimsInBengal1757To1871VolumeIIAWriterMohorAli; Neilesh Bose, *Recasting the Region: Language, Culture, and Islam in Colonial Bengal*, First edition (New Delhi: Oxford University Press, 2014).

[7] The role of the Calcutta based Bengali Hindu *bhadrolok* and their impacts on future developments in Bengal and Indian history has been well documented in recent works of the region. The foremost amongst these

under the provincial capital of Calcutta. This situation continued until 1947 when Dhaka became the administrative capital of East Pakistan in the aftermath of the end of British colonial rule in the Indian subcontinent. British policies favoring the landed Hindu elite in Calcutta until late in the nineteenth century, and the apathy or antipathy of the latter towards the generally miserable conditions of Muslim subjects throughout British India fostered feelings of distrust amongst many Muslims. Such sentiments found their most ardent expressions in Muslim majority urban centers in East Bengal, such as Dhaka and Murshidabad, where Muslim landed elite (*ashraf)* such as the nawabs of Bengal were not just powerful and wealthy, but strong allies of the British colonial government as well. The impact of this was evident throughout the twentieth century. In the early years of the twentieth century, which saw the partition of Bengal, and its reunification in the face of the strong opposition from the Calcutta based Hindu *bhadrolok* class, Dhaka was the founding seat of the movement for Muslim separatism in 1905. This movement eventually triggered the formation of two nations after the British colonial apparatus left India in 1947.

Throughout the colonial rule in Bengal, western Bengal was both much more urbanized and the region where the colonial apparatus situated itself. Moreover, it was also the cultural center of the region, while the eastern part was virtually constituted as the hinterland of western Bengal. This reality has been reflected in the historiography of the region as well. Most of the accounts of the history of Bengal are simply reflections of events and developments in and around Calcutta in western Bengal, where a significant European population resided alongside a native population of the mostly Hindu landed gentry known as the *bhadrolok*. The roots of this historiography can be traced to the Bengal Renaissance, a nineteenth-century literary and intellectual movement fostered in the Hindu colleges of Calcutta. It was both inspired by European Renaissance ideas and was uniquely Hindu and of the *bhadralok* class in terms of the identity of its leading intellectuals, such as Raja Rammohan Roy, Bankim Chandra Chattopadhyay, and Rabindranath Tagore.[8] Recent scholarship shows how the dominating

works is that of Joya Chatterji, *Bengal Divided: Hindu Communalism and Partition, 1932-1947* (Cambridge: Cambridge University Press, 2002). The book casts the Calcutta based Hindu *bhadrolok* in their roles as interlocutors for the colonial administration as native employees, and as a landlord class always mindful of their petty economic and political interests, to the extent that the author claims that the *bhadrolok* were instrumental in reversing colonial administrative decisions such as the partition of Bengal, and in formulating the divisive course of Congress politics in Bengal in the decades leading to the Partition. A key aspect of the landed *bhadrolok* politics was that many of them had their lands and properties in the more fertile eastern region of Bengal, due to which the subjugation of peasant politics in eastern Bengal at the hands of the colonial administration was a key aspect of safeguarding the Calcutta based *bhadrolok* interests.

[8] The best instance of scholarship delineating the influence of the British Orientalists on the figures of the Bengali Renaissance is David Kopf, *British Orientalism and the Bengal Renaissance: The Dynamics of Indian Modernization, 1773-1835* (Berkeley, California: University of California Press, 1969),

tendency of these Calcutta-centric intellectual and cultural developments have led to the overshadowing of both Muslim Bengali politics and the study of the literary and cultural history of Bengali Muslims centered in the Muslim majority regions of eastern Bengal. Through a meticulous study of the cultural history of Bengali Muslims, Neilesh Bose shows that Muslim separatism of the early twentieth century in Bengal arose not from external calls for a separatist "Muslim" state of Pakistan, but as a result of a sustained engagement with other Bengali intellectual and literary traditions such as the Bengal Renaissance, which represented the interests of the Calcutta based Hindu *bhadrolok* elite.[9]

1.2. Changing themes in South Asian Environmental History: From Forest to Delta

Environmental history has made some inroads into the study of the Bengal Delta, though it also suffers from similar problems of under-representation as in general socio-political history. Although this is due to several reasons, one can identify the most important among them as being the fact that environmental history in India developed and blossomed as a subset of decolonial and subaltern history, rather than as an independent field of inquiry, whereby the initial focus was more on environmentalism and the study of ecology as an independent category rather than the placement of ecology within general historiography.

Arnold and Guha note that dealing with a region like South Asia is no easy task due to its continental scale in terms of internal diversity – the landscape is a topographical treasure trove with its mountain ranges, river systems, once vast forests, deserts, deltas, and offshore islands. At the same time, its history and culture are undoubtedly rich and varied. It presents problems of choosing appropriate spatial contexts, whether ecosystems or ecological zones, for historical analysis.[10] In terms of scholarship, however, one will find that forests and water bodies have featured prominently in South Asian environmental historiography. Moreover, a long period of around two centuries of exploitative colonial rule has tended to push environmental historians towards dominantly featuring the colonial state, its policies, and attitudes in their scholarship.

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https://archive.org/details/dli.bengal.10689.12441. The author clearly traces the impact of European Renaissance ideals on the various figures of the Bengal Renaissance, almost all of whom were centred in Calcutta, and hailed from the elite landed Hindu gentry of Western Bengal.

[9] Bose, *Recasting the Region: Language, Culture, and Islam in Colonial Bengal*, 187–236.

[10] David Arnold and Ramachandra Guha, eds., *Nature, Culture, Imperialism: Essays on the Environmental History of South Asia*, Oxford India Paperbacks (Delhi: Oxford University Press, 1995), 7–8.

While mapping the historiography of the discipline of environmental history, John McNeill noted that South Asia was among the few regions outside the United States where the subject of environmental history had taken a lively and robust foothold since the 1990s, especially in India. He attributed this liveliness to various factors - the engagement of Indian scholars with social and environmental struggles since 1980, the availability of historical records from the colonial British Raj, and the willingness of such scholars to engage with scholarship on environmental history done in the United States.[11] He critically evaluated the tendency of South Asian environmental historians to focus on the colonial state and the deep state-society divide, noting that it has dominated environmental history scholarship. In contrast, McNeill noted that African environmental historians had moved away from focusing on the colonial period, demoting colonialism from its earlier historiographical priority, and thus gave a lead for the South Asian environmental historiography.[12]

Early work on South Asian environmental history focused more on land use and forests, especially on issues such as tensions between official conservation efforts and their impacts on peasantry during the colonial period. McNeill observed that Ramachandra Guha's 1989 book *The Unquiet Woods: Ecological Change and Peasant Resistance in the Western Himalaya* is an influential representative in this regard.[13] On the other hand, according to Cole (2016), *The Fissured Land* (1992) by Guha and Gadgil was the most critical work representative of the first generation of South Asian environmental history. Shedding broader contexts, Cole noted that the work sought to make the environment as an object of historical analysis, and identified colonialism as a watershed or turning point. The narrative in these early instances of scholarship was generally declensionist and sought to adopt a moralizing stance on the question of the environment.[14]

Arnold and Guha, in the introduction to their book, *Nature, Culture, and Imperialism,* noted the developments in the field of environmental history in India up to their day. According to them, Indian environmental history was primarily focused on the past century - colonial forestry management, and by extension land management, the river systems, hunting and conservation, the Indian Ocean, and the field of colonial medicine. An intriguing discussion in

[11] John Robert McNeill, "The Historiography of Environmental History," in *The Oxford History of Historical Writing Vol. 5: Historical Writing since 1945*, ed. Axel Schneider and Daniel Woolf (Oxford: Oxford University Press, 2011), 169–70.

[12] McNeill, 171.

[13] McNeill, 171.

[14] Camille Cole, "From Forest to Delta: Recent Themes in South Asian Environmental History," *South Asian History and Culture* 7, no. 2 (April 2, 2016): 2, https://doi.org/10.1080/19472498.2016.1143664.

the scholarship was on epidemic diseases and vaccination, where the authors noted the differences between the Indian example and that of the Americas, as discussed in Crosby's book, *The Columbian Exchange* (2003), and accused the latter of a measure of biological determinism.[15]

Before venturing further, it is essential to note that one needs to place South Asian scholarship on environmental history within the broader trend of historiography in South Asia. Iqbal noted that the scholarship on environmental history came about when subaltern studies were at their peak in India.[16] Indeed, the pioneers of South Asian environmental history, such as Ramachandra Guha and David Arnold, were also pioneers in subaltern studies. Subaltern studies, as a subset of Marxist historiography, is interested in the peripheral landscape in social and political history and questions of power, hence the similar trends in environmental historiography. However, Iqbal criticized South Asian environmental historians for not seriously addressing the question of locating nature within broader political and social practices, choosing to focus instead on the realm of nature and its relations with the state.[17] Cole has a similar opinion while reviewing South Asian environmental history scholarship, noting that the approach of environmental, historical blame-narratives had tended to exclude environmental history from 'real' history throughout the 1990s and that it was only recently that environmental history in South Asia was being incorporated into broader historical, political, economic and social narratives.[18]

Cole argued that it was only in 1999 that narratives on environmental history began to change when several published works attempted to bring South Asian environmental history into conversation with other fields methodologically and thematically.[19] According to Cole, the work that stands out in typifying the shift in environmental history from this period is K. Sivaramakrishnan's *Modern Forests* (1999). Through studying colonial forest management as a function of scientific forestry, Sivaramakrishnan's study tried to understand the development of various concepts in a manner that linked "environmental history with agrarian history, histories of science, and the history of colonial state formation." Sivaramakrishnan looked at how the production of seemingly universal concepts such as scientific forestry was conditioned

[15] Arnold and Guha, *Nature, Culture, Imperialism: Essays on the Environmental History of South Asia*, 15.

[16] Iftekhar Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943* (London: Palgrave Macmillan UK : Imprint : Palgrave Macmillan, 2010), 5.

[17] Iqbal, 5.

[18] Cole, "From Forest to Delta," 2–3..

[19] Cole, 3.

by local realities, whether political, historical, or ecological, which he used to illustrate the formation of universal discourses through struggles with shifting 'zones of anomaly.' These 'zones of anomaly' in the forested areas and amongst certain tribal groups were seen as exceptions to imperial methods of administration, where the colonial authorities accepted the limits to their authority due to problems such as accessibility or intractability, unlike in non-forested agricultural lands. As such, colonial land laws such as the Permanent Settlement were suspended for these specific inaccessible intractable forested frontier areas.[20] Through this, Sivaramakrishnan used a micro-historical analysis and approach to challenge the earlier thesis of Guha in *The Fissured Land* (1992), which had identified colonialism as a watershed moment for environmental history.[21] This, Cole argued, set a new precedence in scholarship for environmental history.

Following this new direction, Cole identified the third wave of scholarship on South Asian environmental history, whereby environmental concerns were no more just confined to social and natural margins, but placed in meaningful conversations with other genres of history. Moreover, the conversation shifted from forests as the dominant theme to the realm of islands, deltas, and the Indian Ocean, which offer new and critical ecological frameworks. Another major shift in the discourse entailed a move away from the dominant theme of the state and its relation to/with the environment. The first major work that Cole analyzed was Iftehkhar Iqbal's *The Bengal Delta* (2010), where the latter attempted to locate ecology in politics and society in South Asia. Iqbal argued for a merging of the environmental and the social to make the category of the 'agrarian' more meaningful in the context of South Asian historiography.[22] Apart from Iqbal's work, Cole also reviewed Sujit Sivasundaram's *Islanded* (2013) and Sunit S. Amrith's *Crossing the Bay of Bengal* (2013). While Cole noted that Sivasundaram's *Islanded* was not environmental history, but instead focused on the environment as representation, there was a similarity in approach to Sivaramakrishnan's *Modern Forests* wherein the author focused on questions of "colonial continuity and change, and the place of knowledge and power in colonial transition" in the analytic space of the island.

On the other hand, Amrith's *Crossing the Bay of Bengal* is a good example of environmental history scholarship in that it looked at the role in the sea in human history and the impact of human history on the sea. In work, the Bay of Bengal was seen as a connected

[20] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 11.
[21] Cole, "From Forest to Delta," 5.
[22] Cole, 6.

region in terms of social, economic, cultural, and environmental histories. Moreover, the author's focus on migrants in the Bay of Bengal showcased human agency in climatic and ecological history.[23]

In the manner elucidated above, one can get a grasp of how a formidable shift has occurred in the realm of study of South Asian environmental history, from a focus on the realm of nature to locating nature within general historiography, from forests as an object of study to locating histori(es) within ecological frameworks such as islands, oceans, and deltas. This change in focus is a beneficial one for our study since it would allow us to re-examine histories of the colonial period while keeping in mind the broader framework of the Bengal Delta and its ecology.

1.2.1. A note on declensionist narrative and environmental history vis-à-vis the Bengal Delta

Among the significant criticisms of environmental historians in their attempts to locate human history vis-à-vis ecology and the environment is that works by environmental historians tend to be 'declensionist' narratives. Declensionist narratives are those narratives that tell tales of woe and decline, mainly when dealing with themes such as environmental degradation and resource depletion. Cole noted 'declensionist' narratives as one of the primary reasons behind the sidelining of environmental histories and narratives of South Asia from the general historiography of the region.[24] In evaluating Iqbal's account of the state, society, and environment in terms of the introduction of railways and water hyacinth in eastern Bengal, Cole noted the declensionist tone of Iqbal's arguments. However, she credited Iqbal with being attentive to details and the multifaceted causal interactions in his narrative.[25]

There is a deep connection between declensionist narratives of environmental history and research findings by ecologists regarding environmental degradation resulting from the impact of anthropogenic activities in the Bengal Delta. The construction of dams, barrages, embankments, and ambitious irrigation schemes has not just altered the riverscape of the Bengal Delta, but pose a critical risk to its very existence, such that the GBM deltaic system is

[23] Cole, 9.
[24] Cole, 2.
[25] Cole, 7.

seen as unsustainable considering the immense impact of anthropogenic processes to which it is subjected.[26]

Thus, a declensionist narrative of the Bengal Delta is inevitable if one were to study it as part of the environmental history of the region. What needs to be kept in mind is to be vigilant regarding environmental determinism, and whether one's work is sliding towards that end. The penetrating role of state during the colonial period is helpful in this regard since it helps one not to fall into environmental determinism. The opposite is true, and the overt focus on the role of the colonial state in general historiography of South Asia, and a lack of narratives on environmental history proves this contention.

1.3. Epidemic Disease as a subset of environmental history study in colonial eastern Bengal

The study of epidemic diseases and their spread has been a core theme in environmental history since its inception, beginning with Alfred Crosby's *The Columbian Exchange* (1972). The "Columbian Exchange" was the transfer of not just animals and plants, but also of pathogens between the Old and New Worlds. The native peoples were subject to pathogens which they had not encountered before, and against which they did not have immunity or resistance. Thus, diseases such as smallpox, yellow fever, scarlet fever, measles, and malaria brought by the Europeans abroad their ships led to multiple outbreaks of epidemic disease amongst the native peoples in the Americas, which ultimately led to the catastrophic decrease of local populations. Warfare, sickness, and social disorganization played a crucial role in European invasions of the Americas. Following Crosby, another major work which detailed disease history was William McNeill's *Plagues and Peoples* (1976), which extended Crosby's understanding of the role of epidemic disease in history to explain other events such as the devolution of the Roman Empire, Chinese and European imperial expansion, and the rise of Christianity and Buddhism.[27]

Speaking for Indian historiography, however, Arnold and Guha noted that Crosby's scholarship on European 'portmanteau biota' invasion of the Americas was akin to biological determinism. The authors noted that since Europeans found the Indian subcontinent

[26] John W. Day et al., "Delta Winners and Losers in the Anthropocene," in *Coasts and Estuaries* (Elsevier, 2019), 152, https://doi.org/10.1016/B978-0-12-814003-1.00009-5.

[27] Andrew C. Isenberg, ed., *The Oxford Handbook of Environmental History*, Oxford Handbooks (Oxford ; New York: Oxford University Press, 2014), 77.

inhospitable and the native population was much more resistant to European diseases than in the Americas, Crosby's reasoning implied that European colonial forces had a little ecological impact in India, which was untrue. They argued that European colonialism had significant ecological impacts on the Indian subcontinent since they fundamentally reshaped the socio-ecological fabric of the colony and the colonized.[28] While the authors were right in criticizing Crosby, a fundamental feature of their critique was the role of the colonial state intervention in the environment, which highlighted the importance that South Asian environmental historians gave to the state when writing their environmental history.

The study of epidemics in the nineteenth and early twentieth-century India, especially in Bengal, has been of particular concern to environmental historians. The focus on the colonial state and its intervention form key tenets in the study of epidemic disease in India. As noted by McNeill, this was mainly because there existed ample documentation from the state authorities in the colonial era,[29] detailing medical developments and responses by colonial medical authorities to disease in the region. Historically speaking, the major epidemics in the nineteenth and twentieth-century India up to independence included the cholera epidemics (1817-1923), the bubonic plague (1900 to 1920s), malaria epidemics (1890's to 1920s), and Spanish influenza (1918-1919). Apart from this, smallpox was also a deadly disease that appeared from time to time but was not seen as deadly as the other diseases due to its endemic nature, and persistent vaccination measures by authorities. Notably, epidemics in India were often accompanied by famine and famine-like conditions that ravaged several parts of India throughout the period around the 1900s, due to which, as it will be seen below, many historians have tended to study epidemics and famine in conjunction with each other.

There is a wide-ranging scholarship available on the study of epidemics and disease in the nineteenth and twentieth-century India. However, for this section, the approaches of a few selected scholars on this topic will be discussed. David Arnold is a well-known and prolific historian of science, technology, and medicine in colonial India. His book *Colonising the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (1993), in the tradition of Michel Foucalt, explored how medicine was a colonizing force, and it was part of a state-centered system of scientific knowledge and power. The site of contestation between the colonizer and the colonized in Arnold's scholarship is the Indian body. Arnold looked at both

[28] Arnold and Guha, *Nature, Culture, Imperialism: Essays on the Environmental History of South Asia*, 15.

[29] McNeill, "The Historiography of Environmental History," 171.

colonizing power of Western medicine and the resistance it generated from the locals in cultural and indigenous terms to the colonial state while writing the history of epidemic diseases such as cholera, smallpox and the plague.[30] This notion of power in Arnold's thesis of 'occidental therapeutics and oriental bodies' encapsulates various themes, that of Foucault's notions of power, Said's notions of Orientalism, and the erstwhile currents of post-colonial subaltern studies that were dominant in Indian scholarship. Although the notion of the body in Arnold's scholarship may be seen as akin to the environment backdrop for Western medicine, the author did not deal with scholarship on disease as environmental history but instead focused on how colonial medicine functioned as a tool of the increasingly powerful 'British Raj,' and how Indians resisted this tool. It is notable, however, that later scholarship by the same author in subsequent decades incorporated a certain measure of environmental history approaches in addition to the central role of the colonial state towards assessing the former attitudes towards epidemic disease and famine.[31] This change in approach confirms with Cole's observation on environmental history shifting from the periphery in the 1990s to within Indian historiography in recent times, as discussed earlier in this section.

Mark Harrison, in his *Public Health in British India* (1994), on the other hand, studied the response of colonial public health and medical authorities in dealing with epidemics, often noting the accompanying municipal developments in sanitation and public health throughout the nineteenth century. In more recent work, *Fractured States* (2005), Harrison, and others have taken an interdisciplinary approach to the history of smallpox and public health. They pointed out the failings of current historiography on medicine in British India, noting that historians have constructed narratives around colonizers and the colonized in a manner, which often distorted the picture of diverse and conflicting in-the-field execution of state policies. It was mainly due to focus by historians on the concerns of senior bureaucrats and scientists, laws, and regulations while giving relatively little importance to aspects such as technology and implementation level discussions in areas such as municipalities. In trying to find a more suitable mechanism, the authors broke down monolithic portrayals of both British administrations and the Indian opposite to form a more nuanced argument. Recent scholarship

[30] David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley: University of California Press, 1993), 7–8.

[31] Such works include David Arnold, "The Medicalization of Poverty in Colonial India," *Historical Research* 85, no. 229 (August 2012): 488–504, https://doi.org/10.1111/j.1468-2281.2012.00596.x; David Arnold, "Smallpox and Colonial Medicine in Nineteenth-Century India," in *Imperial Medicine and Indigenous Societies*, ed. David Arnold (Manchester University Press, 2017), https://doi.org/10.7765/9781526123664.00006.

by Harrison on the first cholera epidemic of 1817-1821 focused on the epidemics as historical settings for study. He examined changing responses to cholera from part of the East India Company authorities from ameliorative towards preventive action and looked at how the epidemics themselves accelerated this change. Harrison sought to understand how the epidemic affected different communities and their relationship with the colonial state and traced the legacy of the epidemic in shaping global discourse on 'epidemic' or 'Asiatic cholera.' [32] As clear from the above, like David Arnold earlier, Harrison can be seen as more interested in public policy and response to epidemics rather than placing epidemics and analyzing them within their ecological setting.

Although scholarship by Arnold and Harrison gives an answer to important questions concerning power hierarchies and relations and changing notions of public health in the colonial state, aspects of geography, ecology, and the environment were generally silent in their respective accounts of colonial medical history related to epidemic disease. Apart from sidelining ecology and environment in epidemic disease historiography, this also gave the false notion of an unchanging nature of ecology or environment in the region, whether it be the Ganges basin, North-Western India, or the eastern Bengal region.

1.4. Research Gap in ecology and health in eastern Bengal Delta

Taking a cue from the above literature on the environmental history of the Bengal Delta and the epidemic disease in the South Asia, this study will take into account the following research problem. Despite the recorded high incidence of cholera and malaria in Bengal in general throughout the latter nineteenth and early twentieth century, C.A. Bentley, the Director of Public Health in Bengal, noted in 1925 that the population of eastern Bengal was much healthier than that of the western part of the Bengal Delta, owing to lower incidence of disease, and higher population growth.[33] He attributed this to the higher fertility of the soil and high agricultural output of the eastern part in Bengal due to its status of being the active section of the Bengal Delta.[34] This acute observation alone on human health in correlation with the

[32] Mark Harrison, "A Dreadful Scourge: Cholera in Early Nineteenth-Century India," *Modern Asian Studies* 54, no. 2 (March 2020): 502–53, https://doi.org/10.1017/S0026749X17001032.

[33] Chas. A. Bentley, *Malaria and Agriculture in Bengal: How to Reduce Malaria in Bengal by Irrigation* (Calcutta: Bengal Secretariat Book Depot, 1925), 4–7, https://archive.org/details/in.ernet.dli.2015.42235/.

[34] Bentley, 10–12.

dynamics of the Bengal Delta by Bentley is vital in terms of the scope it offers us in overcoming the under-representation of the eastern Bengal in general historiography and environmental history of the region.

However, it can be observed that the disease incidence in eastern Bengal itself steadily increased at the turn of the century, turning a whole region into a less healthy one, despite improving public health and medical infrastructure throughout Bengal. Moreover, despite Bentley's observation of the fertility of the eastern Bengal Delta in 1925, the region experienced one of the worst famines of the twentieth century, leading to 3.5 million deaths in the year 1943. This rasies the question of why there was an increase in the incidence of epidemic disease in previously healthy region of eastern Bengal, and how this increase can be understood in conjunction with rising incidence of scarcity and famine in the region.

Studies on the history of the region demonstrated that the sidelining of ecology in the significant historical accounts of colonial medicine pertaining to epidemic disease in eastern Bengal of colonial India prevents one from understanding the nature of the relationship between ecology and epidemic disease. For example, why did diseases endemic to the Bengal region such as cholera or malaria become so deadly to the point of generating global pandemics in the nineteenth century and not before? Moreover, how could one assess and understand the impact of ecology (and changes to ecology) upon epidemic disease? Taking cue from the significance of such queries, it is believed that the incorporation of ecology and its relation to the dynamics of epidemic disease will be a major contribution of this study.

1.5. Thesis statement

This study will seek to place significant nineteenth-century medical and public health developments towards combating cholera epidemics at colonial Dhaka in eastern Bengal within more significant previous human-induced ecological developments in the Bengal Delta. Through exploring the Bengal Delta as an ecological framework for the study of epidemic disease in eastern Bengal, it can be argued that colonial efforts to combat the epidemic disease at Dhaka in eastern Bengal failed due to two reasons. First, the colonial medical institutions and health infrastructure in the nineteenth and early twentieth century Dhaka, despite being at the nucleus of public health and sanitation developments in the region, disproportionately distributed and remained inadequate and out of reach of those who needed it most. Second,

colonial developmental projects and attitudes leading to the loss of ecological balance in the Bengal Delta contributed to famine-like conditions and hyperendemicity of epidemic disease in the region, which together contributed to higher mortality in the region.

1.6. Research Questions

In light of the thesis statement explained above, the research questions that this thesis will pursue are as follows: How can we understand epidemics in eastern Bengal in relation to the ecology of the Bengal Delta? In this regard, is it possible to formulate an ecological framework that helps us to explore the relationship between ecology and epidemic disease? What was the nature and adequacy of the colonial response towards epidemics in eastern Bengal in terms of medical infrastructure and public health steps? How and why did these colonial medical efforts to combat epidemics fail?

1.7. Chapterization of thesis

The introduction chapter, through a detailed analysis of the environmental history of the South Asian region, attempted to place the current study in context. Significant studies on the epidemics during the colonial period in the Indian subcontinent, despite claiming to adhere to the discipline of environmental history, often fail to situate ecology in their analysis of epidemic disease. As such, attempt to help us overcome this deficiency will be carried out through the first chapter, which will focus on developing a working theoretical framework for the study epidemic disease in eastern Bengal by exploring the Bengal Delta as an ecological framework for environmental history. Following that, the second and third chapters will focus on the incidence of epidemic disease in the Bengal Delta such as malaria and cholera, with a view towards understanding the nature of colonial medical responses to these epidemics in the eastern Bengal region, especially focusing on Dhaka, the socio-political urban centre of eastern Bengal. The fourth chapter will attempt to place health and epidemic disease in relation with ecology of the Bengal Delta, and trace the impact of human-induced changes in the ecology of the delta on incidence of disease and scarcity.

CHAPTER II

THE BENGAL DELTA AS AN ECOLOGICAL FRAMEWORK FOR STUDYING EPIDEMIC DISEASE IN EASTERN BENGAL

2.1. The Bengal Delta: A Detailed Overview of Its Geo-ecology

The spatial specificities of North Eastern part of South Asia, which would be of interest to environmental history, include the high mountain peaks, the deltaic system, and the coastal regions adjacent to the Bay of Bengal. The dynamic nature of the ecological regime of Eastern Bengal stems from the fact that it is home to the largest delta in the world, the Bengal Delta. A diverse array of natural processes make up for this dynamic nature of the delta. Its geology consists of the uplifting of the Himalayan mountains to the North, and frontal Belt of the Indo-Burman Range to the east, followed by the rivers mentioned above flowing to the south. The geological setting of the Bengal Delta has a series of natural controls, such as the uplifted Barind and Madhupur Tracts and the Comilla Terrace, which regulate river course shifting or avulsion (see Figure 2.1).[35]

The primary fluvial sources of the Bengal Delta basin are the Ganges, the Brahmaputra, and the Meghna rivers. In a process that started several million years ago, the sediment carried by these rivers from the Himalayas has contributed to the present size of the Delta, which is about 100,000 km^2 and extends from the Hooghly River in the west to the Meghna River in the east, which is an extension of 18,000 km^2 across. The Bengal Delta is better known in studies about environmental ecology by the name Ganges-Brahmaputra-Meghna (GBM) Delta.[36] The global impact of the GBM river system can be understood from the fact that it delivers 30 percent of the world's total load of river sediment into the Bay of Bengal, despite 55 percent of the combined annual sediment of the Ganges and Brahmaputra being retained by their delta,

[35] Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," 1214.
[36] Akter et al., 1213.

and rest flowing to the Bay of Bengal.[37] The GBM river system sediment load amounts to more than a billion tonnes of sediment every year, of which 80 percent is delivered during the monsoon months via increased water flow and flooding processes.[38] The deposition of silt and sediment over the course of river flow leads to the continuous creation of enormous tracts of new land known as *chars* or *diaras*.

Moreover, the coastline regions to the south of delta are the site of action of the silt carrying rivers and the sand depositing sea. The heavy outflow of the rivers into the Bay of Bengal, which reach their peak during the monsoon seasons, lead to the additional formation of land on the coastal regions due to deposition of sand.[39] A saline water environment famous for its mangrove forest habitat characterizes the coastal region. The growth of forest in the coastal deltaic region over time led to the formation of the world's largest mangrove forests known as the Sundarbans.

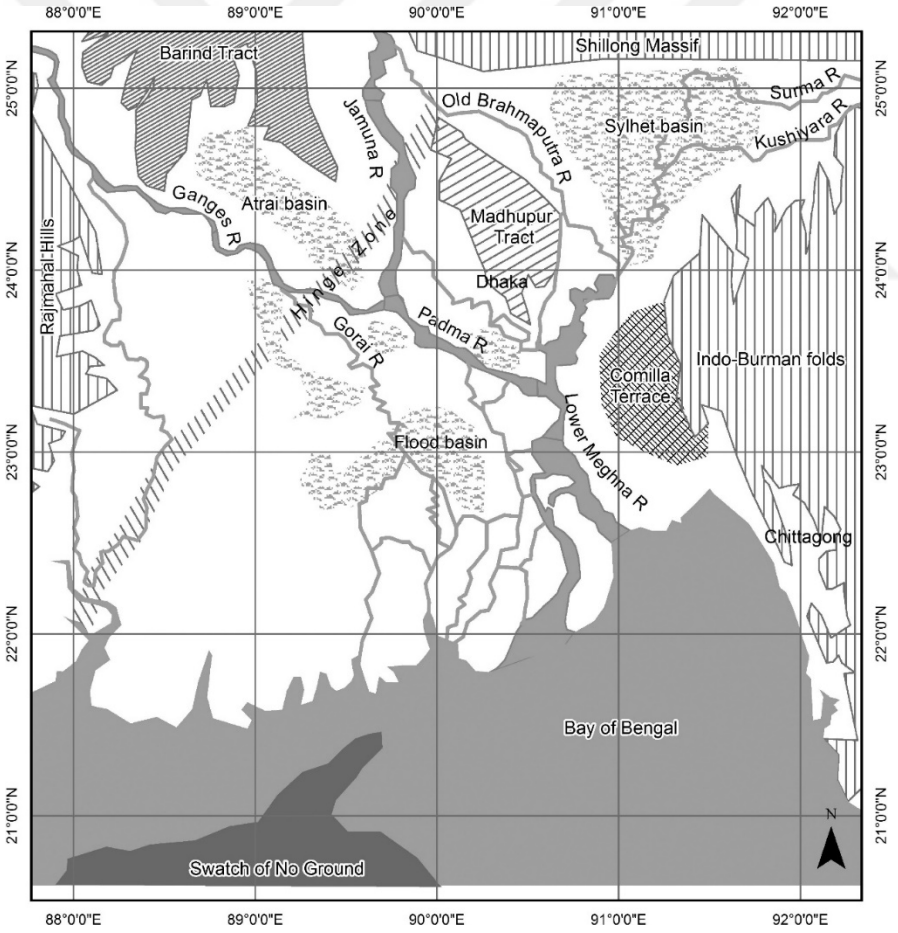

Figure 2.1: The geological setting of the Bengal Delta. (Source: Akter et al., 2016)

[37] Ramesh et al., "Integrated Management of the Ganges Delta, India," 189.
[38] Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," 1212.
[39] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 1.

2.2. The Bengal Delta in Environmental History

Despite its importance, environmental historians of South Asia have largely neglected the study of the Bengal Delta. As seen earlier, this neglect stemmed from a tendency of earlier environmental historians of South Asia to study the realm of nature and describe its relations with the state rather than locate environment and ecology within general historiography. Cole argued that this approach by earlier scholars of environmental history had been "a major reason for historiographical sidelining of environmental narratives."[40] As Iqbal noted, the onset of scholarship on environmental history at a time when subaltern studies were at their peak in Indian scholarly debates meant that chief questions were those of power and resistance between the state and those it governed. As a result, environmental history often provided an ecological setting for such actors, whether they be forest dwellers, hillsmen, or the *adivasis*, and their number is not insignificant in eastern Bengal. This approach, however, tended to ignore larger domains of land and water; in the case of eastern Bengal, it was the Bengal Delta.[41] On the other hand, if environmental historians have failed to highlight the importance of the Bengal Delta within the context of South Asia, historians of general historiography have largely relegated eastern Bengal to the periphery of South Asian historiography. As such, the pre-colonial and colonial history of the region largely focuses on economic and political urban history, which tend to focus on powerful political actors and their actions.

The first major authoritative work challenging this trend of history writing concerning eastern Bengal and the Bengal Delta was Richard Eaton's *The Rise of Islam and the Bengal Frontier, 1204-1760* (1996). Eaton attempted to cover the social history of eastern Bengal through identifying it as a frontier region for the rise and spread of Islam during the medieval period. He identified an aggregate of many connected factors in the process, among them religious change and agrarian growth connected with the dynamic ecology of the Bengal Delta. Although Eaton's scholarship is not strictly work in environmental history, he nonetheless attempted to locate the Bengal Delta in the socio-political history of the region, particularly in the rise and spread of Islam, which makes it very relevant to scholarship on the environmental history of the Bengal Delta region.

Eaton's chapter on Islam and the agrarian order in eastern Bengal, in the section labeled "Riverine changes and Economic growth," took into account how riverine changes in the

[40] Cole, "From Forest to Delta," 2.
[41] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 5.

Bengal Delta strongly affected economic growth in the Eastern part of Bengal during the Mughal era. During the fifteenth and sixteenth centuries, sedimentation in the floodplains led to the gradual shifting of the main course of the Ganges from what is now Bhagirathi-Hooghly channel in West Bengal, to the present day Ganges-Brahmaputra system running through the middle of today's Bangladesh. This gradual eastward shift of the active portion of the delta left the former regions in the western part of the delta with diminishing levels of freshwater and silt, making them moribund. Urban centers along the banks of abandoned channels declined with the decline of trade and the rise of diseases associated with stagnant water. The eastern part of the delta, on the other hand, flourished, both from this shifting of the course of the Ganges and the onset of Mughal rule in the late sixteenth century. This was accompanied by phenomenal agricultural and demographic growth in eastern Bengal, which eventually promoted widespread economic integration and trade, mainly in food grains and textiles, making it the wealthiest province of the Mughal empire.[42]

The ecological framework of the study presented by Iqbal in his book *Bengal Delta* (2010) built upon both the suggestions and drawbacks of earlier trends in South Asian environmental history scholarship and the promise of Eaton's approach. Iqbal's framework sought to locate ecology in general historiography. The author incorporated the category of the "ecological" in assessing the colonial history of the region situated in the Bengal Delta. He did this by framing the analytic of the "agrarian" as consisting of both ecological and social aspects, taking inspiration from Mahesh Rangarajan's suggestion that the "ecological" aspect of environmental history only made sense when merged with and understood in a broader context of social history. While the above notion of the 'agrarian environment' would favorably inform the dynamics of an agro-environmental history of the colonial Bengal Delta, Iqbal cautioned against an uncritical acceptance of harmony between the 'agrarian' and the 'environmental.' It was because such a notion of harmony would tend to exclude non-peasant or urban social forces and their agrarian-environmental practices and attitudes. [43] Furthermore, Iqbal built upon Sivaramakrishnan's notion of 'zone of anomaly' in *Modern Forests* (1999), arguing that it was not just inaccessible forested areas that were subject to exemptions from general imperial administrative laws, but that eastern Bengal as a whole could be considered as a broader space of 'anomaly' until later in the early twentieth century when the colonial state

[42] Eaton, *The Rise of Islam and the Bengal Frontier, 1204-1760*, 194.

[43] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 5.The reference to Rangaranjan is as follows: Mahesh Rangarajan, *Fencing the Forest: Modernizing Nature. Forestry and Imperial Eco-Development 1800–1950* (New Delhi, 1999), 206.

became more knowledgeable about the interior of the East Bengal countryside.[44] This 'anomaly,' as he later argued, could be understood from the estimate that only around fifty percent of the cultivable lands in the eastern part of Bengal was subject to the *zamindari* system under the jurisdiction of the Permanent Settlement, unlike in other agricultural areas. The rest of the land in the region was subject to *khas* management practices, which were non-permanent settlement agreements under the authority of the government. [45]

Using this ecological framework, Iqbal elucidated a new perspective of studying colonial history in eastern Bengal. Beginning with the changeable landscape of the Bengal delta, Iqbal focused on social history and colonial politics surrounding the unpredictable formation of new land (*chars*) in light of the implementation of the Permanent Settlement.[46] The fluidity of the Bengal delta gave the upper hand to the peasantry of eastern Bengal in their relations with the colonial state. However, the decline of the hydraulic regime of the Bengal Delta stemming from the building of railways in the 1880s and the introduction of the Brazilian water hyacinth in the 1910s led to adverse social and economic impacts. Although Cole criticizes Iqbal's adoption of a somewhat declensionist perspective regarding the introduction of railways by the colonial authorities, she acknowledged the usefulness of the author's attentiveness to detail and multifaceted causal interactions between various entities. [47] An essential aspect of Iqbal's scholarship on the adverse impacts of development includes the study of how human-induced ecological changes in the Bengal Delta led to both the spread of water-borne diseases and the causation of famine.

Several recent instances of scholarship on the Bengal Delta have incorporated this dynamic nature of the fluid landscape of the Bengal Delta. Debjani Bhattacharya's *Empire and Ecology in the Bengal Delta: The Making in the Bengal Delta* (2018), which focused on Calcutta as a deltaic city, took into account the dynamic nature of the Bengal Delta to study the narrative of land, law, and profit during colonial rule. Bhattacharya argued that land as a fixed and definitive entity came with the British rule, and chronicles the process by which the administration worked to designate frequently changing riverine sedimentation and watery margins, initially touted as a wasteland, into solid land. Bhattacharya looked at how the legal entities of the colonial administration grappled with this mobility of fluid landscape as they

[44] Iqbal, 12.
[45] Iqbal, 23.
[46] The words changeable, fluid, and dynamic are used interchangeably throughout this study to denote a character of the Bengal delta in scholarly literature that is opposite to inert and static.
[47] Cole, "From Forest to Delta," 7.

incorporated the new attitudes of the administration towards the landscape.[48] Similarly, Sinha (2014) added to the agrarian-ecological history of the Bengal Delta by attempting to look at the interplay of law and revenue to understand colonial practices and policies towards *diaras* (another name for *chars*) in the nineteenth century. The author took a strong note of the fluidity of the *diaras* situated within the heart of the colonial riverine territory of Bengal and how this fluid nature challenged notions of fixity in land management codes such as the Permanent Settlement.[49]

2.3. The Bengal Delta as an Ecological framework for the study of Environmental History

This section will look at two different aspects of the Bengal delta as an ecological framework for an environmental history of eastern Bengal. On the one hand, we will try to understand the natural processes regulating the dynamic processes of delta formation. On the other hand, human-induced changes in the delta will be examined for how they hamper or affect these natural dynamic processes, resulting in changes elsewhere. These two ecology-based aspects together help in forming a lens with which to explore the environmental history of the Bengal Delta. First, the dynamic and fluid nature of the Bengal Delta in terms of its natural processes can help us to establish a relation between ecology and disease. Second, the notion of the Delta as a broader 'zone of anomaly' helps us to evaluate historical actors and the impact of anthropogenic activity on deltaic ecology. In terms of this study, it will help towards a richer understanding of the history of colonial administration of the region.

A deep understanding of the dynamic nature of the deltaic processes is required to appreciate the various delta formation processes that shape the ecology of the Bengal Delta. However, the fluidity or dynamic nature of the delta and delta formation processes is often an overlooked aspect in both natural and social science studies concerned with the Bengal Delta. Akter et al. noted that many of the existing delta models to assess impacts of climate change in ecological studies consider a static river system, and rarely include the complex interactions between rivers, floodplains, and tidal plains while assessing long-term effects of climate

[48] Debjani Bhattacharyya, *Empire and Ecology in the Bengal Delta: The Making of Calcutta*, 1st ed. (Cambridge University Press, 2018), 9, https://doi.org/10.1017/9781108348867.

[49] Nitin Sinha, "Fluvial Landscape and the State: Property and the Gangetic Diaras in Colonial India, 1790s-1890s," *Environment and History* 20, no. 2 (May 1, 2014): 212, https://doi.org/10.3197/096734014X13941952680990.

change.[50] Similarly, Bhattacharya (2018), in her exploration of the legal history of land management practices in the deltaic city of Calcutta, noted that previous histories of Calcutta considered its terrain as an 'inert background' to explore colonial power dynamics and that her account aimed to encompass the dynamic and shifting riverine space by foregrounding the study on the temporality of the landscape in colonial history.[51] It is this very dynamic nature of the Bengal Delta, which acted as the impetus for Iqbal (2010) to ask, "What historical sense can we make of this highly fluid and sea-faced frontier territory of Bengal characterized by an extensive span of silty Sundarbans and alluvial land-forms?"[52] The following section will briefly explore the various complex and dynamic natural processes of the Bengal Delta.

2.3.1. An overview of delta formation processes in the Bengal Delta

The Ganges-Brahmaputra-Meghna (GBM) river system is the lifeline of the Bengal Delta. Several dynamic processes associated with this river system are associated with delta formation. These dynamic processes in the Bengal Delta can be differentiated based on which part of the delta they occur in, whether upstream or downstream (the coastal regions). Major delta formation processes upstream include sedimentation and river avulsion and are regulated by subsidence, water flow, and tectonic plate dynamics. The delta formation processes downstream and in the coastal regions are accretion and erosion and are regulated by subsidence, monsoon flooding, tidal movement, and sea-level rise (SLR).

2.3.1.1. Upstream delta formation processes

Avulsion or river shifting in the upstream is a rather complicated process, often resulting from major geological changes such as tectonic plate shifting (in the form of earthquakes), but also subsidence (settling or sinking of the surface) and events such as large scale flooding. In tectonic terms, the deltaic region lies in the northeastern Indian plate at the junction of three

[50] Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," 1212.
[51] Bhattacharyya, *Empire and Ecology in the Bengal Delta*, 9.
[52] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 4. Other recent studies in environmental history encompassing the dynamic nature of the Bengal Delta include D'Souza, Rohan. "Drainage, River Erosion, and Chaurs: An Environmental History of Land in Colonial Eastern India." *Nehru Memorial Museum and Library Occasional Paper: History and Society*, New Series, 2015, and Mukherjee, Erica. "The Impermanent Settlement: Bengal's Riparian Landscape, 1793–1846." *South Asian Studies*, April 22, 2019, 1–12.

tectonic plates – the Indian plate, the Eurasian plate, and the Burmese microplate, the continuous motion of which is regulated by active faults. The active faults include the Dauki fault located along the southern edge of Shillong Plateau, the Madhupur Fault between the Madhupur tract and Jamuna floodplain, the Assam-Sylhet fault located in the southern Surma Basin, and the Chittagong-Myanmar plate boundary fault parallel to the Chittagong Myanmar Coast.[53] Though the earthquake frequency of the deltaic region is low, the region saw multiple earthquakes in the past 450 years, their intensity being of the magnitude 4 to 9 on the Richter scale. Some notable large earthquakes in the past several centuries were the ones in Bengal in 1762, 1812, 1865, and 1885, and the 1897 Great Indian earthquake.[54]

Many scholars have traced the various instances of avulsion in the Bengal Delta over past centuries, mainly in the eastwards avulsion of the Ganges River, and the westwards avulsion of the Brahmaputra River to join the Meghna River. Akter et al. noted that the modern Bengal Delta began to develop during late Quaternary and before the Holocene, due to the shifting of the Ganges from the west to the east (see Figure 2.2), mainly as a result of tectonic subsidence of the Sylhet Basin and effects of SLR.[55] Because of this, the Ganges abandoned its former courses of the Hoogly and Gorai Rivers as it shifted eastwards, leaving them behind as distributaries.[56] Eaton noted that before the present day Padma-Meghna system, the main flow of the Ganges into the Bengal Delta changed from Bhagirathy-Hoogly channel in West Bengal, to the Bhairab, the Mathabhanga, the Garai-Madhumati, and the Arial Khan Rivers respectively.[57]

The Brahmaputra avulsion, occurring between 1776 and 1830, was the last major avulsion of the past two centuries. In this period, the Brahmaputra River shifted from the east of the Madhupur tract to the present course of the Jamuna River. Akter et al. (2016) note that this change, related to delta building processes, was attributable to many factors – tectonic dynamics in the Madhupur tract and associated subsidence in Sylhet Basin, earthquakes,

[53] Syed Humayun Akhter, "Earthquakes of Dhaka," 2010, 402–4, http://univdhaka.academia.edu/SyedHumayunAkhter/Papers/410774/Earthquakes_ohttp://univdhaka.academia.edu/SyedHumayunAkhter/Papers/410774/Earthquakes_of_Dhaka.

[54] Akhter, 423.

[55] Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," 1215; Maminul Haque Sarker, Jakia Akter, and M.M. Rahman, "Century-Scale Dynamics of the Bengal Delta and Future Development," in *Proceedings of the International Conference on Water and Flood Management* (Dhaka, Bangladesh, 2013), 94, https://www.researchgate.net/profile/Jakia_Akter/publication/281035488_Century-Scale_Dynamics_of_the_Bengal_Delta_and_Future_Development/links/55d242a008ae7fb244f47ecc/Century-Scale-Dynamics-of-the-Bengal-Delta-and-Future-Development.pdf.

[56] Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," 1215.

[57] Eaton, *The Rise of Islam and the Bengal Frontier, 1204-1760*, 194.

tributary diversions, and major floods. As a result of this, the course of the Jamuna and Ganges Rivers received more water flow, ultimately resulting in the shift of active delta building processes to the eastern part, while rendering the western part as a moribund delta, leaving it open to coastal erosion.[58] The authors further note that these changes can be corroborated from eighteenth and early nineteenth-century maps drawn by Rennell (in 1776) and Colonel Wilcox (in 1830), respectively, giving an overall idea of the degree of avulsion in the rivers of the Bengal Delta (see figure 2.3 below).[59]

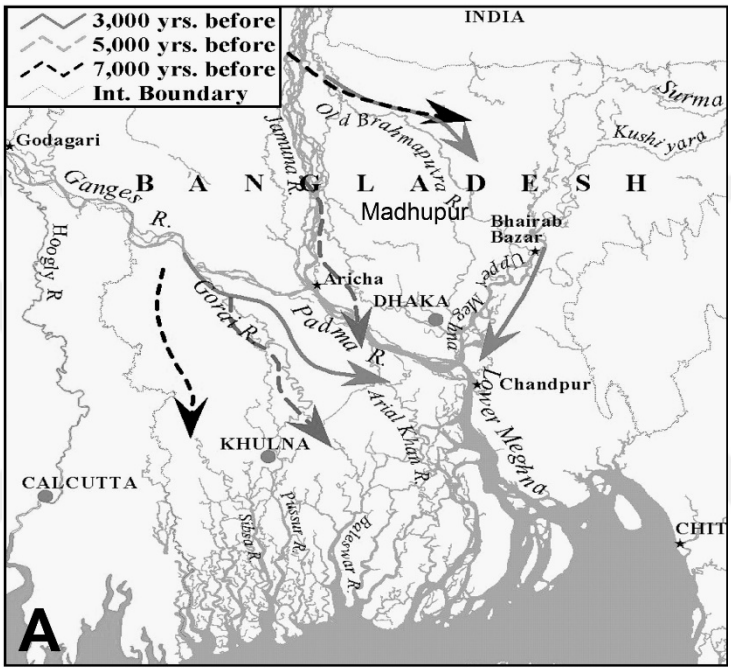

Figure 2.2: Shifting of the Ganges Brahmaputra rivers in the Bengal Delta over the paleo-geographic map. (Source: Sarker, Akter and Rahman, 2013).

[58] Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," 1215.
[59] Akter et al., 1215–16.

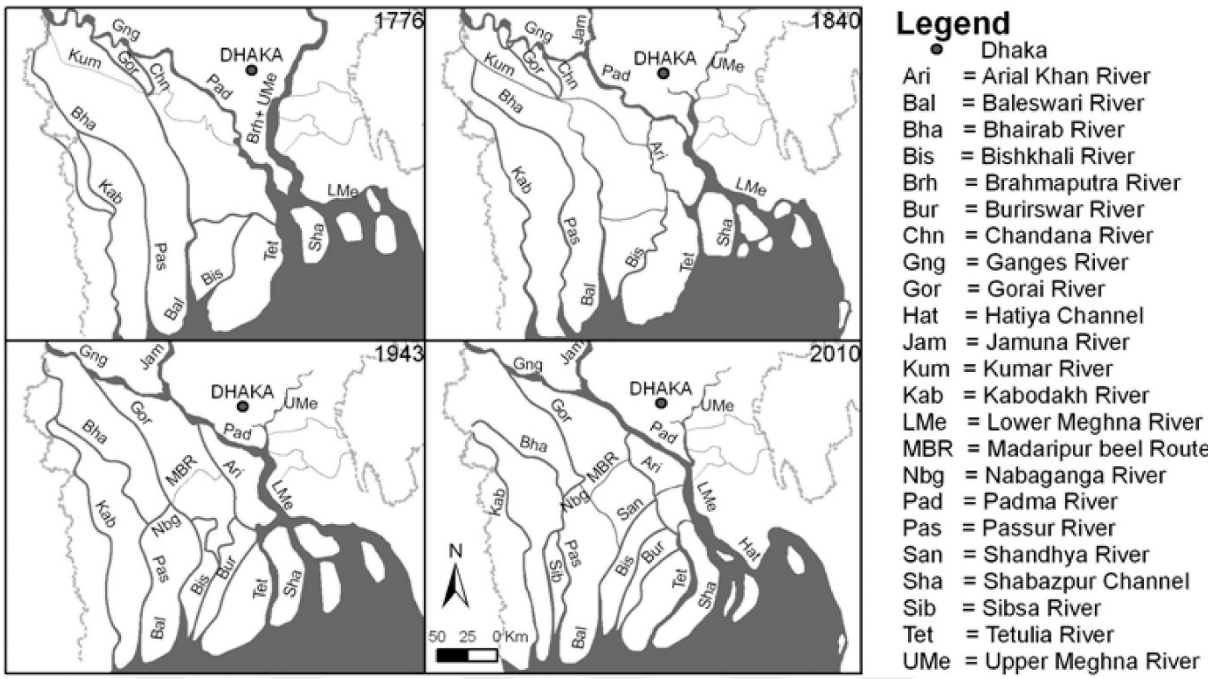

Figure 2.3: Development of Bengal rivers over time, starting from Rennell's map in 1776 to date. (Source: Sarker, Akter and Rahman, 2013)

2.3.1.2. Downstream and coastal region related delta formation processes

As alluded to before, delta formation processes in the downstream and coastal region part can be mainly attributed to accretion and erosion. In the coastal regions, the Bengal Delta is tide-dominated as a result of which the tide dominates delta formation processes. The process of accretion, or the gradual increase of deltaic land due to deposition of sediment, is responsible for delta formation in the downstream or lower region of the Bengal Delta, with the continuous formation of *chars*. Akter et al. note that more than 50 percent of the area is less than five meters above sea level, which means that the delta is highly susceptible to changes due to subsidence in the delta and Sea Level Rise (SLR) due to climate change.[60]

Flooding is a regular occurrence in the delta region, mainly during the monsoon season. The significance of this phenomenon is that 88 percent of the annual sediment load and 76 percent of the annual water discharge in the GBM river system gets carried out during the annual monsoon season.[61] Since flooding is associated with both increased sediment deposits and increased water flow, it is significantly involved with erosion-accretion processes in the deltaic region. While instances of flooding are generally beneficial as they are essential in delta

[60] Akter et al., 1222.
[61] Ramesh et al., "Integrated Management of the Ganges Delta, India," 189.

formation and bring in fresh silt, which supports the production of crops, they also cause land erosion, which are often detrimental to riverside communities. Moreover, regular cyclonic storms during the monsoon seasons cause havoc and large-scale destruction to life and biota in the deltaic region due to strong winds, heavy rain, and accompanying extensive flooding.

The century-scale process of gradual avulsion described earlier in this chapter is connected with a distinct variation of water flows within the Bengal Delta. The Bhagirathy-Hooghly channel, which once was the main channel for the water flow of the Ganges, turned into distributaries of the main Ganges River over several centuries, with reduced water flow. As a result, the western Bengal Delta is moribund, and the reduced water flow is connected to higher levels of salinity. On the other hand, the eastern Bengal Delta enjoys increased water flow and a much more hyposaline environment as compared to the western part of the Delta.

Akter et al. note that in the tide-dominated delta, the river carries the sediment, which is then redistributed by the tides. In areas of the Bengal Delta with reduced water flow regimes, the tidal dynamics play a more influential role in salinity and erosion-accretion processes since the reduced water flow is connected with incoming seawater during high tides. Moreover, such hypersaline estuaries of the delta are often deprived of sediment throughout the dry months.[62] During the monsoon season, however, the sediment inflows into the Meghna estuary in regions such as Tentulia, Hatiya, and Shahbajpur are 20 to 30 times higher than the average dry seasonal flow, while the distribution of freshwater during monsoon seasons are 15%, 10%, and 75% respectively. The sediment characteristics, tidal range, and geography of the estuary are main governing processes affecting delta formation in such estuary regions.[63]

2.3.2. Understanding the impact of anthropogenic activity on the dynamic Bengal Delta

While previous sections have explored how natural processes in the Bengal Delta have shaped delta formation and regulation over the time scale of centuries and millennia, it is essential to note that anthropogenic activities in the Bengal Delta from the late nineteenth and early twentieth century have been driving forces in shaping delta formation. However, the Bengal Delta is hardly unique in this regard. The level of impact of human activity on global

[62] The western and central part of the Bengal delta, due its tidal dynamics, higher salinity and reduced sediment content, are populated by species of mangrove which thrive in such swampy environments. These mangrove trees have formed vast swathes of forests known as the Sundarbans in the western and central coastal estuaries of the Bengal Delta and constitute a thriving estuary ecosystem of their own. Rising sea levels and high levels of anthropogenic activity, however, constitute grave threats to the existence of the Sundarbans today.

[63] Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes," 1218.

ecosystems in the past century has sparked a debate in geological sciences as to whether we are in a new geological epoch called the Anthropocene. While debates over whether a new epoch in the earth's history has been reached where humans themselves have become a new geological force are far from concluding, the fact that anthropogenic activities have led to sweeping changes in the environment can be little contested. Likewise, the extensive scope of anthropogenic activities over the past century has deeply affected the Bengal delta region, bringing about far-reaching ecological changes in a manner unseen over several millennia. It has also affected how the Bengal Delta is being studied by scholars from the natural and social sciences.

Ecologists till recently tended to study changes over the longer period (10,000 to 11,000 years), mainly during the late Quaternary period of the Holocene. However, with the advent of notable anthropocentric activity in the past two centuries, starting from the colonial period, the human-induced changes and their environmental impact has featured prominently in recent works by ecologists.[64] This involvement of ecological scientists in assessing the impact of anthropogenic activities on the ecology of the Bengal Delta is an indication of two aspects – the severity of human impact on the environment, and the multi-disciplinary nature of inquiry needed for the assessment of human activity on the Bengal Delta.

In order to further understand the attitude and nature of responses by ecological scientists towards encroaching anthropogenic activity in the Bengal Delta, two notable frameworks assessing anthropogenic action from ecological sciences can be explored in this short section. Thiele-Eich (2018), while assessing flooding in Dhaka and the challenge of climate change, notes that effective disaster management in flooding situations requires an understanding of its impact on mortality in the population. The author argues that the adverse impact and severity of flooding has increased with climate change, and develops a conceptual socio-hydrological framework to assess this impact. The socio-hydrological framework is employed to show that both natural and anthropogenic processes and their two-way feedbacks

[64] Some recent works by ecological scientists which examine the impact of anthropogenic activities on the Bengal Delta as a deltaic ecosystem include Akter et al., "Evolution of the Bengal Delta and Its Prevailing Processes"; Ramesh et al., "Integrated Management of the Ganges Delta, India"; Kimberly G. Rogers et al., "Doomed to Drown? Sediment Dynamics in the Human-Controlled Floodplains of the Active Bengal Delta," *Elem Sci Anth* 5 (November 10, 2017): 66, https://doi.org/10.1525/elementa.250; Fabrice G Renaud et al., "Tipping from the Holocene to the Anthropocene: How Threatened Are Major World Deltas?," *Current Opinion in Environmental Sustainability* 5, no. 6 (December 2013): 644–54, https://doi.org/10.1016/j.cosust.2013.11.007; Day et al., "Delta Winners and Losers in the Anthropocene."

need inclusion in the assessment of climate change impact on flooding intensity in the region.[65] Ramesh et al. argue for an integrated approach to address delta sustainability in the face of upstream activities within the delta, cost-related phenomena such as salinity and sea-level rise, and anthropogenic activity, which threatens the delta as a whole. The authors argue that an integrated approach linking these various challenges should include water and land management, conservation of ecosystems, ensuring the sustainability of livelihood, managing pollution, and disaster preparedness.[66] It can be observed from the above frameworks that assessments by ecological scientists are often carried out with the view of prescribing ameliorative action. Detailed empirical assessments of decades and centuries of adverse anthropogenic activities on the delta environment are often followed by advice of further anthropogenic intervention, armed with the latest scientific ideas on conservation and integrated management of the delta environment.

From the point of view of social sciences, environmental history is one field of inquiry that is well equipped to appreciate the severity of human impact on nature in the Anthropocene through aiming to understand human action vis-à-vis nature and ecology. Unlike ecological scientists, the drive-in environmental history is not necessarily one of environmental activism, but that of an alternative inquiry into politics and human-centered historical accounts of the past. The environmental history approaches of Iftekhar Iqbal and Debjani Bhattacharya in studying the Bengal Delta through the category of the agrarian-ecological have been discussed earlier in this chapter. An alternative and innovative approach from within environmental history that attempts to move away from land-centered narratives is D'Souza's notion of 'colonial hydrology.' Through the framework of 'colonial hydrology,' D'Souza attempted to formulate and explain a distinct paradigm for hydraulic interventions in South Asia in the colonial period by realigning land and water in new sets of social, political, and ecological relationships.[67] Through employing this concept, the author attempted to delineate the conceptual turn within environmental history whereby previously understood calamitous events such as flooding in South Asia are presently considered in varying capacities as geomorphological processes, biological pulses, and livelihood strategies. The author explored the failure of previous colonial administrators in grasping the ecological significance of

[65] Insa Thiele-Eich, "Flooding in Dhaka, Bangladesh, and the Challenge of Climate Change" (PhD Thesis, Mathematisch-Naturwissenschaftlichen Fakultät, Rheinischen Friedrich-Wilhelms-Universität Bonn, 2018), 55–66, http://hss.ulb.uni-bonn.de/2018/4949/4949.htm.

[66] Ramesh et al., "Integrated Management of the Ganges Delta, India," 201–3.

[67] Rohan D'Souza, "Water in British India: The Making of a 'Colonial Hydrology,'" *History Compass* 4, no. 4 (July 2006): 625, https://doi.org/10.1111/j.1478-0542.2006.00336.x.

flooding when they treated all river inundations as natural disaster events and examined recent attempts at the history that treat flooding and associated riparian processes as geomorphological and ecologically significant processes.[68] The significance of the ecology of the Bengal Delta in D'Souza's analysis can be seen in the author's criticism of land-centredness of colonial imagination and the impact of such thinking with regards to the Delta, whereby the deltaic region was seen as a collection of isolated fluvial elements rather than a dynamic organic process.[69]

2.3.3. The Bengal Delta as a broader region of 'anomaly'

Instead of understanding human-induced changes in the Bengal Delta, the question of sequence and time needs to be both understood and accounted for. For example, although it may be taken as a given that the railways were introduced by the colonial administration later into eastern Bengal, the delay in the introduction of technology to the region needs to be accounted for in any analysis since such delays could signify a lot of different things. One could be the inability or unwillingness of the state or administration to introduce railways earlier, or that the belated introduction of railways into eastern Bengal meant that the ecological changes associated with its introduction came at a later stage in the colonial period. Often, colonial laws were applied uniformly throughout all of the lands but were exempt in certain areas or circumstances such as in the case of specific forested areas where the colonial administration was not strong enough to implement them. Earlier environmental historians such as Sivaramakrishnan tried to explain such events or incidents as anomalies, and such zones, where otherwise strictly applied laws were made lax, as 'zones of the anomaly.'

As seen above, Iqbal extended Sivaramakrishnan's idea of 'anomaly' into the eastern Bengal region, arguing that the Bengal Delta can be seen as a broader region of 'anomaly' due to adoption of land management practices by the British colonial authorities that were markedly different from the Permanent Settlement.[70] It stemmed from initial gaps in colonial knowledge

[68] Rohan D'Souza, "Event, Process and Pulse: Resituating Floods in Environmental Histories of South Asia," *Environment and History* 26, no. 1 (February 1, 2020): 37–43, https://doi.org/10.3197/096734019X15755402985541.

[69] Rohan D'Souza, "Drainage, River Erosion, and Chaurs: An Environmental History of Land in Colonial Eastern India," *Nehru Memorial Museum and Library Occasional Paper: History and Society*, New Series, 2015, 7–17, http://nehrumemorial.nic.in/images/pdf/occasional/Rohan_D_Souza_Ecology_and_History_23_December_2015.pdf.

[70] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 12.

and authority of the eastern Bengal countryside that was often dense forest or swampy marshland. These initial gaps, however, were overcome by the colonial administration by the turn of the beginning of the twentieth century, leading to extensive human-made ecological changes in the Bengal Delta arising from the construction of railways and river dams.

2.4. The Bengal Delta as an Ecological framework for the study of Epidemic Disease

The relationship between epidemic disease and ecology is well known in environmental history scholarship. The idea that disease is linked to environmental conditions can be traced back to the ancient times of Hippocrates, whose text aptly named *Airs, Waters and Places* links aspects of climate and geography with the incidence of disease in various peoples. Moreover, works such as William H. McNeill's *Plagues and Peoples* (1976), Alfred Crosby's *Columbian Exchange* (1972), John McNeill's *Mosquito Empires* (2010) showcase the role that environment and peoples have in spreading disease, and how epidemic diseases in history decimated entire populations in different regions. Although the recent works mentioned above exploring the role of disease in human history tend to feature some degree of environmental determinism,[71] it does not detract from their importance in showcasing the significant effect that disease as part of the environment can have on human history. This discussion makes it clear that the study of the incidence of epidemic disease in the Bengal Delta as a subset of environmental history also demands a closer inspection of the ecology of the deltaic region, and its role in aiding the spread of epidemic disease, or in curbing its spread. To do that, however, the epidemic disease needs to be studied in the context of the broader ecology of the region, and how changes to that ecology affect the incidence and spread of epidemic disease.

Looking at previous discussions, several points and aspects of the Bengal Delta could be identified, which could inform one of how to focus on an ecological framework. Iftekhar Iqbal identified the dynamic nature of the ecological regime of Eastern Bengal as the reason for the potential importance of the Bengal Delta as a case study for environmental history. It is this dynamic and fluid nature of the Bengal Delta, which would similarly act as the key to setting up an ecological framework that would help us make a historical sense of epidemic disease and its spread in the Delta. Iqbal connected the ecological changes stemming from the introduction of railways with a twofold adverse impact on the health and wellbeing of the

[71] J. Donald Hughes, *What Is Environmental History?* (Cambridge: Polity, 2006), 4–5.

general population – decrease in water flow and water stagnation in the Delta led to the resurgence of the disease. In contrast, decreased water flow led to a decrease in nutrition and the occurrence of scarcity and, ultimately, famine. Stagnant water and shallow water bodies, resulting from lack of rainfall or reduced water flow, were havens for both diseases, including microorganisms such as *V. Cholerae*, and sites for the breeding of malarial disease vectors such as the *Anopheles* mosquito. Moreover, Iqbal noted that developmental projects caused not just siltation, but reduced nutrition in the river waters as well, leading to scarcity of fish, a crucial item food in the diet of the people of eastern Bengal.

In light of the above, one may map out two ways in which ecology and changes to ecology can influence the dynamics of epidemic disease. First, one can directly study the role of ecology and changes to ecology in the spread of disease (Diagram 2.1). This has been done in studies on how human-induced changes to ecology have led to the spread of cholera and malaria in the works of Klein.[72] Second, one can delve much more in-depth and explore the relation of epidemic disease to nutrition, especially in conditions such as scarcity and famine. In this regard, the role of ecology and changes to ecology can be studied through placing epidemic diseases concerning the overall health of the people of the region (Diagram 2.2). It is by placing epidemic disease with a framework of the general health of the populace that one will understand the connection of epidemic disease with other health concerns such as food availability and nutritional intake.[73]

[72] Ira Klein, "Imperialism, Ecology and Disease: Cholera in India, 1850-1950," *The Indian Economic & Social History Review* 31, no. 4 (1994): 491–518, https://doi.org/10.1177/001946469403100403; Ira Klein, "Malaria and Mortality in Bengal, 1840-1921," *The Indian Economic & Social History Review* 9, no. 2 (1972): 132–60, https://doi.org/10.1177/001946467200900202; Ira Klein, "Development and Death: Reinterpreting Malaria, Economics and Ecology in British India," *The Indian Economic & Social History Review* 38, no. 2 (June 2001): 147–79, https://doi.org/10.1177/001946460103800202.

[73] The relation between starvation or famine like conditions and epidemic diseases has been explored extensively in several works, including Frederik B. Bang, "The Role of Disease in the Ecology of Famine†," *Ecology of Food and Nutrition* 7, no. 1 (January 1978): 1–15, https://doi.org/10.1080/03670244.1978.9990506; Andrew B. Appleby, "Epidemics and Famine in the Little Ice Age," *Journal of Interdisciplinary History* 10, no. 4 (1980): 643, https://doi.org/10.2307/203063; John Walter, ed., *Famine, Disease and the Social Order in Early Modern Society*, 1. paperback ed, Cambridge Studies in Population, Economy and Society in Past Time 10 (Cambridge: Cambridge University Press, 1991); David Arnold, "Social Crisis and Epidemic Disease in the Famines of Nineteenth-Century India," *Social History of Medicine* 6, no. 3 (1993): 385–404, https://doi.org/10.1093/shm/6.3.385.

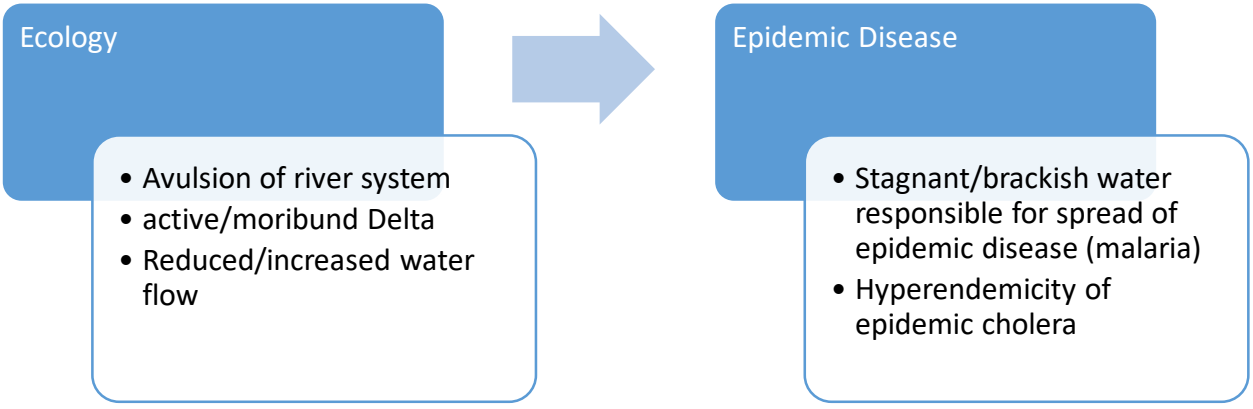

Diagram 2.1: Direct impact of ecology on the spread of epidemic disease in the Bengal Delta

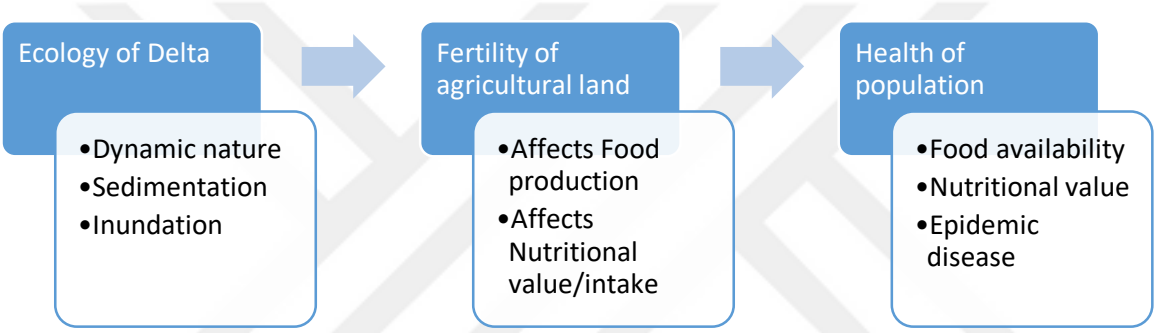

Diagram 2.2: Indirect impact of ecology on epidemic disease as a subset of the overall health of the general population

Coming back to the issue of epidemic disease, it was noted that Arnold and Harrison have often failed to locate ecology within their analysis, despite attempting to work with geographical locations where such epidemics occurred. The historian Ira Klein provides valuable insight in this regard, dealing with the issue of epidemics and modernization efforts during the colonial period in a manner that aims to incorporate ecology into an understanding of the epidemic disease. Klein focuses on malaria and cholera in his studies on epidemic disease mortality, highlighting the close relation of ecology and changes to the ecological regime in the diffusion of these two epidemic diseases at various periods, which were leading causes of mortality in the Bengal region.

In assessing the impact of malaria on Bengal, and later throughout India[74], Klein evaluates how ecological changes induced by developmental policies increased malaria mortality in nineteenth-century India, regardless of the relative prosperity of its victims.[75] At a time in the latter part of the nineteenth century, when newer and deadlier strains of malaria emerged, developmental works exacerbated the spread of disease and mortality rates. Significant developmental works such as railways and irrigation canals were constructed without much thought regarding the environmental impact since the colonial administration considered environmental reclamation as being too costly. Moreover, Klein considers public health activities by the colonial administration to have been too limited in scope and size to contain such spread of malaria. In many cases, this was made worse by allegations and claims by colonial intellectuals that Indians were 'a dying race' and were 'physically inferior.'[76]

Similarly, Klein chalks the spread of cholera, a disease endemic to Bengal, through various development projects such as the railways, and its impact on the silting of rivers and stagnation of waterways.[77] Apart from the ecological impacts of developmental projects, a common underlying concept in Klein's discussions on cholera and malaria is the effect of famine and scarcity on mortality rate. This discussion of the relationship between disease mortality and scarcity related famine mortality can be complemented by Iqbal's detailed discussion on the ecological roots of the Great Bengal famine of 1943.[78]

2.5. Conclusion

This chapter explored the Bengal Delta as an ecological framework for the study of epidemic disease, the latter being a subset field of the discipline of environmental history. The basis of this framework rests on the appreciation of two aspects, the dynamic natural processes of delta formation in the Bengal Delta, and the means to assess the impact of anthropogenic activity in the Bengal delta, which in the context of the study is that of the Bengal Delta as a 'zone of anomaly' in terms of colonial administration till the turn of the century. Following from a focused literature on the history of epidemic disease, it was concluded that except for a few

[74] Two articles by Klein cover Bengal and India, respectively; Klein, "Malaria and Mortality in Bengal, 1840-1921"; Klein, "Imperialism, Ecology and Disease."
[75] Klein, "Development and Death," 156.
[76] Klein, 158–59.
[77] Klein, "Imperialism, Ecology and Disease."
[78] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 160.

ones, most studies exploring epidemic disease history in Bengal such as that of cholera and malaria often failed to establish a conclusive link between ecology and incidence of epidemic disease, mainly due to the failure to include deltaic ecology as an important factor into their broader framework of analysis.

The inter-disciplinary nature of this ecological framework is among its major strengths, since it strives to fuse works from both ecology and the social sciences. This allows for a deeper level of environmental history that is sensitive to the impact of the topography of the delta, and changes to that topography, on aspects of socio-political history such as epidemic disease. This framework can also help guide research in other fields such as the impact of science and technology on ecology such as the ecological impact of dams and railways, as carried out in the works of Iftekhar Iqbal and others. A criticism of the above framework that was addressed within the chapter is that of declensionism, and how environmental history tends to be declensionist. A point to note in this regard is that this study looks at colonial activity in the nineteenth and early twentieth century, right throughout a time period which saw great technological advancement and urban expansion, all at the expense of natural resources throughout the world. As such, colonial exploitation activities were accompanied by large environmental degradation in a manner that can be said to be characteristic to the period itself. Instead of viewing it as a limitation of the environmental history approach, one can identify this focus on environmental mismanagement as a definitive and damning criticism of colonialism and the colonial mindset itself.

CHAPTER III

EPIDEMICS IN THE BENGAL DELTA – A CASE STUDY OF COLONIAL DHAKA

3.1. Bengal Delta as a 'zone of anomaly': Implications for epidemics and health

In etching out an ecological framework of the Bengal Delta for the study of epidemic disease, two aspects were mentioned - the dynamic nature of the Bengal Delta, and its framing as a broader region of 'anomaly' in the light of Sivaramakrishnan's notion of 'zone of anomaly' in *Modern Forests*. Iqbal's notion of the Bengal Delta as a broader region of 'anomaly' till the turn of the twentieth century, when the state began to become more knowledgeable about the interior of the eastern Bengal countryside, is a significant one. It implies that the colonial 'modern' state was less assertive and more restrained when it was less knowledgeable about the agro-ecology of the region, but that it became more assertive and less restrained after this period of 'ignorance' was over and it acquires proper understanding. On the other hand, there was the indigenous peasantry, who benefited from this 'anomaly' and 'ignorance' of the colonial state to appropriate the ecology of eastern Bengal till the turn of the twentieth century, not just as passive bystanders, but through exercising their capacity to generate and employ their assertiveness.[79] As discussed earlier, aspects of this 'anomaly' included most of the eastern region of Bengal not being under the remit of the Permanent Settlement revenue code, and the relatively later introduction of the railways in the eastern Bengal at the turn of the twentieth century. Iqbal explained the resulting favorable situation for the indigenous peasantry of the eastern Bengal, noting the relative prosperity of peasants in eastern Bengal throughout the nineteenth century[80], as compared to that of western Bengal.

The problem sought to be addressed in this chapter and the next, however, is that of a different aspect – epidemic disease, the response to epidemic disease, and how one can

[79] Iqbal, 13.
[80] Iqbal, 49.

understand the phenomenon of epidemic disease within this notion of the Bengal Delta as 'zone of anomaly'. In terms of state-led Western medical intervention, Iqbal's notion of eastern Bengal as a broader region of 'anomaly' could help explain the scope and nature of colonial medical interventions in the region, and aid us in evaluating colonial medical administrative responses towards epidemic diseases such as cholera, and later malaria. While colonial medical intervention in the form of hospitals and dispensaries were often inadequate throughout the nineteenth century, they were also disproportionate in terms of coverage. This was because health establishments were usually found in the urban centers like Calcutta in western Bengal, where the European population usually resided, rather than in the more populous rural areas of eastern Bengal. It naturally follows that if the notion of the Bengal Delta as a broader region of 'anomaly' means a less assertive colonial state, it also means that it is less interventionist and less penetrative. The state of health and medical establishments in the delta region of eastern Bengal also corresponded to such a reality – the only major hospital in eastern Bengal till the turn of the century, the Mitford Hospital, was built in 1858 in the city of Dhaka, and it only became a government institution in the 1920s.[81] In light of such inadequate capabilities to combat large-scale epidemics in eastern Bengal delta region, colonial medical authorities often viewed the climate, ecology, and environment of the Bengal delta with hostility, characterizing it as highly disease-prone. Epidemic outbreaks were often seen as closely connected to the topography and the environment. It is keeping this general picture of the region in mind that Dhaka could be identified as a representative center of eastern Bengal in order to proceed with the twofold approach of the study of the incidence of epidemics followed by the evaluation of colonial health responses towards combating these epidemics in two chapters.

3.2. Delta environment and epidemic disease theories in the eyes of nineteenth-century colonial medical authorities: Studying the case of Dhaka

As in the seventeenth and eighteenth centuries, miasmatic theories of the disease continued to be used to explain the spread of epidemics until the late nineteenth century. It was only after the discoveries of Koch and Pasteur in the 1890s that the germ theory of disease gained traction amongst medical professionals. In respect to colonial India, Harrison noted that a shift in

[81] Keeping in mind our goal towards studying both the incidence of epidemics, and the colonial response in terms of health infrastructure, Dhaka is best suited as the representative area of study from eastern Bengal. See next chapter for a much more detailed exploration of the medical infrastructure of Dhaka during the colonial period.

attitudes regarding germ theory of disease only began to occur amongst the officers of the IMS during the time of the 1896-97 bubonic plague epidemic, which swept through western and central regions of India.[82] An interesting aspect of theories of miasma, which makes it relevant for our study of epidemic diseases, was the focus on how environmental conditions play a central role in the generation of disease, and will be discussed in more detail below.

Epidemic diseases such as smallpox and cholera were thought to belong to a group of diseases known as zymotic diseases. Grimshaw gave an idea of the wide range of diseases grouped under this category, noting that the chief diseases of this class were "Fevers, Diarrhoea, Scarlatina, Small-pox, Whooping-cough, Cholera, Measles, Erysipelas, Metria (or Puerperal Fever), Croup, Diphtheria." The term zymotic was used to refer to any contagious disease arising from a morbidific principle or pathological process alongside or identical to biochemical changes in organic matter such as fermentation.[83] Fermentation was associated with putrefaction and decomposition of organic matter, especially from filth and sewage, releasing *miasm* into the atmosphere, which spread infection and was seen as a source of disease. *Malaria*, literally meaning 'bad air,' was such a kind of *miasm*, and a *malarious* region referred to an unhealthy region in which conditions were ripe for the generation of disease.[84] While fermentation was seen as being responsible for the generation of ague[85] and disease from the outside, the zymotic disease was also thought to be generated correspondingly from within the body and spread through contagion amongst humans.[86] Thus, causes of the transmission of intermittent fever or cholera were explained in nineteenth-century texts as emanating both from unhealthy external conditions and from diseased to healthy persons.

While Jon Snow's famous London water pump experiment in 1854 proved that cholera was a waterborne disease, many nineteenth-century medical professionals, in line with theories

[82] Mark Harrison, "Towards a Sanitary Utopia? Professional Visions and Public Health in India, 1880-1914," *South Asia Research* 10, no. 1 (May 1, 1990): 31, https://doi.org/10.1177/026272809001000102.

[83] Thomas W Grimshaw, *On Zymotic and Preventable Diseases: Scientific Lectures on Public Health, Royal Dublin Society* (Dublin: Alexander Thom, Abbey Street, 1873), 4, https://archive.org/details/b21456094/.

[84] The use of the word 'malaria' in the 19th century texts does not refer to the same term malaria that is used nowadays to refer to the infectious mosquito borne disease caused from *Plasmodium* group of parasites. 'Malaria' was understood as a poison which is generated through fermentation processes arising from soil, vegetation, temperature and moisture. The poison was believed to be an agent of disease and was thought to exert the widest influence on the health of the population.

[85] Ague is defined by Merriam Webster dictionary as a fever (such as malaria) marked by paroxysms of chills, fever, and sweating that recur at regular intervals, "Definition of Ague," Merriam Webster, accessed May 16, 2020, https://www.merriam-webster.com/dictionary/ague

[86] For a more detailed nineteenth century discussion of causes of zymotic disease, see William James Moore, *Health in the Tropics, or, Sanitary Art Applied to Europeans in India* (London: John Churchill, New Burlington Street, 1862), 16–18, https://archive.org/details/b21908369.

of miasma, long continued to support the theory that cholera was an airborne disease. The most well-known of these theories was von Pettenkofer's 'localist' theory, which identified the 'poison' of cholera as emanating *de novo* from a series of localized *unhealthy* environmental conditions, mainly sub-soil water,[87] conditions closely resembling that of the riverine basin of the Bengal Delta. The influence of his ideas can be seen in works by several medical and health professionals of the colonial administration in the nineteenth century. William J. Moore, Surgeon General of Bombay and author of several notable books on tropical medicine, noted in his *A Manual of Diseases in India* (1886) that cholera had a 'special preference' to the Delta of Bengal. Moore explained that this was due to the 'malarious,' low-lying situation of overcrowded urban centers on alluvial soil, which were located at the mouth of rivers, and had inadequate sanitation.[88] Moore was not alone in this respect, many from the same period writing on cholera in colonial India have tried to find links between its unique environment and disease generation[89]; some such as J.L. Bryden even claimed that in terms of epidemic diseases such as cholera, India was 'epidemiologically unique.'[90]

This keen interest in the relationship between environment and epidemic disease in scholarship by the nineteenth-century colonial health and medical administrative professionals in British India emanated from the fact that the death rate of European troops in India was amongst the highest in the world.[91] This high mortality rate served as an impetus to colonial health administrators to discover causes behind it. The foremost amongst them was Ranald Martin, who was serving as Bengal Presidency Surgeon and was in charge of the Calcutta Native Hospital Medical in 1835 when he suggested to the colonial government that medical

[87] Harrison, "Towards a Sanitary Utopia?," 31.

[88] William James Moore, *A Manual of the Diseases of India, with a Compendium of Diseases Generally*, Second Edition (London: J &A Churchill, New Burlington Street, 1886), 76.

[89] Some notable authors related to the Indian Medical Service (IMS) and their works on epidemic cholera include: James Jameson, *Report on the Epidemick Cholera Morbus, as It Visited the Territories Subject to the Presidency of Bengal, in the Years 1817, 1818, and 1819* (Calcutta: Government Gazette Press, A.G. Balfout, No. 1, Mission Row, 1820), https://archive.org/details/b21971547/; James Ranald Martin, *The Influence of Tropical Climates in Producing the Acute Endemic Diseases of Europeans, Including Practical Observations on the Nature and Treatment of Their Chronic Sequele, under Theinfluence of the Climate of Europe*, Second edition (London: John Churchill, New Burlington Street, 1861), https://archive.org/details/influenceoftropi00martrich/page/n5/mode/2up/search/hospital; Moore, *Health in the Tropics, or, Sanitary Art Applied to Europeans in India*; John Macpherson, *The Early Seats of Cholera in India, and in the East : With Reference to the Past and the Present* (London : Printed by T. Richards, 1869), http://archive.org/details/b22350354; Nottidge Charles Macnamara, *A Treatise on Asiatic Cholera* (London : John Churchill and Sons ; Calcutta : Thacker, Spink, and Co. ; Bombay : Thacker, Vining, and Co., 1870), http://archive.org/details/b21353621.

[90] Harrison, "Towards a Sanitary Utopia?," 31.

[91] Moore mentions that the death rate of European troops in India was as high as 69 per 1000 troops for the first 50 years of the nineteenth century, in Moore, *A Manual of the Diseases of India, with a Compendium of Diseases Generally*, 3.

officers should be called upon to write medico-topographies of their stations and districts.[92] The government adopted the proposal, and several essential medico-topographies were written at the time, among them Martin's *Notes of the Medical Topography of Calcutta* (1837) and James Taylor's *A Sketch of the Topography & Statistics of Dacca* (1840). Martin's medico-topography of Calcutta was evident in that it seeks to make an extensive and detailed study of the climate and the environment or topography of the area, and its relation to disease and epidemics. Similar remarks could be made of Taylor's detailed medical topography of Dhaka.

Dacca in 1840 as described by Taylor and others after him, is presented as having grown into "an unhealthy and unsanitary place, a condition accentuated by the physical layout of the city and the uncivic habits and customs of its inhabitants." [93] Despite the presence of wealthy inhabitants – *zamindars*, bankers, merchants, and indigo planters, among others, the bulk of the population- among them artisans, craftsmen, small traders, menials, and laborers were very poor. Other than the spacious riverfront areas to the south of the city, where the well-to-do inhabitants of the city, both Europeans and Indians, lived, most of the city dwellings were haphazardly built, consisting of a mixture of thatched mud huts and brick houses (*pukka*) close to each other. There was a lack of a proper drainage system for the discharge of rainwater, sewage, or liquid refuse. Well-privies to store sewage, were located dangerously close to drinking water wells and sewage often seeped into drinking water; they were cleared once or twice a year. The household rubbish and refuse collected were discharged into large pits nearby patches of jungle, which were only washed off when overflowed during rains. [94]

Following incumbent disease theories of miasma, Taylor (1840) discussed the high incidence of cholera amongst inhabitants of Dhaka and the abundance of malaria in the region. His discussions on cholera in the region are not very detailed and limited to statistics. However, he noted in the medical topography of Dhaka that it abounded with poison malaria, especially after the monsoon rains subside from the middle of September to the end of November when the water levels of the rivers and creeks fall. During this time, there was decaying vegetation and a specific temperature that changes the color of water in various to brown or dark shades of green – some emitting foul odor. Taylor pinpointed low lying rice fields and encroaching

[92] D.G. Crawford, *A History Of The Indian Medical Service(1600-1913)*, vol. II (London, Calcutta & Simla: W.Thacker & Co., 1914), 166.

[93] Sharif Uddin Ahmed, "The History of the City of Dacca, c. 1840-1885." (Ph.D., School of Oriental and African Studies (University of London), 1978), 235, https://ethos.bl.uk/OrderDetails.do?did=1&uin=uk.bl.ethos.447086/.

[94] Ahmed, 235–38.

and luxuriant forest areas within Dhaka as the most fertile sources of malaria in the district.[95] Following discussions on the sources of the poison malaria, Taylor went on to describe a series of diseases and ailments which were indicative of mosquito-borne malarial disease and dengue fever – intermittent fever, remittent fever, and enlargement of spleen amongst others.[96] Wise, in 1868, reiterated the unhealthy environment of the city, noting the abundance of malaria, and incidentally, of intermittent fever and the enlargement of the spleen near the jungles to the northeast of Dhaka.[97] In short, the delta environment was seen as being unhealthy and disease-causing. The adoption of stringent sanitary measures in urban centers such as Dhaka, and the designation of low-lying rice field areas, wasteland such as *chars* and forests as unhealthy formed a vital part of the narrative of colonial medical officers

3.3. An overview of Cholera epidemics 1817-1881 in colonial Dhaka

As discussed in the previous section, medical professionals of the nineteenth century understood cholera to be endemic to the Bengal region. The numerous studies to this effect helped professionals to characterize the disease, pinpoint specific symptoms, and collate suggested remedies for treatment. It was generally characterized throughout nineteenth-century accounts as consisting of sudden and sometimes violent bouts of vomiting and purging, abdominal cramps, fever, and extreme weakness followed by pallid complexions, leading to death within a short time, sometimes just hours.[98] Cholera is a water-borne disease and is generally spread through contamination of drinkable water sources by human stool and feces. In this regard, the conditions were ripe for the spread of cholera in early nineteenth-century urban centers worldwide, as they generally lacked sanitation and waste management practices. Like other urban centers of that time, sanitation and waste management in nineteenth-century Dhaka were rather inadequate.

Though cholera was not a new disease, it became a public health concern during the early part of the nineteenth century after appearing as an epidemic for the first time in 1817. This epidemic is thought to be the first cholera pandemic, as it eventually spread throughout

[95] James Taylor, *A Sketch of the Topography & Statistics of Dacca* (Calcutta: G.H. Huttman, Military Orphan Press, 1840), 322–32, https://archive.org/details/in.ernet.dli.2015.22705.

[96] Taylor, 335–38.

[97] "First Annual Report of the Sanitary Commissioner For Bengal, for 1868, With Selected Extracts from Forty District Reports; Special Remarks on These; General Observations Regarding the Sanitation In Bengal; Appendices." (William Jones, Alipore Jail Press, 1869), 119.

[98] Macpherson, *The Early Seats of Cholera in India, and in the East*, 18–19.

large parts of the British Empire at the time. Contemporary sources pinpoint the beginning of the outbreak at Sonargaon, in the district of Dhaka, where cholera cases were first reported in July 1817. From there, it spread through Narayanganj to the city of Dhaka in August of the same year.[99] Taylor noted that the epidemic simultaneously broke out in Dhaka, Jessore, and Natore.[100] It is claimed that while the fatality in the rural areas of Dhaka district was as high as 59 percent, in the city of Dhaka itself, the fatality was around 6.6 in the first year, and 8.9 in the second year. [101] Treatment was carried out by six native doctors under the direction of the Civil Surgeon Dr. Todd, at different points in the city. However, although the disease was most fatal initially, no accommodation was provided for in-patients from 1817-1830 at the Native Hospital, making it difficult to ascertain the disease mortality rate in the period. In 1819, 830 out-patients were treated at the hospital, showing the widespread nature of the disease. It again increased between 1822 and 1826; Taylor's 1840 report mentioned that 427 people died of cholera in the year 1825.[102] Modern-day studies on the cholera epidemic of 1817-21 throw greater detail on how official East India Company (EIC) attitudes towards cholera in Bengal began to change from being ameliorative to that of preventive action, a shift which became more pronounced in England in the later cholera epidemics of 1831-32.[103]

The second global cholera pandemic is claimed to have begun at around 1829, and it eventually ravished large parts of Europe and the Americas several years later.[104] This pandemic was significant in terms of setting off ideas of sanitation and sanitary reforms in urban centers in Britain, followed eventually by its colonial possessions such as India. In Dhaka, between 1830 and 1838, the rate of mortality in the Native Hospital was 48 percent, while at the military Regimental Hospital, between 1828 and 1837, the rate of mortality was 39.3 percent. It was found that the disease was more prevalent in the rainy months at the time, between July to September than in the drier months. It was different; however, after 1840, when the disease was more prevalent in the hot drier months, and more or less subsided in the rainy

[99] Jameson, *Report on the Epidemick Cholera Morbus, as It Visited the Territories Subject to the Presidency of Bengal, in the Years 1817, 1818, and 1819*, 171.

[100] Taylor, *A Sketch of the Topography & Statistics of Dacca*, 335.

[101] "First Annual Report of the Sanitary Commissioner For Bengal, for 1868, With Selected Extracts from Forty District Reports; Special Remarks on These; General Observations Regarding the Sanitation In Bengal; Appendices." The section on Dacca was prepared by the Civil Surgeon of Dacca at the time, Dr. J.F. Wise.

[102] "First Annual Report of the Sanitary Commissioner For Bengal, for 1868, With Selected Extracts from Forty District Reports; Special Remarks on These; General Observations Regarding the Sanitation In Bengal; Appendices.," 103.

[103] Harrison, "A Dreadful Scourge."

[104] "History of Cholera," History, https://www.history.com/topics/inventions/history-of-cholera, accessed on May 16, 2020

months. Between 1840 and 1849, cholera was most prevalent in Dhaka during the years 1842 and 1845. Dr. Wise alludes to the severity of the disease in both these years by mentioning that most of those affected often died in the collapse after a few hours' illnesses; in 1845, out of 40 affected prisoners in the Jail Hospital, twenty-eight died, while fourteen out of nineteen died in the Lunatic Asylum in that same year. The mortality rate from cholera between 1840 and 1849 was 53.7 percent in the Jail Hospital (71 out of 132 prisoners died), and 66.3 percent in the Native Hospital (124 out of 187 in-patients died). Between 1842 and 1849, the mortality rate from cholera was 64.7 percent in the Lunatic Asylum.[105]

The third global cholera pandemic stretched out between 1852 and 1859.[106] The statistics from Dhaka throughout the decade between 1850 and 1859 give us a very bleak picture of mortality from cholera, the rate of mortality in the hospitals generally being around, and above 60 percent. Wise noted that cholera outbreaks increased in severity throughout the city, especially the years 1851, 52, 53, and 55. In 1851 and 1852, there were severe cholera outbreaks in the winter months between October to December, while in 1853, the outbreaks were noted to be in the rainy seasons, and was attributed to have spread from an annual fair in Munshiganj. Wise characterized the severity of cholera in the city terms of hundreds of deaths, very common and very fatal, although it is likely that deaths may have run to the thousands, courtesy of the inadequate medical facilities and healthcare. According to records between 1850 and 1859, the mortality rate in the Native Hospital(s) (it was replaced by the Mitford Hospital in 1858) was 63.7 percent (183 out of 287 in patients died), 31.6 percent in the Jail Hospital, and 45.4 percent in the Lunatic asylum.[107]

Although globally, two more pandemics were observed from the 1860s till the end of the nineteenth century, they were considered to be less deadly in Europe and assumed more localized through still deadly forms in places such as colonial India. Populations in Bengal continued to suffer from the scourges of cholera epidemics, which had two aspects – the epidemics were more diffused, i.e., they occurred over more extended periods, and they seemed to follow a triennial cycle, i.e., deadly outbreaks over every three years. In Dhaka, the Mitford

[105] "First Annual Report of the Sanitary Commissioner For Bengal, for 1868, With Selected Extracts from Forty District Reports; Special Remarks on These; General Observations Regarding the Sanitation In Bengal; Appendices.," 103.

[106] "History of Cholera," History, https://www.history.com/topics/inventions/history-of-cholera, accessed on May 16, 2020

[107] "First Annual Report of the Sanitary Commissioner For Bengal, for 1868, With Selected Extracts from Forty District Reports; Special Remarks on These; General Observations Regarding the Sanitation In Bengal; Appendices.," 103–4.

Hospital was established in 1858, which promised the offer of better healthcare to the residents of the city, the district, and the division of Dhaka as a whole. While healthcare services offered new hope for the people of eastern Bengal, it also brought to light the high mortality rate of in-patient admissions in the hospital. An important conclusion from the report of the Sanitary Commissioner in Dhaka during this period was that outbreaks of cholera in Dhaka were often postponed or delayed by late rains and slow subsidence of flooding, or inundation.[108] It suggested a strong relationship between climatic conditions and epidemic cholera outbreaks.

Table 3.1: Cholera and mortality in Dhaka between 1860-1868, Source: "First Annual Report of the Sanitary Commissioner For Bengal, for 1868," 105-108.

Cholera and mortality in Dhaka between 1860-1868	
1860	Peak intensity between March and April. 77 percent mortality amongst in-patients at Mitford, 60 percent mortality among jail inmates
1861	Peak intensity between November and December. 59.4 percent mortality amongst in-patients at Mitford, 31.5 percent mortality among jail inmates, 18 percent at the Asylum
1862	Between March to September, the death rate of in-patients at Mitford Hospital was 70 percent.
1863	Maximum intensity in March. Fifty percent mortality amongst in-patients at Mitford Hospital (30 out of 59 in-patients).
1865	Fifty-one percent mortality amongst in-patients at Mitford Hospital (34 out of 64 in-patients).
1867-1868	Fatal outbreak at the end of 1867 after later rains, which continued through 1868.

The decade starting from 1870 can be considered as special in the study of cholera epidemics for several reasons. Firstly, the 1872 census was carried out by the colonial government, which was the first all-India census to be formulated in modern India. The

[108] "First Annual Report of the Sanitary Commissioner For Bengal, for 1868, With Selected Extracts from Forty District Reports; Special Remarks on These; General Observations Regarding the Sanitation In Bengal; Appendices.," 108.

statistics obtained from the census provided valuable information for the colonial authorities to more accurately map out population dynamics and the toll of epidemic diseases in specific localities. Secondly, a select committee was formed by the colonial government in September 1881 to find out the relation of cholera activity and climate conditions. The committee's report was unique in that it not just incorporated earlier data on cholera epidemics, but also presented a detailed history of cholera in India and its relation to the regional climatic conditions from 1862 to 1881. Comprehensive data was available in the report for the various districts in eastern Bengal for the given period. In terms of the Dhaka division, data was given for all its four districts – Dhaka, Fureedpore, Mymensingh, and Bakarganj. As it can be seen from the table below, there was a spike in mortality between 1872 and 1873 in the districts of Dacca, Bakarganj and Mymensingh. It was followed by another deadly spike in the outbreak of epidemic cholera in the Dhaka division continued from 1877 to 1881 throughout the district, being most severe in Bakarganj, Dhaka, and Mymensingh in 1877.

Table 3.2: Cholera and mortality in the Dhaka division of eastern Bengal from 1871 to 1881. Source: Henry Walter Bellew, *The History of Cholera in India from 1862 to 1881*. London: Trubner and Co., Ludgate Hill, 1885, 199.

Mortality for Selected Districts of eastern Bengal	**Population in 1872**	**1871**	**1872**	**1873**	**1874**	**1875**	**1876**	**1877**	**1878**	**1879**	**1880**	**1881**
Dacca	1,852,993	427	770	1869	392	571	977	7927	3409	4061	1339	3213
Fureedpore	1,012,589	519	429	303	162	85	723	4070	2459	4457	924	2180
Bakarganj	2,377,433	288	1080	2726	91	177	415	19177	2610	4293	965	1606
Mymensingh	2,349,917	255	881	1508	208	404	947	7979	2628	2504	659	839

Furthermore, as previously mentioned regarding Dhaka, the report again validated the contention of the 1868 sanitary commissioner report that late rains and accompanied slower flooding in Dhaka led to subsidence or delay in cholera outbreaks. Cholera essentially was much reduced or absent when the flow of rivers, streams, and canals was high, and attained

most severity in the drier months, whether in winter or summer.[109] At this point, it may be noted that improvement in healthcare services such as the functioning of the Mitford Hospital, gradual public health improvements such as sanitary measures and introduction of filtered water under the aegis of the Dhaka municipality led to abatement in frequent cholera outbreaks in the city after the 1880s. However, epidemic cholera outbreaks did not subside in Dhaka but attained a somewhat different form and nature due to factors reasons which shall be discussed in the following sections.

3.4. Hyperendemicity of epidemic disease in Dhaka (1882-1920)

It can be claimed that the notion of the Bengal Delta as a 'zone of anomaly' began to end with the introduction of railways in eastern Bengal in the 1880s. The period after the 1880s is also special for another reason, the discovery of the comma bacillus by Koch, and the attribution of the *Vibrio Cholera* as a causal organism to cholera. Another significant development in the field of medicine was the discovery by Ronald Ross[110] in 1897 that the mosquito was the vector for malaria in humans. It was especially significant in changing perceptions of how and why many people in specific regions of Bengal, which were home to significant mosquito populations, used to die from all kinds of 'fever.' Both these discoveries were responsible for helping health professionals to significantly narrow their analysis as to the causes of the spread of epidemic diseases such as cholera and malaria, and how to curb them. Sanitary measures and preventive measures assumed a more critical role in government attitudes towards combating outbreaks of epidemic disease.

3.4.1. Cholera epidemic outbreaks

Several cholera outbreaks continued to occur in the Dhaka division from the 1880s up to the early decades of the twentieth century. Unlike the diffused and prevalent nature of cholera in preceding decades, the nature of these outbreaks was sudden and highly fatal, especially in the years 1882, 1893, 1904, 1905, and 1909, suggesting that cholera in the district had turned into a hyperendemic form. B.C. Allen, a District Commissioner of Dhaka, noted that the 1882

[109] Henry Walter Bellew, *The History of Cholera in India from 1862 to 1881* (London: Trubner and Co., Ludgate Hill, 1885), 222, https://archive.org/details/b21910091.

[110] Ronald Ross was a British medical doctor who worked with the Indian Medical Service for 25 years, and received the 1902 Nobel Prize in Medicine for his discovery.

cholera outbreak was peculiar in the sense that it occurred between July and September at a time when the district was underwater from flooding. It was peculiar since earlier visitations of cholera usually followed a pattern of being absent in the rainy months, and affected most people in the drier months. The situation created panic amongst the inhabitants of the city, and Allen noted that many people fled the city at the time as a result. As a testament to a clearer understanding of the causes of disease outbreaks during his time, Allen noted that the widespread nature of this outbreak might have been caused because the milkmen's quarter was infected at the very commencement of the cholera outbreak of that year. In the city, the 1882 outbreak claimed 527 lives, while in 1893, a cholera epidemic claimed 582 lives. The years 1904 and 1905 were also years of high cholera mortality, claiming about five hundred lives each year. [111]

Allen further noted that throughout the whole Dhaka district, the worst epidemics during this period were in 1893 and 1895. The region most affected in the 1893 epidemic was the island lying between Dhaleshwari and the Padma rivers, and the total number of deaths registered in the last three months of 1893 was 17,610. In 1895, the number of registered deaths from cholera in the district was 16,970, which was the highest in Bengal for that year.[112] In trying to find out causes for the high mortality, Allen noted instances at Aricha in the Dhaka district where filth from public latrines was being dumped into the Padma River, and water from the same river water was being supplied to the region subsequently affected by cholera outbreaks.[113]

Allen further noted that cholera outbreaks in the city of Dhaka began to reduce due to the supply of filtered water, which started in 1877 in a limited capacity and reasonably covered the whole city by 1910.[114] Ahmed, in a recent work, however, noted that the progress in the reduction of cholera due to the supply of filtered water was hindered by the overall inefficiency of the municipality in waste management and removal of sewerage from the city. An ambitious 1912 proposal of an underground sewerage system for the whole city failed in terms of implementation when it was put in place in 1922. The system put in place covered just a fraction of the city, which was incidentally inhabited by the elite and wealthy, while the poorer and more populated sections of the city, such as Dakhsin Maisundi, Narinda, Dayagong, etc. were deliberately excluded. As such, while the new sewerage covered two-thirds of the city, the fact

[111] Basil Copleston Allen, *Dacca*, 1912, 74, https://archive.org/details/daccaallen00alle.
[112] Allen, 74.
[113] Allen, 73.
[114] Allen, 74.

that the municipality resumed the use of removal of filth from more impoverished and more densely populated parts of the by bullock carts, and dumping it in the center of the city, simply made the sewerage condition of the city even worse.[115]

While the endemic nature of cholera in the Dhaka district has been well documented, one may argue that the nature of cholera, as seen in the region from the 1880s, was different, both in terms of increased intensity and continued high fatality. While scientific research is lacking as to whether a different strain of cholera bacillus was responsible for these outbreaks, looking at the nature and intensity of the outbreaks, it may be claimed that this was hyperendemic cholera. This claim follows the understanding of Klein (1994), who noted that cholera throughout Bengal in the later nineteenth century and early twentieth century was 'hyperendemic' and caused a 'great loss of life.' As shall be seen in greater detail in the coming chapters, Klein attributed the rise of this form of cholera to environmental degradation in Bengal during the period.[116]

3.4.2. A note on lower incidence of malaria in eastern Bengal vis-à-vis rest of Bengal Delta

Since the discovery of the cause for malaria by Ross in 1897, it was understood that the significant number of people who used to die every year from the so-called 'fever' could have been victims of mosquito-borne malaria, especially if it was an intermittent kind of fever accompanied by enlargement of the spleen. However, Allen noted that even by the turn of the century, deaths were usually recorded by non-medical personnel, and anything that they could not identify outside the realm of usual diseases of smallpox, cholera, dysentery, they would put it down as 'fever'. This was a problem because a person can display a fever, or a high temperature, as part of a symptom of a host of other illnesses.[117]

[115] Sharif Uddin Ahmed, "Dhaka Under The British Crown (1858-1947) - Aspects of Urban History," in *400 Years of Capital Dhaka and Beyond: Politics, Society, Administration*, ed. Abdul Momin Chowdhury and Sharif Uddin Ahmed, vol. 1 (Dhaka: Asiatic Society of Bangladesh, 2011), 63.

[116] Klein, "Imperialism, Ecology and Disease," 510–13.

[117] Allen, *Dacca*, 72..

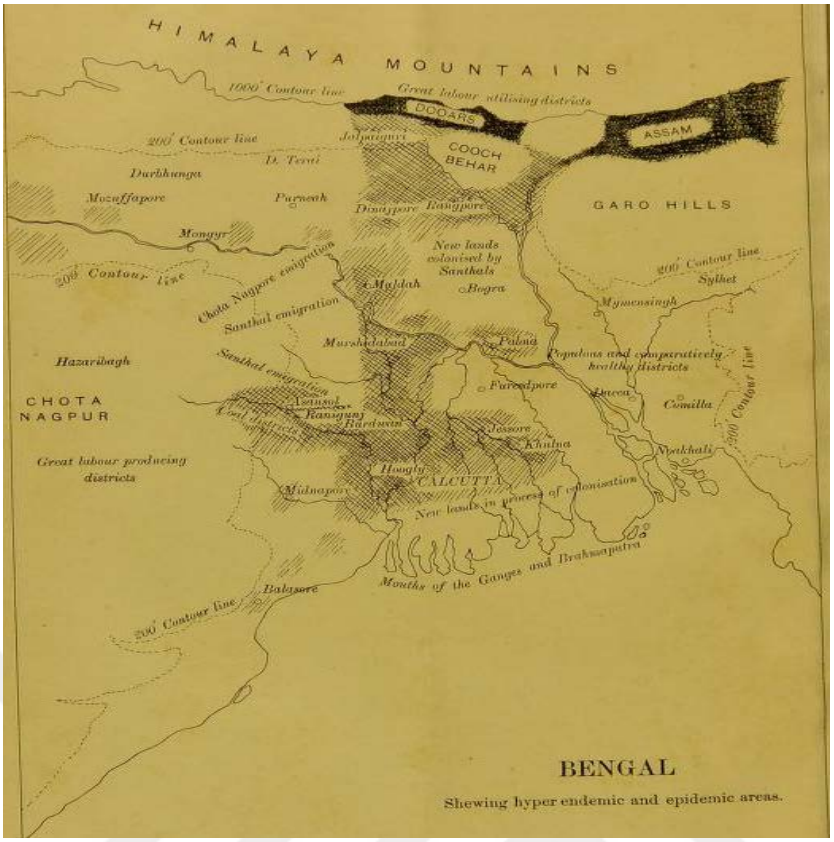

Figure 3.1: The hyperendemic and epidemic areas of Bengal for malaria Source: S.R. Christophers, and C.A. Bently. "Malaria in the Duars." Government Monotype Press: Simla, 1911.

Malaria was a deadly disease in the latter part of the nineteenth and early twentieth century in Bengal. However, the spread of malaria in Bengal was disproportionate – it ravaged the western regions and central regions of Bengal, but its presence was negligent in Eastern Bengal. Klein (1972) notes the devastating effects of the malarial disease in the west and central regions of Bengal between the years 1871 and 1921 when he notes that Burdwan, Midnapore, Rajshahi, Murshidabad, and Hooghly were virtually stagnant in population. Moreover, places such as Nadia and Jessore showed a decline of ten percent of their populations between 1881 and 1921. In contrast, he notes that regions in eastern Bengal such as Dacca, Mymensingh, Faridpur, Tippera, and Noakhali practically doubled their populations and had the least incidence of malarial fever in Bengal.[118]

[118] Klein, "Malaria and Mortality in Bengal, 1840-1921," 159.

This is not to say that the incidence of malaria was non-existent in eastern Bengal. In the division of Dhaka, the district of Manikganj was known for its high incidence of 'fever.' Moreover, within Dhaka, the Madhupur jungle was considered the most malarious tract. In the decade ending in 1902, 542 deaths out of every 1000 deaths in the whole district were attributed to this 'fever,' with the Kapasia station reporting 813 deaths out of a thousand, and Raipura station reporting 731 deaths.[119] In 1912, the death rate per mille from malarial fever for the Dhaka division was 9.9 as compared to much higher rates in Burdwan and the Presidency divisions (above 30 per mille). Within the Dhaka division, however, the spread was uneven – Faridpur was 16.9, and Bakarganj was 10.6, while Dhaka was 7.1 and Mymensingh 5.3.[120] It changed somewhat during the decade from 1921-30, as the death rate per mille from malarial fever in the districts of the division was as follows - Dacca (12.7), Mymensingh (14.1), Bakarganj (13.9) and Faridpur (17.3). However, as before, the western districts in Bengal had much higher death rates from malaria - 11 districts in western Bengal had death rates above 20 per mille in the period from 1921-1930. It was a trend that would continue during the remaining years of British rule in India.[121]

The lower incidence of malaria in eastern Bengal, as compared to the western parts of Bengal was intimately connected to the pace of socio-economic developments in the region, and the resulting impact on the riverine ecology of the region had a significant role towards this pattern of incidence of disease. The continued avulsion of the river Ganges towards the eastern part of Bengal throughout the nineteenth century ensured that there remained a reduced water flow regime in the western part of the Bengal Delta. The eastern part of the Bengal Delta remained the active delta part during this time, and the avulsion of the Brahmaputra River to join the Meghna River in the early decades of the nineteenth century further enhanced the water flow in the eastern part of the Bengal Delta. As such, a higher incidence of malarial disease and disease-related mortality was observed in the western part of the Delta, as compared to the eastern part, which was relatively healthier. However, the incidence of cholera was in urban centers of the eastern Bengal, such as Dhaka was much higher than that in urban centers in the western part. It was due to a host of reasons, both ecological and human-induced. However, since our focus is on urban centers in the eastern and the western regions of the Bengal Delta,

[119] Allen, *Dacca*, 72.

[120] C.A. Bently, "Bengal Public Health Report for the Year 1925" (Bengal Secretariat Book Depot, Calcutta, 1927), 40–41, https://archive.org/details/b31406403/page/n1/mode/2up.

[121] R.B Khambata, "Bengal Public Health Report for the Year 1931" (Bengal Secretariat Book Depot, Calcutta, 1933), 56, https://archive.org/details/b31406464/page/n1/mode/2up.

it can be safely claimed that the higher incidence of cholera in Dhaka could have been a result of poor sanitary conditions and inadequate medical health infrastructure, a topic which shall be dealt with in detail in the next chapter.

3.5. Conclusion

This chapter is the first of two chapters focusing on a case study of Dhaka in eastern Bengal in terms of incidence of epidemic disease and colonial response to epidemic disease in the form of health infrastructure. Although the relationship between ecology and epidemic disease in eastern Bengal forms an essential part of the discussion on the incidence of epidemic disease in this study, that discussion is carried out in more detail in the final chapter in order to incorporate the broader ecological backdrop of the Bengal Delta and the broadest possible number of factors affecting that relationship. In order to understand the nature of the colonial response to epidemic diseases, this chapter was geared towards the description of the challenges to the colonial health infrastructure.

The concept of the Bengal Delta as a 'zone of anomaly' is quite useful for understanding how the colonial authorities assessed the threat of epidemic disease and their subsequent preparations in terms of medical and health infrastructure to combat this threat. Due to eastern Bengal being further away from colonial centres such as Calcutta, western medical men in the nineteenth century often viewed the vast riverine wetlands and forested areas in eastern Bengal with suspicion, deeming these low lying lands to be highly miasmatic, or capable of generating disease. Despite this general bias, data and empirical studies from the period, especially in the latter part of the nineteenth and early twentieth century, enable us to get a view of the prevalence of epidemic disease such as cholera and malaria during that period. It is observed that the prevalence of epidemic disease was intimately connected with the deltaic landscape, whether it was cholera or malaria. Dhaka, located in the active part of the delta, was generally healthier than in areas of western Bengal, but the higher incidence of epidemic cholera and malaria at the turn of the century calls for a more thorough exploration of larger human induced causes such as ecological changes in the Bengal Delta.

CHAPTER IV

COLONIAL HEALTH DEVELOPMENTS IN RESPONSE TO EPIDEMICS IN DHAKA

4.1. Situating Dhaka as a microcosm for studying the colonial response to epidemics in eastern Bengal

The long nineteenth century is synonymous with rapid industrialization and unplanned urbanization. Urban centers during this period were generally subject to poor waste management, and outbreaks of epidemic disease. It led to developments of ideas of sanitation and public health during the latter part of the nineteenth century. In colonial Bengal, urbanization was more concentrated in the western region, with Calcutta at the center. As such, medical developments and sanitary measures in response to cholera epidemics and other diseases were also much better coordinated and concentrated in western Bengal than in the eastern rural parts. Therefore, such developments often had little impact upon the vast masses of people located in rural areas of eastern Bengal, far away from the centers of such developments, till the turn of the century, as they were often unable to have access to such cures or breakthroughs.

The urban center of eastern Bengal, Dhaka, or Dacca, as it was known then, was historically significant for being the administrative and financial center of eastern Bengal under previous Muslim rulers. Apart from its historical importance, Dhaka was important to the colonial administration due to its central location in the Delta, past role in revenue administration, and extraordinary communication system through waterways. Moreover, Dhaka remained the headquarters of the Dhaka division under British rule, constituting vast sections of the Bengal Delta. During the nineteenth century and early twentieth century, the

Dhaka division consisted of the regions, including Dhaka (including the city and its suburbs), Fareedpore, Bakarganj, and Mymensingh.[122]

The Indian Medical Service (IMS), based in the Presidency towns of Calcutta, Bombay, and Madras, was largely responsible for health administration in British India. The Bengal Medical Service, as part of the IMS, was formed in 1763, under a Head Surgeon based at the General Hospital at Calcutta. In place of its growing administrative importance with the colonial administration, Dhaka was declared as a Surgeon's station starting from the foundation of the Bengal Medical Service. Under the aegis of the Calcutta Hospital Board (later Medical Board), it was assigned at various times as a station of a Superintending Surgeon (S.S.), and Administrative Medical Officer (A.M.O). [123] After the abolishment of the Medical Board, Dhaka was designated a first-class civil Surgeoncy.[124] Crawford mentioned that, in the spirit of the Presidency town such as Calcutta, Bombay, and Madras, Dhaka was one of such locations where incumbent medical staff often opted to remain, passing over any further military promotions. It was due to a sizeable European population enabling the surgeon to practice his profession, and the opportunity to earn from contracts, *zamindari*, trade and indigo planting, among others.[125] Moreover, Dhaka was also the site for the first and only major hospital for a long time in eastern Bengal. Keeping the above reasons in mind, it can be argued that Dhaka is best suited to be studied as a microcosm of colonial response to epidemics in eastern Bengal.

4.2. Health institutions in Dhaka before 1858

In light of the ebbing and resurgence of epidemic disease in the nineteenth century discussed in the previous chapter, a discussion of the current health and medical infrastructure is vital to understand the capability of the colonial state in combating these epidemics. This section will look at the health infrastructure in place in Dhaka before the construction of the Mitford hospital in 1858.

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[122] *The Imperial Gazetteer Of India Coondapoor To Edwardesabad Vol-Xi*, Published under authority of Secretary of State for India in Council (Oxford: The Clarendon Press, 1908), 101, http://archive.org/details/in.ernet.dli.2015.207014.

[123] D.G. Crawford, *A History Of The Indian Medical Service(1600-1913)*, vol. I (London, Calcutta & Simla: W.Thacker & Co., 1914), 321–24.

[124] Crawford, *A History Of The Indian Medical Service(1600-1913)*, 1914, II:330.

[125] Crawford, *A History Of The Indian Medical Service(1600-1913)*, 1914, I:273–74.

4.2.1. The Native Hospital in Dacca

Despite the presence of military hospitals for a long time, interestingly called the General Hospital or later the Regimental Hospital for the troops, it was not until the beginning of the nineteenth century that hospitals for the general native population were built, and were incidentally called the native hospital. The Calcutta native hospital for the Indian poor was opened in 1793 and accepted both in-patients and out-patients. The superintendent of the institution was John Shoolbred, who was appointed Assistant Surgeon in 1794 and became Surgeon in 1807. It was chiefly in the evaluation of his efforts in this regard that a Public Letter from Calcutta, dated January, 13th, 1804, reports that "the benefits of the native hospitals in Calcutta have been fully realized, and that the Governors of the hospital have been directed to communicate with the senior civil servants at Dakka, Patna, Murshidabad, and Benares to open similar hospitals in those towns."[126] In the case of Dhaka, this was an impetus for the founding of the now famous Mitford Hospital, although it became only functional in the year 1858.

Taylor's 1840 report mentioned the chief medical establishments in Dhaka as the following – Jail Hospital, Native Hospital (with an attached dispensary), Lunatic asylum, Military Hospital, and the vaccine establishment. Apart from this, there existed a conservancy establishment, a charitable fund for relief of the poor, and a municipal committee of Europeans and natives for improving the town.[127] He refuted claims that the British were the first to build a hospital for the poor in Dhaka, and noted that there were hospitals and almshouses for the poor and sick in the city since the close of the 15th century from the time of the Mughal emperor Jahangir. The expenses of these institutions were paid from the income of the *khalsa* lands (belonging to the Crown). He noted that the annual expenditure for Dhaka for purposes of charity in 1769, as settled by Sykes and the native princes, was Rs. 8390.80, a sum which was still higher than that spent on several charitable institutions by the British Government during Taylor's time in 1840.[128]

The Native Hospital was instituted in 1803 as a branch of the Calcutta Native Hospital. It was built to accommodate only 40 patients, i.e,.; it had one ward, was confined, poorly planned, and ill-suited for the purpose for which it was built. The small number of beds meant

[126] Crawford, *A History Of The Indian Medical Service(1600-1913)*, 1914, II:430.
[127] Taylor, *A Sketch of the Topography & Statistics of Dacca*, 89.
[128] Taylor, 318.

that a considerable number of patients, who usually from the poor and destitute, were out-patients, who either attended daily or were attended by the medical personnel. [129]

4.2.2. Other institutions supplementing the Native Hospital

Meanwhile, a series of related developments, such as the vaccine establishment and the institution of dispensaries, steps that supplemented and strengthened the Native Hospital, were also instituted side by side. Taylor mentioned the presence of the vaccine establishment in Dhaka in his 1840 report. The central role of the institution was vaccination against smallpox, mainly of the British troops and European residents at Dhaka, followed by a number of the native residents and inhabitants of the city, under the aegis of a medical officer responsible for vaccination, and his team of mainly native vaccinators. Vaccination was introduced in Bengal in 1802, as per the detailed report by John Shoolbred, who was the Superintendent of Vaccine Inoculation in 1805.[130] The official responsible for vaccination at the Dacca vaccine establishment was William Tutin, and the number of patients vaccinated from November 1802 till the end of 1803 in the station was 652 persons, including the native population.[131]

Taylor mentioned that the Native Hospital, after its institution in 1803, was improved by later officials in Dhaka, such as Walters and J. Grant. The latter added a charitable dispensary and out-houses to the Native Hospital in 1839.[132] It was through the dispensaries that vaccination campaigns against smallpox were conducted after the 1830s, and Ahmed noted that the Vaccine Department was attached to the newly established Dacca Charitable Dispensary.[133] There were several such charitable dispensaries built by philanthropists throughout the 19th century in different places in the district of Dhaka, such as at Joydevpur in Bhowal, at Joinshar in Bikrampur pergunnah, and the sub-divisional headquarters in Manikganj. These dispensaries were usually staffed by a Bengali class native doctor, appointed and paid by the Government while other staff included the Compounder, the Dresser, the Chowkidar (guard/watchman), and the *mehter* (cleaning staff). Apart from these larger dispensaries, there also existed numerous smaller indigenous dispensaries kept by native

[129] Taylor, 89.

[130] John Shoolbred, *Report on the Progress of Vaccine Inoculation in Bengal, from the Period of Its Introduction in November 1802 to the End of the Year 1803*, Reprint: London, Blacks and Parry, 1805 (Calcutta: Honorable Company's Press, 1805), 8–9, https://archive.org/details/b30372951/page/n6/mode/2up.

[131] Shoolbred, 10.

[132] Taylor, *A Sketch of the Topography & Statistics of Dacca*, 56.

[133] Ahmed, "The History of the City of Dacca, c. 1840-1885.," 81.

kobirajes and *hakeems*, who also practiced and gave indigenous remedies and medicine. The dispensaries played essential roles in providing healthcare to the masses who lived far from the larger hospitals and did not have ready access to them.[134]

Taylor testified to the miserable, dilapidated, and inadequate condition of the 40-bed Native Hospital, especially its inadequacy in treating in-patients in times of epidemic disease outbreaks. Apart from this, he also notes the absence of a 'Lungur Khana', or the almshouse for the poor and the destitute, as had existed in the Mughal period.[135] A charitable fund by Rev. Shepherd founded in 1836, with the help of donations from European inhabitants, distributed Rs. 80-100 a month among the poor in Dhaka, but as Taylor repeatedly noted, it was nowhere near to official charitable efforts in the Mughal times.[136]

4.3. Mitford Hospital in combating epidemic disease (1858-1920)

This section will discuss the role of Mitford Hospital as a health institution in combating epidemic disease in eastern Bengal. It will also look at significant sanitary and public health developments accompanying the growth of the Mitford hospital at the turn of the century, which were essential towards administrative efforts to counter epidemic disease.

4.3.1. Towards the founding of a new hospital for Dhaka

The health infrastructure of Dhaka – the native hospital and dispensary, mental health asylum, jail hospital, etc. were inadequate in terms of healthcare for the population of the city itself, and could in no way provide services to the people of the Dhaka division of eastern Bengal. A significant step towards providing health infrastructure for the people of Dhaka came in the form of a donation by Robert Mitford, a civil service official of the East India Company who had resided in Dhaka for many years, first as Collector and then as Judge of the Provincial Court of Appeal. After retiring in 1831, Mitford died in Europe in 1836, bequeathing the bulk of his amassed fortune, between six and eight lacs of rupees, to the Government of Bengal for

[134] *Principal Heads of the History and Statistics of the Dacca Division* (Calcutta: E.M. Lewis, Central Press Company Ltd., 1868), 60–62, https://archive.org/details/principalheadsh00unkngoog.

[135] The general apathy of the administration and elite towards looking after the poor, and the depopulated condition of the city of Dhaka can be understood from the fact that it was only in 1866 that a 'Lungur Khana' was erected for the poor and destitute by a member of the native elite, Nawab Abdul Ghani.

[136] Taylor, *A Sketch of the Topography & Statistics of Dacca*, 370.

charitable, beneficial works and public works in Dacca.[137] While legal proceedings from the family of the deceased[138] blocked the use of funds for some time, it was eventually handed over to the Bengal Government, who used the funds to open, among other things, a new hospital in Dhaka in 1858, called the Mitford Hospital, on the banks of the Buriganga river. The earlier Native Hospital and Dispensary were incorporated into the Mitford Hospital.[139]

4.3.2. Mitford Hospital and health infrastructure in eastern Bengal (1858 – 1920)

The Mitford hospital was at the forefront of the colonial attempt to fight epidemic disease in eastern Bengal since its establishment in 1858. In time, the Mitford Hospital became much more than a hospital; it became an institution at the nodal center of a network of smaller health institutions such as dispensaries in the more rural areas of the Dhaka division. The civil surgeon of the station was the superintending surgeon of the Mitford hospital, and from 1858 till 1883, the hospital was run with the help of a committee of local government officials, called the Mitford Hospital Committee.[140] In 1883, the colonial administration decided to hand over governance of the hospital to the Dacca municipal administration consisting of locally elected representatives, which became increasingly difficult for the municipal body as it struggled to pay the expenses and fund repair and maintenance developments. The chief manner in which the hospital was maintained and grew till the early twentieth century was through the implementation of local taxes and generous donations from wealthy eminent citizens of Dhaka. It was only much later in 1920 when the institution had become too important to fail that the colonial government made the Mitford hospital into a government-run public institution.

In this regard, it is mentionable that the hospital institution was often left handicapped in its endeavors to provide healthcare to the residents a variety of connected reasons. The first among these was the perpetual problem of funding, an issue that determined a lot of other factors. The second issue related to funding was the administration of the hospital since the hospital always appeared to remain understaffed for its role. The problem of funding and staffing often led to decisions by successive hospital administrative bodies that had significant

[137] Taylor, 368.

[138] "Bengal Past And Present," *Calcutta Historical Society*, 101, 51, no. 1 (1936): 132–33, https://archive.org/details/in.ernet.dli.2015.501562.

[139] For more details, see *Principal Heads of the History and Statistics of the Dacca Division*, 59.

[140] Sharif Uddin Ahmed, *Mitford Hospital and Dhaka Medical School – History and Heritage, 1858-1947 (in Bengali)* (Dhaka: Academic Press and Publishers Limited, 2007), 41.

repercussions on the development and growth (or setbacks to the growth) of the Mitford hospital as a health institution for eastern Bengal. The third issue related to the above two was the problem of custodianship or governance. It was chiefly because the Bengal Presidency government centered at Calcutta often shied away from taking ownership of the Mitford Hospital, directing the municipal administration to be the governing body instead. It stemmed from the propensity of the former towards cutting down on public spending and encouraging local self-government.

The civil surgeon at the Dhaka station often played an essential role in the early growth of the Mitford hospital. The first civil surgeon to head the Mitford hospital as its Superintendent after its establishment in 1858 was Alex Simpson. Although the hospital was supposed to be a hundred bed institution, delays in construction and procurement, and a shortage of funds meant that in the first year, it started with a 50 bed capacity.[141] The bulk of the patients coming to the hospital were the poor and destitute, and often at an advanced stage of the disease. It could perhaps explain what we have seen in earlier sections, that the death rate of admitted patients for epidemic diseases such as cholera in the Mitford hospital in the early part of the 1860s was very high, about 60-77 percent. Incidentally, Dr. Simpson passed away in Dhaka due to diarrhea in 1864, and a medical ward was opened in his name that very year to honor his legacy.[142] In 1873, Dr. Wise, superintendent of the hospital, spearheaded efforts for renovation of hospital buildings, and in order to cope with the high number of patients, demanded that the medical staff be increased, and nursing be introduced. As a result of his efforts, the new plan for hospital staff in 1875 allowed for the increase of two native doctors. However, due to constraints of funds, the nursing staff was not introduced in the new plan, and the number of wound dresser staff was increased to two instead. Notably, nursing was already established in the major hospitals of Calcutta at this time.[143] It was much later in 1917 that nursing was first introduced at the Mitford Hospital.

In order to spread healthcare to the more rural areas, charitable dispensaries were set up in the 1870s through the initiative of the colonial government and generosity of philanthropists in various stations and towns of the Dhaka division. The dispensaries and establishment dates in the Dhaka district were as follows – Jaidevpur Dispensary in Bhawal fiscal division (1866), Jaunsar Branch Dispensary in Bikrampur fiscal division (1866),

[141] Ahmed, 43.
[142] Ahmed, 48–51.
[143] Ahmed, 77 & 86.

Bhagakul Branch Dispensary (1868), Manikganj Branch Dispensary (1864), and Kalipara Branch Dispensary (est. 1870), Malucha Branch Dispensary (1872). Hunter mentioned that these dispensaries catered to the rural populations and usually were staffed by native doctor and compounder. These institutions were often rivaled by native doctors known as *hakims* and *kobirajes.*[144] In Bakarganj district, there was a small hospital and dispensary in Barisal town, and branch dispensaries at Pirojpur and Madaripur.[145] In Mymensingh, there were five dispensaries, three of them having some form of indoor accommodation for patients.[146] The only charitable dispensary recorded by Hunter in Faridpur district was the Padamdi Branch Dispensary, established in 1867.[147] The civil surgeon of the station was expected to visit the dispensaries, usually located in rural areas far from the civil station, at specified intervals. In Dhaka, this was quite challenging, since the civil surgeon was in charge of several institutions, including the mental asylum, the jail hospital, and the Mitford hospital. When, as early as in 1868, the colonial administration inquired as to why Dr. Cutcliffe, the Dacca Civil Surgeon, was not visiting the charitable dispensaries, he mentioned the lack of qualified medical staff in Dhaka to look after administrative duties at the Mitford hospital as a strong reason for his inability to visit the dispensaries in the *mofussil* areas (rural areas) of Dhaka.[148]

The period from 1883 till 1920 was mainly one of growth, expansion, and consolidation of the Mitford hospital as a health institution. Funding, however, continued to be a significant issue, which often made maintenance and expansion of the institution a rather slow process. In order to cut down on expenses, the colonial administration handed over the financial administration of the hospital to the Dhaka municipality in 1883.[149] Eventually, however, it became complicated for the municipality to cover expenses, and the hospital administration was given to a board of governors in 1898, who managed the hospital on behalf of the municipality.[150] In the meantime, donations from the wealthy people of the district led to several notable instances of expansion - Khwaja Ahsanullah donated funds amounting to Rs. 20,000 in 1875 for a female ward completed in 1883, combined funds from Armenian residents F.A. Barjohn, A.N. Pogose, and the Dhaka-Mymensingh railway fund were used to construct

[144] William Wilson Hunter, *A Statistical Account Of Bengal*, vol. Vol. 5, 1877, 150–53, http://archive.org/details/in.ernet.dli.2015.38980.

[145] Hunter, Vol. 5:248.

[146] Hunter, Vol. 5:480.

[147] Hunter, Vol. 5:359.

[148] Ahmed, *Mitford Hospital and Dhaka Medical School – History and Heritage, 1858-1947 (in Bengali)*, 67.

[149] Ahmed, 98.

[150] Ahmed, 123.

the European ward in 1893[151], the Eye ward (1893) from funds by Bhagyakool *zamindar* Raja Srinath Rai, the Johnson ward (1897) for the poor and destitute,[152] a separate donation of Rs. 50,000 by Khaja Ahsanullah for construction of Lady Dufferin Women's Hospital in Dhaka (1888), and the Maternity and Female Eye ward (1903) funded by Sir Salimullah.[153]

The conversion of the hospital to a government institution in 1920 came at the back of a succession of developments, starting from the establishment of the King Edward Memorial Fund in 1910 for the establishment of a King Edward Memorial Hall at the Mitford Hospital in the aftermath of the death of the king.[154] In light of the overall condition of the hospital, the urgent need for maintenance and planned expansion, Dr. E.A.R Newman, the then Superintendent of the Mitford Hospital, drew up and submitted a plan for the 'Reconstruction of the Mitford Hospital' in 1912, with a proposed budget of Rs. 871,510, which was much more than what was available in the memorial fund.[155] In light of the need for funds, the government accepted Newman's proposal, seeking to step in and take over the responsibility of reconstruction through the Public Works Department. In light of this resolve, the board of governors of the hospital ratified the plan and handed over all funds to the government in a meeting in 1916. The reconstruction began in earnest and was completed in 1920. From April 1, 1920, Mitford Hospital was upgraded from a Class III Municipality Hospital to a Class I governmental hospital, the first in the Eastern Bengal region.[156] By this time, however, in light of the system of diarchy and the Government of India Act 1919, where elected representatives of the Indian people would be in charge of departments such as health and agriculture, the spread of healthcare services in terms of dispensaries throughout eastern Bengal had increased

[151] Ahmed, 107.

[152] Ahmed, 111–16.

[153] The colonial era *zamindari* system meant that the wealthy elite people in question were usually the very large and influential landowners of the district or the region, whose fortunes were often tied with that of the colonial administration. For example, Iqbal noted that Khwaja Abdul Ghani, Nawab of Dhaka, was one of the most influential zamindars of East Bengal, and often went about claiming large tracts of wasteland territories (such as river *chars*, swamps, uncleared forestland) throughout the region, with approval or disapproval of the colonial administrative apparatus, in Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 25. Thus such instances of philanthropy by native elites, irrespective of intentions, often worked out as a leverage to gain power, prestige and influence with the colonial administration.

[154] Ahmed, *Mitford Hospital and Dhaka Medical School – History and Heritage, 1858-1947 (in Bengali)*, 142–43. The fund established by the colonial government to honour the memory of the deceased King George was for the purposes of collecting funding from local sources such as the Nawabs and elite zamindar families for the Mitford hospital. For further details, see Thomas David Baron Carmichael, "Speeches Delivered By Thomas David Baron Carmichael During 1914-15," 1915, 69–71, Internet Archive, http://archive.org/details/in.ernet.dli.2015.42396; L.J. Lumbley Dundas, "Speeches By Lawrence John Lumley Dundas, Governor of Bengal during 1918-1919," 1919, 166–69, http://www.new.dli.ernet.in/handle/2015/38917.

[155] Ahmed, *Mitford Hospital and Dhaka Medical School – History and Heritage, 1858-1947 (in Bengali)*, 145.

[156] Ahmed, 149.

from its humble beginnings in 1870s, there were 26 dispensaries in Dhaka district alone in the year 1917,[157] a number which increased to almost double in the same district, 57 dispensaries, by the year 1940.[158] However, this spread and increase in eastern Bengal were inadequate and insignificant compared to the medical infrastructure in other regions of Bengal.

4.3.3. Mitford hospital and public health developments in Dhaka

As in other urban centers throughout colonial India in the latter part of the nineteenth century, sanitary measures and the introduction of civic services complemented the improvements in medical and health infrastructure in Dhaka. It was instrumental in improving the urban public health of Dhaka and lowering the incidence of epidemic disease outbreaks. These developments were chiefly spearheaded by the Dhaka Municipal Committee, which, as seen in the previous section, was also responsible for the functioning of the Mitford Hospital for the period from 1883 to 1920.

Although an unofficial municipal Committee had existed before 1864, it was severely constrained by a lack of finances and lacked any legal powers to enforce its plans. This changed with the enforcement of the Bengal Municipal Act of 1864, which allowed the Municipal Committee formed in its aftermath to enforce taxes and go about improving the sanitary condition of Dhaka. It mainly consisted of removal of sewage, cleaning of privies, and improving drainage, among others. The Committee worked to improve public graveyards at Aga Sadiq Maidan to discourage the practice of burying the dead in family graveyards beside the dwellings where people lived since officials identified the practice with the spread of disease and contamination of drinking water sources.[159]

In the Sanitary Administration and Inspection Report of 1868, the Sanitary Commissioner of Dhaka wrote that “Dacca has been long famed for its uncleanliness.” He went on the reiterate that Dhaka was still a very filthy and unclean city as in 1868.[160] In 1912, B.C. Allen noted that, although some changes had occurred, Dhaka remained a quite filthy and

[157] Robinson, “Report on the Working of Hospitals and Dispensaries under the Government of Bengal for the Year 1917, ”LXXXV.

[158] W.C. Paton, “Triennial Report on the Working of Hospitals and Dispensaries in the Presidency of Bengal for the Years 1938, 1939, and 1940” (Bengal Government Press, Alipore, Bengal, 1942), 138.

[159] Ahmed, “Dhaka Under The British Crown (1858-1947) - Aspects of Urban History,” 52–53.

[160] “First Annual Report of the Sanitary Commissioner For Bengal, for 1868, With Selected Extracts from Forty District Reports; Special Remarks on These; General Observations Regarding the Sanitation In Bengal; Appendices.,” 114.

unclean city in the main.[161] As such, the uncleanliness of Dhaka was a perpetual problem that successive Municipal committees continued to face in light of rapid population growth and unplanned urbanization. Ahmed noted that in the early days of the Mitford hospital, when frequent cholera outbreaks in Dhaka were responsible for high mortality rates at the hospital, unclaimed dead bodies used to be thrown into the Buriganga river running beside the hospital. The Civil Surgeon Dr. Wise, in a report to the Hospital Committee in August 1868, said that from 1861-67, the yearly average of unclaimed corpses was 156. Since the practice of throwing dead bodies of those dying from fatal diseases in the river was considered a high risk to public health, the magistrate of Dhaka stopped the practice, and several Domes[162] were employed to ensure proper burials of these unclaimed dead bodies in the Municipality designated graveyards.[163]

A definitive step towards combating epidemic diseases such as cholera came in the form of installation of modern waterworks, and the supply of filtered water to the residents of Dhaka. It was, however, a protracted process that took a very long time to finish. It was made possible by generous private donations from Khwaja Abdul Ghani and his son Khwaja Ahsanullah, who donated Rs. 1,50,000 for the purpose.[164] The Bengal government gave additional funds required for the waterworks project, and the waterworks were opened for public use on 24 May 1878. The area supplied with water was limited; however, water pipes were laid over four miles area only, supplying Mitford Hospital, the lunatic asylum, Jail, and the Chauk Bazar.

Moreover, the daily supply amounted to about 35,000 gallons of water as opposed to the planned initially 200,000 gallons of water; this could not be increased without extending the mains. However, in time, improvements were made – by 1883, it was 95,000 gallons of water, and by 1893 it was 360,000 gallons of water, covering 70,000 of the city's 84,000 resident population.[165] Further modernization and extension of the waterworks was completed

[161] Allen, *Dacca*, 79.

[162] The Domes are a lower Hindu caste whose caste profession was to cremate dead bodies. They were often employed in hospitals in British India to work in hospital mortuaries and deal with dead bodies. For a comprehensive picture on the role of Domes in colonial medical history, see introduction in Arnold, *Colonizing the Body*.

[163] Ahmed, *Mitford Hospital and Dhaka Medical School – History and Heritage, 1858-1947 (in Bengali)*, 58–60.

[164] See comments on footnote no. 153 for relations between generous private donators and colonial administration.

[165] Ahmed, "Dhaka Under The British Crown (1858-1947) - Aspects of Urban History," 56–57.

in 1910, with the daily supply up to 800,000 gallons. Moreover, a water tax was levied from that year to cover costs and fund further improvements.[166]

Despite the vast improvements made in the waterworks, some aspects of public health for Dhaka, such as a proper drainage system, remained neglected. Allen spoke about the absence of a proper drainage system in the city. Moreover, he noted the presence of about five thousand private latrines in the city, which could not be approached and were generally left uncleared from year to year, becoming sources of both stench and disease.[167] The above discussion brings to light some lacking in approach by the colonial administration towards aspects of public health in Dhaka, especially one of near apathy towards building drainage systems and care towards city planning. In light of these above developments (or lack of them) that one can place the phenomenon pf resurgent epidemic cholera in eastern Dhaka in the later nineteenth and early twentieth century, as discussed in the previous chapter.

4.4. Disproportionate and Inadequate nature of the medical response to hyperendemic epidemic disease in eastern Bengal

The nature of the medical infrastructure of eastern Bengal, as discussed above, can be characterized as having organically grown out of the tensions between colonial administrations keen in cutting costs for public spending, versus growing medical needs of expanding local populations going through a process of urbanization. In the overwhelmingly agrarian economy of eastern Bengal, the interest of the landowning class was intimately tied with the condition of the land, and the people tilling that very land, the peasants. With the health of a high number of peasant population at stake from epidemic outbreaks of disease and tendencies of colonial administrations towards cutting costs, we have seen above how major landowners of eastern Bengal regularly contributed towards medical infrastructure and public health spending in the sections on the Mitford hospital, the numerous charitable dispensaries, and public health acts such as supplying filtered water to the residents of Dhaka.

However, the hyperendemic nature of the epidemic disease in the region during the latter part of the nineteenth century and early twentieth century required a different form of medical intervention, a state-led one. The scene of the medical infrastructure in the Dhaka

[166] Ahmed, 63–64.
[167] Allen, *Dacca*, 79.

division at various points in the early decades of the twentieth century, in the 1910s and 1940s, as compared to other urban centers in Bengal, gives us a picture that is at once both inadequate and disproportionate. At the end of a long era of cholera and other epidemic disease outbreaks starting from early in the nineteenth century, the 1911 all-India census shows that the Dhaka division in eastern Bengal was the most populous in Bengal. The population of the Dhaka division, comprising of Dacca, Mymensingh, Faridpur, and Bakarganj in the 1911 census were 12,037,649 persons. The increase in population in this region of eastern Bengal had been robust, growing at a rate of 11.4 percent from 1901-11, and 9.6 percent from 1891-1901.[168] However, the number of hospitals and charitable dispensaries for such a large population in the Dhaka district in 1914 was just 18, while in the whole of the Dhaka division comprising of the four districts, it was 95. The hospitals in the Dhaka district in 1914 consisted of the Mitford hospital (141 beds for males, 28 beds for females) and the small Lady Dufferin hospital (4 beds for females) in Dhaka, and the Victoria hospital in Narayanganj (26 beds for males, six beds for females), while there were only two more hospitals in the entire division, in Mymensingh and Bakarganj, both having below 50 beds.

In contrast, the Presidency division in western Bengal, where Calcutta was situated, had a much lower population, but a much better health infrastructure. The Presidency population had a population of 9,145,321 persons; its growth had been 5.1 percent from 1901-11, and 5.4 percent from 1891-1901.[169] Nevertheless, in the year 1914 in the city of Calcutta alone, there were ten large hospitals, with a combined capacity of 1148 beds for males and 741 beds for females.[170]

The situation in the 1940s was not much different, although the number of dispensaries in the Dhaka Division had increased significantly. According to the report on Hospitals and Dispensaries in Bengal, there were a total of 290 medical institutions in the Dhaka division for the year 1939. The increase was mainly due to the proliferation of dispensaries in the districts of the Dhaka Division. In the Dhaka district, the leading institutions remained the Mitford Hospital in Dhaka, and the Victoria Hospital in Narayanganj, while the total number of beds for in-patients throughout the district was 236 for males and 109 for females. In the relatively

[168] E.A. Gait, "Census of India, 1911, Volume I, Part II - Tables" (Superintendent Government Printing, Calcutta, 1913), 396, Internet Archive, https://archive.org/details/in.ernet.dli.2015.196121/page/n5/mode/2up/search/dacca.

[169] Gait, 394.

[170] Edwards, "Report on the Working of Hospitals and Dispensaries under the Government of Bengal for the Year 1914,"iv-v.

malarious Mymensingh district, the largest hospital was the Mymensingh Surjakanta Hospital (including the Bidyamayee Female Hospital), with 89 beds for male and 43 beds for female in-patients. The largest hospital in the district of Faridpur was the Faridpur Sadar Hospital (34 male, 11 female in-patient beds), while that in Bakarganj district was the Barisal Sadar Hospital (76 male, 51 female in-patient beds).[171] The total population of the Dhaka division, according to the 1931 all-India census was 13,864,104 persons, which was a growth rate of 8.17 percent in the period from 1921-31. The Presidency division, with Calcutta at its centre, had a population of 10,108,229 persons in 1931 and a growth rate of 7 percent in the period from 1921-31. [172] In contrast to urban centers of the Dhaka division, the 37 medical institutions in the city of Calcutta alone had a combined capacity of 1,999 beds for male in-patients and 1,521 beds for female in-patients in the year 1939.[173]

This discrepancy in the medical health infrastructure between the western and eastern regions of Bengal gives us an idea of both the inadequacy and disproportionately weaker nature of the colonial response to epidemic disease in eastern Bengal, especially in the Dhaka division. Moreover, it was clear that the logic of infrastructural development in terms of health and medical institutions followed the logic of the concentration of European population, the larger the European colonial presence in an area, the more the focus on infrastructure and development, irrespective of either the needs or presence of native populations. As seen in this section, this manner of infrastructural development was very true in the case of Calcutta, both as a seat of colonial power and for housing a significant European population; in contrast, urban centers in eastern Bengal remained neglected mainly as the hinterland of Calcutta.

4.4.1. A note on issues of mismanagement in colonial anti-malarial activities

Among the more well-known measures by the colonial government in combating the scourge of malaria in Bengal at the turn of the century was a series of state-sponsored measures to sell the anti-malarial drug quinine at a reduced price to the general public. According to Bentley,

[171] P.S. Mills, "Annual Report on the Working of the Hospitals and Dispensaries in Bengal for the Year 1939" (Bengal Government Press, Alipore, Bengal, 1941), 40–51, Internet Archive, https://archive.org/details/b31831680/mode/2up.

[172] A.E. Porter, "Census of India, 1931, Volume V, Bengal & Sikkim Part II - Tables" (Usha Publications, 1931), 4–5, Internet Archive, https://ia801601.us.archive.org/35/items/in.ernet.dli.2015.500806/2015.500806.Census-Of.pdf.

[173] Mills, "Annual Report on the Working of the Hospitals and Dispensaries in Bengal for the Year 1939," 20–21.

these measures began with the sale of government quinine, a 5-grain powder packet at the price of a *pice* (paisa) to the general public through post-offices in 1892. By 1904, it was pointed out that the 5-grain dose packet of quinine was inadequate for malaria treatment, and the dose was increased to 7 grains; in 1909, the dose was increased to 10 grains of powdered quinine. Bentley notes that the prices were eventually increased, and was doubled in 1918, because there was a large amount of profiteering going on due to the high price of quinine in the open market. The government then introduced measures to reduce the amount that a single person could purchase to prevent fraudulent purchases of large amounts of quinine, which the author notes was repackaged and sold by unscrupulous persons at enhanced profits. Bentley revealed the inadequacy and inefficiency of the government quinine system in place when he noted from sales figures in 1919-20 that not only was the amount of quinine sold too small to be effective in eradicating malaria in the general populace, but the highest amount of quinine consumption unusually appeared to be in less malarious districts in eastern Bengal such as Bakarganj and Tippera, indicating that it was probably purchased by unscrupulous persons to resell and profit from the drug.[174]

Bentley, through his description of the anti-malaria measures of the government, noted the inadequacy of simply resorting to sale of quinine or supplying mosquito nets, and advocates for more effective and ambitious measures of amelioration of malaria by enhancing the drainage of the deltaic tracts through irrigation measures such as bonification.[175] Iqbal reported that despite reports by government officials linking the incidence of malaria and vector mosquito populations with ecology, the colonial government in a 1910 resolution related to Eastern Bengal and Assam, prioritized prophylaxis and quinine treatment instead of choosing a more long term solution such as anti-larval operations for the extermination of mosquitoes. The then Lieutenant-Governor, Lancelot Hare, did not 'intent to do more than was necessary,' and chose to sell quinine to the masses at a reduced rate to fight malarial fevers. Although the quantity sold was quite large in number, three million doses in East Bengal and four million in Assam, Iqbal noted that it was inadequate considering that East Bengal was a highly populous province, and that small doses of quinine often proved ineffective for malarial treatment, which usually required continuous and regular quinine treatment.[176]

[174] Bentley, *Malaria and Agriculture in Bengal: How to Reduce Malaria in Bengal by Irrigation*, 89–92.

[175] Bentley, 83–84.

[176] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 178. Several additional questions could also be asked at this point to get a clearer understanding of government attitudes – was the

4.5. Conclusion

This chapter followed up with the notion discussed in the previous chapter, that of the eastern part of Bengal Delta as a 'zone of anomaly' within the larger narrative of development and administration in Bengal, and the implications of this notion of anomaly for the study of epidemics and colonial health response in eastern Bengal. A detailed discussion on the colonial health infrastructure that was propped up to fight epidemic disease, starting from health institutions in Dhaka before 1858, to the Mitford Hospital and developments surrounding it after its establishment in 1858 was conducted to qualitatively and quantitatively understand the nature of the colonial response to epidemic disease in the region. In the final section of this chapter, the inadequate nature of medical infrastructure in the region was focused upon, alongside instances of mismanagement in colonial efforts to combat epidemic disease, all of which support the thesis of weak colonial government response.

The discussion in this chapter follows from perceptions of colonial authorities of the eastern Bengal region as being administratively and politically less important than colonial centres of western Bengal, and the ground realities resulting from such perceptions. Despite higher local populations, colonial health institutions in eastern Bengal were inadequately distributed. An important observation in this regard was that societal elites were often at the forefront of establishing much needed health instituions. These actions, as noted, should not be simply seen as acts of philanthropy, but need to be studied within larger societal frameworks which depended on exploitation of a large part of the general populace as cheap sources of labour, and needed local collaborator "elites" to maintain the balance in favour of the colonial administrators. While such observations were not central points of study in this thesis, a deep study of the relationship of societal elites with the colonial administration, and manifestations of this relationship in public and philanthropic works is required to truly understand the nature of colonial health institutions and whom they actually benefited.

colonial administration seeking to profit from sale of essential medicines? Were there any specific interest groups, whether in Britian or in India itself, standing to benefit from the sale of such essential medicine to the general populace? These could help in throwing light on economic pressures, if any, on the colonial administration in execution of public health measures, instead of committing towards investment in longer term measures such as enhancement of river drainage systems.

CHAPTER V

DEVELOPMENT POLICIES AND LOSS OF ECOLOGY IN THE BENGAL DELTA: FAMINE AND EPIDEMIC DISEASE IN EASTERN BENGAL

In the first chapter, while contemplating the notion of the Bengal Delta as an ecological framework, it was discussed how the dynamic nature of the Bengal Delta could be attributed to a complex web of interrelated natural processes. This dynamic nature of the Bengal Delta and delta formation processes is crucial for the current study in order to explore the Bengal Delta as an ecological framework for contextualizing and understanding the history of epidemic disease in the eastern Bengal Delta region.

5.1. Contextualizing ecology, epidemic disease and health in the Bengal Delta

Historical accounts on events in the Bengal Delta give us an idea regarding the impact of ecology on both epidemic disease and health. Richard Eaton, in his *The Rise of Islam and the Bengal Frontier* noted that the gradual eastwards avulsion of the Ganges River through the sixteenth and seventeenth centuries caused the Bhagirathy-Hooghly channel, which served as the main course of the Ganges River, to become the distributaries with reduced water flow. This caused the western part of the Bengal Delta to become a moribund delta, and the cities on the banks of the distributaries to "languish or decay" as diseases associated with stagnant waters took hold of local communities.[177] This was associated with reduced navigation of the rivers in this section of the Delta since Eaton noted that "in 1567 the Venetian traveler Cesare Federici observed that ships were unable to sail north of Satgaon on the old Ganges—that is, today's Bhagirathi-Hooghly in West Bengal."[178] The author also gave early instances of disease events related to this process of river shifting. Quoting from the Akbar's court official

[177] Eaton, *The Rise of Islam and the Bengal Frontier, 1204-1760*, 195.
[178] Eaton, 198.

Abu'l Fazl, Eaton noted that the decision by Mughal general Mun'im Khan to shift the Mughal capital in Bengal from Tanda in the eastern part of the Delta to the ancient city of Gaur in 1565 proved catastrophic since a devastating plague in 1575 led to the death of thousands of civilians and soldiers of the Mughal army at Gaur. According to the author, this was probably because Gaur was situated in the moribund western part of the Bengal Delta, where the waters of the distributaries were stagnant and brackish, and the urban centers were susceptible to the easy spread of communicable disease.[179]

In earlier sections, it was seen how Eaton pinpointed the eastwards avulsion of the Ganges River as the reason behind the formation of moribund delta in western Bengal and active delta in eastern Bengal. Eaton also noted that the moribund delta in western Bengal was associated with reduced soil fertility and a higher incidence of epidemic disease. In his study on the high incidence of malaria in the western section of the Bengal Delta, and its relation to the riverine ecology of the Bengal Delta, C. A. Bentley made a special note of the healthiness of the population in eastern regions of the Bengal Delta. His study of the health of residing populations was based on several related parameters – the fertility of the soil, the agricultural prosperity, and the population growth of the region. Put simply, Bentley made a direct connection between agricultural conditions and health – the fertility of the land in eastern Bengal ensured adequate food availability for the population and ensured lower incidence of epidemic disease; in western Bengal, the reduced fertility of the land was associated with agricultural deterioration and a higher incidence of epidemic disease such as malaria.[180]

The reason behind this can be seen in the further avulsion of the Ganges River to the east in the eighteenth and nineteenth centuries, which was responsible for reduced fertility of regions in the western part of the delta due to reduced sedimentation and higher salinity in the tide-dominated coastal section. In the western part of the Delta, this was associated with reduced crop yields (often leading to scarcity and famine) and a higher incidence of epidemic diseases such as malaria. On the other hand, a higher flow of water and sediment into the eastern portion of the Bengal Delta, such as the Dhaka district, meant that the land was much more fertile,[181] and the people were healthier from a lower incidence of disease. An indication of this can be seen in terms of both higher birth rates and an increase in population. Bentley

[179] Eaton, 144.
[180] Bentley, *Malaria and Agriculture in Bengal: How to Reduce Malaria in Bengal by Irrigation*, 4–20.
[181] Bentley, 10–12. Bentley in the year 1925 notes that the soil in eastern Bengal was so much more fertile due to the yearly silt deposits from the Ganges River as compared to the other regions in Bengal that there was no concept of fallow land and that crop rotation did not need to be practiced.

observed that population growth in Western and Central Bengal was very low due to diminished birth rates and excessive mortality from a high incidence of diseases such as malaria.

Meanwhile, in eastern regions of Bengal, the birth rates were found to be higher, and the mortality rate was found to be lower than the other regions of Bengal. The disparity in terms of the healthiness of the population of the two regions can be understood from population growth statistics in Bentley's works – while the population increase in western Bengal from 1901-11 was just 2.8 percent, in eastern Bengal, it was 12 percent in the same period.[182] Coincidentally, Bentley also showed that malaria was five times prevalent in western Bengal than in eastern Bengal.[183] In summing up, Bentley, in order to make a case for his ideas on the necessity of selected irrigation in Bengal, goes on to show that regions such as eastern Bengal with higher fertility sustained healthier populations, while regions such as western Bengal showing agricultural deterioration had unhealthy populations and high incidence of disease.

Table 5.1.: A comparative summary of general observations on ecology and health in the western and eastern regions of the Bengal Delta from Eaton (1993) and Bentley (1925).

Categories (Ecology and Health)	**Western Bengal Delta (Calcutta, Burdwan, 24 Parganas, etc.)**	**Eastern Bengal Delta (Dhaka District, Chittagong)**
Type of Delta	Moribund Delta	Active Delta
Fertility of land	Low inundation and Less fertility	High inundation and Higher Fertility
Water regime	Less water flow; high salinity in the coastal region	High water flow; hypo saline environment throughout
Epidemic Malaria	High Incidence	Lower incidence
Epidemic Cholera	High Incidence (comparatively lesser than in eastern region)	High incidence; hyperendemic to region
Population growth	The lower growth rate of the population	The higher growth rate of the population

[182] Bentley, 4–6.
[183] Bentley, 6–7.

Keeping the above ecological-historical context in mind, several questions need to be addressed at this point. If the population of eastern Bengal was so much healthier, and the agricultural productivity so much higher than in the western region throughout the major part of the nineteenth century, why there was the rising incidence of malaria and high incidence and hyperendemic nature of epidemic cholera in eastern Bengal starting from the latter end of the nineteenth century? Furthermore, what led to large scale famine and scarcity in the land of the plenty in just less than two decades within Bentley's glowing remarks on eastern Bengal? The Great Bengal Famine of 1943 greatly impacted the lives of the people of eastern Bengal, claiming about three million lives. The high mortality often resulted from a combination of severe malnourishment and the scourge of epidemic disease. The upcoming sections will seek to answer these questions by exploring how development-oriented human-induced changes in the Bengal Delta led to a generally adverse impact on epidemic disease and the health of the populace in the region.

5.2. Human-induced changes in Bengal Delta and the loss of ecology

The main anthropogenic activities leading to the loss of ecology in the Bengal Delta in the late nineteenth and early twentieth century were the railroads, the irrigation channels, and the building of large scale bridges and embankments along the river banks. While the general nature of debates surrounding such developments focus on who were the benefactors, whether it was done to further the interests of empire, or for the prosperity of the livelihoods of the people of the region, or both, discussions on the ecological impact of such developments often take the backseat. A question arising at this point would be – why was the assessment of ecological impact always in the backseat? Weren't colonial authorities able to heed to the advice of high-end administration officials such as C. A. Bentley, who wrote extensively on the impact of colonial policies on the rivers of the Bengal Delta? Why did Indian nationalist leaders continue this pattern of ecologically adverse development even after independence from the colonial state, despite claiming to have the best interests of the people of the region at heart? While these questions may require lengthy treatments of their own, one could seek a plausible reason for such ecologically adverse attitudes in how science and economy were ultimately employed as tools of modernization by the colonial state, and how Indian nationalist leaders perceived these tools. Prakash argues that throughout the colonial period, India, as a geographical entity, had become organised as a space constituted by technics – i.e. the colonial

state itself, was forged as a configuration of technical routines, knowledge, practices, and instruments. India and Indians became resources in the state's central role in establishing the network of railroads, irrigation, industries, and scientific and technical agencies of administration.[184] While nationalists argued that colonial power had impoverished this space, they did not fundamentally challenge the relationship of the technological order and the state – the struggle for independence became a struggle for appropriating this space for their slice of the pie of modernity. Thus science as a means for appropriating nature (as a resource) for the sake of development, progress, and modernization became central to the existence of the state, even as it transitioned into the hands of nationalists who claimed to represent the interests of the people they were to govern. Prakash further explained,

> Introduced as a code of alien power and domesticated as an element of elite nationalism, science has always been asked to accomplish a great deal-to authorize an enormous leap into modernity, and anchor the entire edifice of modem culture, identity, politics, and economy. The very existence of India appears crucially dependent upon the stability of the apparatuses and practices it designates as rational-law, civil society, the nation-state, democratic institutions, capitalist economy, modern medicine, and scientific and technological projects to control and exploit human and nonhuman resources. The intelligibility of the dominant political discourses rests upon this architecture of Indian modernity; anything outside and beyond it is an unthinkable regression into the abyss of backwardness, anarchy, and loss of identity.[185]

From the above, it becomes clear as to why the obsession with science as development and development-related policies remained entrenched in colonial attitudes towards administration, and why this obsession with development and development policies continued in the hands of nationalists, despite the adverse ecological implications such as loss of ecology and destruction of nature that occurred in the meantime. The above also clarifies that large scale human-induced changes such as railroads and irrigation channels were bound to lead to loss of ecology and were built regardless of their ecological impact, and as shall be seen below, historical evidence pertaining to the period supports this contention. Furthermore, these development activities were intimately connected with a gradual buildup of a high incidence of epidemic disease in formerly healthy regions of the delta and the creation of conditions of scarcity in former regions of plenty, such as in eastern Bengal.

[184] Gyan Prakash, *Another Reason: Science and the Imagination of Modern India* (Princeton, N.J: Princeton University Press, 1999), 11.

[185] Prakash, 12.

5.2.1. Railroads and embankments towards the loss of ecology in Bengal Delta

As alluded to in the first chapter, the framework of 'colonial hydrology' as articulated by D'Souza provides guidelines through which one can identify the varied hydraulic interventions by the colonial administrative apparatus to alter both land and fluvial regimes.[186] From an environmental perspective, this led to the alteration of the drainage network of the Bengal Delta. The foremost of these were the perennial irrigation canals, which replaced earlier seasonal or inundation canals and involved the construction of barrages and weirs on the river beds. The flood control river embankments built throughout the nineteenth and early twentieth centuries were intended to prevent rivers from spilling over from their main channels or courses during flooding season. Together with railroads and bridges, these colonial constructions served as hydraulic interventions, which served to adversely affect and alter the drainage network of the Bengal Delta. Moreover, D'Souza noted that in regions such as Bengal, where most of the natural drainage systems were north to south, the colonial hydraulic interventions such as railroads were most constructed across these drainage channels, running from east to west (figure 5.1). It not only caused congestions of these natural drainage systems but also led to the aggravation of epidemic diseases such as malaria.[187]

Scholarly work on railroads in British India has long being the remit of economic history, whereby earlier historians often sought to enrich understanding on how railways shaped the Indian economy. The focus then gradually shifted onto railway construction labour and the impacts of managerial aspects of the railway labour force in colonial India, as seen in the work of Ian Kerr. It is only recently that serious scholarship has begun to emerge in colonial historiography on the role of colonial Indian railways as a 'social, cultural and ideological tool of imperial power.'[188] A criticism from the point of the present study is that there is a dearth of studies on the railroads in British India as part of environmental history, especially looking at the fact that railroads were hailed as indispensable markers of material scientific progress and economic development, and thus had a deep impact on ecology. Although environmental history works documenting the appropriation and destruction of forest resources to make way for railroads in British India exist, they are more about forestry than railways, and usually stem

[186] D'Souza, "Water in British India," 625.
[187] D'Souza, 625.
[188] Aparajita Mukhopadhyay, "Review of' Tracks of Change: Railways and Everyday Life in Colonial India'," *Reviews in History*, 2017, https://doi.org/10.14296/RiH/2014/2049.

from environmentalist concerns.[189] For the purposes of this study, relatively newer scholarship by Iqbal will be examined, since firstly it goes beyond earlier environmental history scholarship on forestry, looking at the impact of railways on delta ecology, and secondly, the author's study is based on the Bengal Delta, which is also the area of study of this thesis.

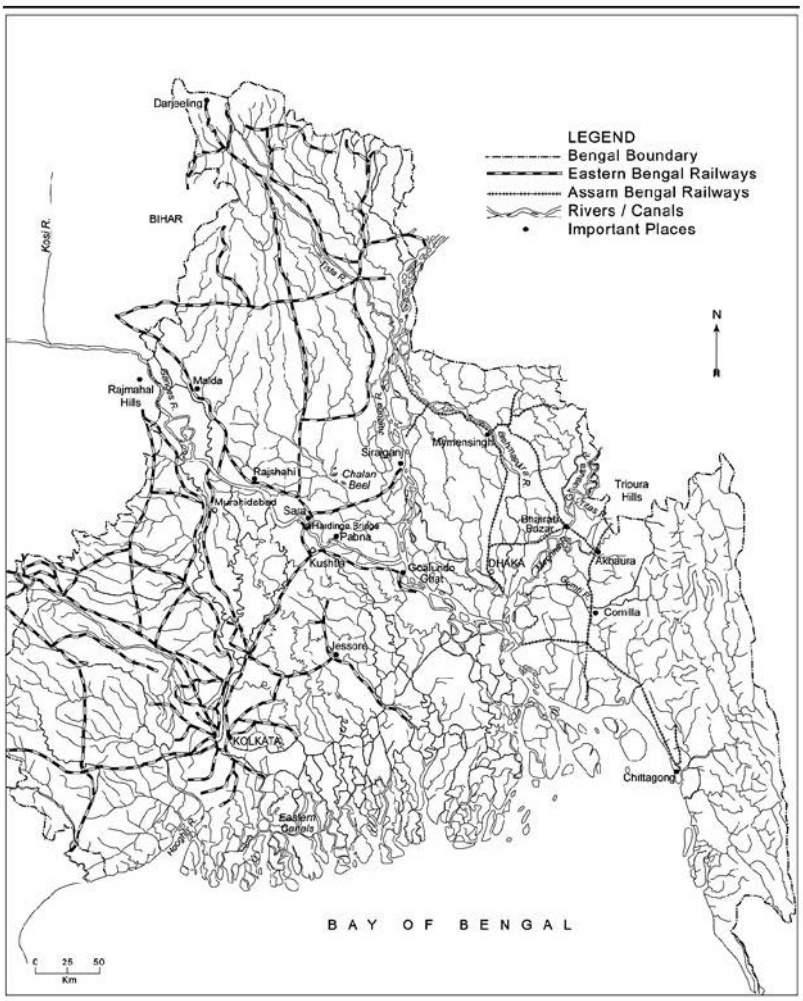

Figure 5.1.: Map displaying west to east running railway tracks as opposed to north to south flowing waterways in the Bengal Delta, 1938–39, Source: Iqbal, "The Railways and the Water Regime," 123.

Iqbal's detailed study into the railways and the water regime of eastern Bengal focuses on two key questions – how did the building of railways exclude environmental considerations,

[189] See discussion on railways and forestry in colonial period in Ramachandra Guha, "Forestry in British and Post-British India: A Historical Analysis," *Economic and Political Weekly* 18, no. 44 (1983): 1882–96; Ramachandra Guha and Madhav Gadgil, "State Forestry and Social Conflict in British India," *Past & Present*, no. 123 (1989): 141–77.

and how did the construction of railways lead to loss of ecology in the Bengal Delta.[190] Forgoing notions that the railways should have a complementary somewhat confrontational relationship with the deltaic water regime, the first railway line connecting the western part of the Bengal Delta with its eastern part was built at the heart of the fluvial deltaic landscape in 1862, extending from Kolkata to the lower Ganga bank in Kushtia. It later became known as the Eastern Bengal Railway (EBR). By 1879, the Northern Bengal State Railway was constructed covering the northern region of the Delta, and the EBR was acquired by the colonial state and merged with the Northern Bengal State Railways in 1887, and the new line also came to be known as the EBR. The entire EBR was situated on the west bank of the Brahmaputra River, except for the line that connected the EBR to Dhaka and Narayanganj. Another line, the Bengal-Assam Railway (ABR), was opened to the left bank of the Ganga and traversed both banks of the Brahmaputra, and aimed to connect the tea estates in Assam with the port of Chittagong. The ABR was acquired by the state and merged with the EBR in 1942 to form the Bengal and Assam Railway. To give an idea of the railway construction activity, it can be noted that the expansion of the railways in Bengal by area in 1933 in British India was the second-highest in terms of the province and was only rivaled by that of the United Provinces.[191]

Even though conditions in the Bengal Delta were much more favorable for waterways communications such as the Eastern Canals, and the cargo movement through waterways was very high; Iqbal notes that repeated concessions and huge investments were accorded to the EBR by the colonial administration.[192] The huge investments and concessions for the railway companies in the Bengal Delta, and unending support from the colonial administration meant that they were given a monopoly over their operations, and were free to spread over waterways and close any channels or courses in the name of 'public service,' whether these were 'non-navigable' or 'navigable.'[193] The results of this free reign given to colonial capitalistic interests were visible in the fact that the engineers of the railway construction went about placing railways keeping financial considerations in mind, and without considering the ecological impact of their activities in the fluid landscape of the Bengal Delta. The fluidity of the deltaic region and the low lying nature of the land meant that the whole of the railway set in eastern

[190] Iftekhar Iqbal, "The Railways and the Water Regime," in *The Bengal Delta: Ecology, State and Social Change, 1840–1943*, ed. Iftekhar Iqbal, Cambridge Imperial and Post-Colonial Studies Series (London: Palgrave Macmillan UK, 2010), 118, https://doi.org/10.1057/9780230289819_6.

[191] Iqbal, 121.

[192] Iqbal, 124.

[193] Iqbal, 126.

Bengal was built on river embankments,[194] which obstructed water flow and drainage, and resulted in bodies of stagnant water and the killing of numerous streams, an observation collaborated by other scholars such as D'Souza.[195] The net result was an increased risk of extreme flooding and the decline of the fertility of the land due to obstruction of the yearly inundations. Bentley, in 1925, strived hard to portray how the railroads had adversely affected the fertility of sections of the Bengal. Pointing out the direct relationship between high density of railroads in western and central Bengal, and the high proportion of fallow lands in these areas, Bentley opined that since fallow land may be taken as an index of soil impoverishment, there is a direct relationship between high density of railroad embankments and reduction of soil fertility and reduced crop yield.[196] Furthermore, Iqbal showed the extent of apathy of the railway officials towards any ecological concerns when he notes that railway engineers were quite miserly in terms of setting up culverts of appropriate depth to allow for seepage of water run-off, and often made shallow culverts which were too far apart to allow for proper drainage or seepage due to the fear that deep pits would endanger the railway lines. In this regard, Iqbal gave examples where railway authorities resisted appeals by locals to cut embankments to drain away stagnant water, due to the former's insistence that locals did not possess the requisite 'modern' knowledge.[197]

Although the Eastern Bengal Railway (EBR) was first laid down in 1862 across the Ganga watersheds, there were almost no outlets for the passing of the river waters through its embankments at the time of its construction. Although regular flooding forced officials to lay down later 'openings' between 1868 and 1885 and later after the floods of 1890, the EBR significantly contributed to the deterioration of the water regime of northern Bengal through its impact on the Chalan Beel, a watershed of about 1547 sq. miles in the districts of Rajshahi and Pabna, and where drainage from 47 rivers of northern Bengal converged. Iqbal notes that the Chalan Beel, acting as the convergence of waterways from the north and north-west, and a springboard for waterways exiting it towards the east and south-east, was responsible for a water regime, which he claims reserved and cleared the drainage of almost half of the Bengal delta.[198] The embankments of the Bogra-Santahar branch line and EBR main line intersected

[194] Iqbal, 127.

[195] D'Souza, "Water in British India," 625.

[196] Bentley, *Malaria and Agriculture in Bengal: How to Reduce Malaria in Bengal by Irrigation*, 33–34.

[197] Iqbal, "The Railways and the Water Regime," 128–29.

[198] The claim that the Chalan Beel cleared the drainage of almost half of the Bengal Delta is a very general one, and Iqbal does not substantiate this claim in empirical terms, but refers to a certain *Report on the Hydraulic Condition of the Area Affected by the North Bengal Floods* (published in 1927). However, the

and restricted water inflow coming in from the north and south-western directions, while the embankments of the Sara-Sirajganj line of the EBR served as an obstacle for the water outflow towards the Brahmaputra River in the south-eastern direction, creating severe drainage problems. The results of these obstructions and inadequate means for seepage and drainage were disastrous – apart from the frequent flooding, which destroyed aman (autumn) paddy and prevented cultivators from sowing rabi (winter) crops, the embankments prevented flush water from the Chalan Beel to drain into the Brahmaputra River, resulting in speedy siltation of the Chalan Beel and reduction of its water retention capacity.[199] Iqbal also discussed at length the adverse environmental effects of the Hardinge Bridge project over the Ganges constructed in 1910-1912, meant to connect two sides of the EBR on the Sara-Sirajganj line. He noted that the engineering works to prop up the Hardinge caused the Ganges River to increase soil erosion upstream, affecting crop output in areas as far upstream as Murshidabad. Moreover, the piers of the bridge led to deposition, silting up and inundations of fields in large areas around the bridge.[200] The deleterious impact of the Hardinge bridge on the riverine landscape was also mentioned by Majumdar, who noted in 1941 that there was large scale siltation in the bridge premises, to the extent that there was a danger of an avulsion of the Ganges.[201]

The Assam Bengal Railway (ABR) covered the eastern half of the Bengal Delta, i.e., the active part of the delta, spanning the area covered by the Brahmaputra River, and the joint flow of the Meghna and the Padma (Ganges). Iqbal noted that the ABR entered the delta plain through Mymensingh, and continued towards Chittagong, passing through Dhaka, Comilla and Noakhali districts. Although the region did not have major *beels* like the Chalan Beel, the embankments of the ABR railway line were responsible for obstructing the right bank spill of the Meghna River into its effluent river, the Ghorautra River, and the smaller *beels* with run-offs from the west side of the Garo hills that fed this river. This caused the spread of the spillover a vast area in the Mymensingh region, often in the form of frequent untimely floods, which severely damaged standing crops in the Tangail region. In the Comilla region, the embankments of the ABR were devastating for the region since they obstructed large scale run-off from the Tripura Hills into the Titas and Gumti rivers. The devastating scale can be gauged

ecological deterioration of the Chalan Beel is documented in early sources such as in R.C. Majumder, *Rivers of the Bengal Delta* (Calcutta: University of Calcutta, 1942), 29–31. The Chalan Beel is also subject to intense studies in ecology today, such as condition of flora, fauna and birdlife, giving one a sene of its ecological importance to the northern Bengal region.

[199] Iqbal, "The Railways and the Water Regime," 130–32.

[200] Iqbal, 134–37.

[201] Majumder, *Rivers of the Bengal Delta*, 43–44.

from the fact that this region is the recipient of the highest rainfall amount in the world, and is inundated with numerous surface water sources from surrounding highlands, already exacerbating pre-existing risks towards waterlogging and devastation of paddy crops. The situation was similar in Chittagong and Noakhali since the narrowness of the railway bridges obstructed drainage and resulted in frequent flooding. [202]

5.2.2. The proliferation of water hyacinth in water bodies of Bengal Delta

In light of the adverse impact of the railway embankments upon the drainage capacity the Bengal Delta and the flow of the deltaic rivers, the introduction of the water hyacinth in the early twentieth century into the waterways of the Bengal Delta exacerbated decay of the river systems by posing an imminent threat to the vitality of the delta and its fertility for agriculture. Early scholars such as Panandikar noted that the water hyacinth began to be considered as a pest in Bengal in 1914.[203] On the other hand, Iqbal noted that although there are debates as to who or how the plant was introduced, by the 1920s the weed was considered as a menace by both the government and non-government agencies due its impeding of water trade, agricultural operations and health of the people in the region. Although various inititatives were taken by municipal authorities in Bakarganj and the Collectorate of Dhaka in the 1920's for the eradication of the pest plant, including using labourers to collect the plants, dry and then bury or burn them, the measures saw little success. Moreover, Panandikar notes that measures to economically utilize the plant as fodder or a source of potassium salts failed as well.[204] Iqbal estimates that by the 1940's the water weed-covered about one-ninth of the total deltaic area, and notes that it was most prevalent in the active part of the Bengal Delta, i.e., the eastern part of the Bengal Delta including the districts of Dhaka, Mymensingh, and Comilla.[205]

The problem with water hyacinth was complicated due to the problems created by the railway embankments in the drainage of the Bengal Delta. The reduced water flow and the increased siltation in the streams, rivers and *beels* as a result of the insufficient drainage and

[202] Iqbal, "The Railways and the Water Regime," 132–34.

[203] S.G. Panandikar, *The Wealth and Welfare of the Bengal Delta: Comprising the Districts of Mymensingh, Dacca, Bogra, Pabna, Faridpur, Bakarganj, Tippera and Noakhali* (Calcutta: Calcutta University Press, 1926), 30.

[204] Panandikar, 298–300.

[205] Iftekhar Iqbal, "Fighting with a Weed: The Water Hyacinth, the State and the Public Square," in *The Bengal Delta: Ecology, State and Social Change, 1840–1943*, ed. Iftekhar Iqbal, Cambridge Imperial and Post-Colonial Studies Series (London: Palgrave Macmillan UK, 2010), 141, https://doi.org/10.1057/9780230289819_6.

reduced water flow served as ideal conditions for the growth of the water hyacinth, alongside the tropical climate conditions of the region. The most significant environmental impact of the water hyacinths was the absorption of nutrients in the water bodies, which had the dual impact of leading to the depletion of the natural fish stocks in the *beels*, and aiding in the proliferation of vectors and pathogens of deadly diseases such as cholera and malaria in these water bodies.[206] The absorption of nutrients also hampered the fertility of the land, since it was particularly destructive to the paddy crops essential for the livelihoods of the peasants.[207]

5.3. Loss of ecology and high incidence of epidemic disease in the Bengal Delta

The high incidence of malaria in the western regions of the Bengal Delta in the latter part of nineteenth-century and early twentieth century could be attributed to the introduction of the railways and the embankments. Many commissions and committees were made in the late nineteenth century and the early decades of the twentieth century to find out the causes of malaria in the Bengal Delta. However, they usually went about dismissing environmental concerns arising from development-oriented policies such as railroads and embankments and often placed their faith on the development of medical interventions such as drugs or vaccines. Some, however, made strong connections between the loss of ecology and the high incidence of malaria in western Bengal. A Drainage Committee was formed in 1906 to enquire into the drainage condition of the Presidency Division, where Calcutta, the capital of the province was situated, and suggest remedies. The report investigated drainage conditions of the districts of Jessore and Nadia in the western part of the delta and Murshidabad in the northern part of the delta, concluded that the obstruction of the drainage, which led to problems in waterlogging and increase in facilities for the breeding of mosquitoes, was the cause behind malaria, and suggested measures to improve drainage of the mentioned regions.[208]

C. A. Bentley's report on malaria and agriculture was the first report of its kind to strongly highlight the impact of the railroads and railway embankments on public health,

[206] Scientific evidence on the relationship between spread of diseases such as cholera and water hyacinth can be found in various studies, including W. M. Spira et al., "Uptake of Vibrio Cholerae Biotype Eltor from Contaminated Water by Water Hyacinth (Eichornia Crassipes)," *Applied and Environmental Microbiology* 42, no. 3 (September 1981): 550–53; Mohammad Sirajul Islam, Bohumil S Drasar, and R Bradley Sack, "The Aquatic Flora and Fauna as Reservoirs of Vibrio Cholerae: A Review," *Journal of Diarrhoeal Diseases Research* 12, no. 2 (1994): 87–96.

[207] Iqbal, "Fighting with a Weed: The Water Hyacinth, the State and the Public Square," 143–47.

[208] *Report of the Drainage Committee of Bengal (Presidency Division)* (Calcutta: The Bengal Secretariat Press, 1907), 40, https://archive.org/details/b21356634.

showing that the construction of railroads and embankments was often connected with outbreaks of fever near construction. He mentioned the yearly sanitary reports reporting incidences of disease in this regard. The 1878 Sanitary Commissioner's Report showed the prevalence of an epidemic during the construction of Jessore and Faridpur roads in lower Bengal, the 1884 Sanitary Report mentions the malaria epidemic which broke out when the railway was being constructed between Dhaka and Mymensingh, while the 1907 Sanitary Report blames the fever outbreak in Murshidabad the railway authorities building railway embankments without placing means of draining the pits and hollows at the side of the embankments. Speaking of events in his time in the 1920s, Bentley noted a spike in fever index in Mymensingh due to the railway construction of the Sara-Sirajganj line of the EBR.[209] The relation between communications development, loss of ecology, and exacerbation and renewed distribution of epidemic diseases such as malaria can be understood from the various maps in Bentley's 1925 work on the relationship between malaria and agriculture. The areas in the western part of the Bengal delta, which were subject to more urbanization and communication infrastructure such as railways and roads, are the areas where the incidence of malaria was found to be highest. On the other hand, areas in eastern Bengal Delta, where the introduction of the railways was relatively done later, and where the proportion of railroads was a little more than half of the other divisions as of 1925, had a significantly lower incidence of malaria (figure 5.2).

[209] Bentley, *Malaria and Agriculture in Bengal: How to Reduce Malaria in Bengal by Irrigation*, 34–37.

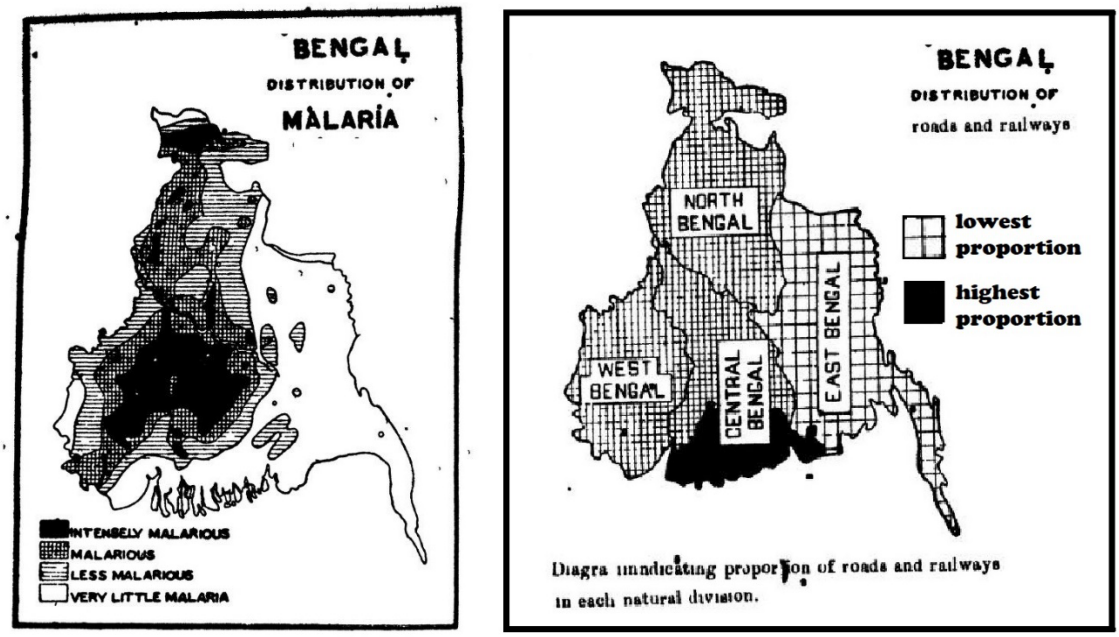

Figure 5.2: Direct relation of distribution of malaria to the distribution of roads and railways in Bengal as of 1925. Source: Bentley, *Malaria and Agriculture*, 1925.

Ira Klein, in building upon the ideas of Bentley, is an example of a modern scholar who has revived Bentley's ideas as to how ecological devastation caused by railroads and embankments has led to malaria epidemics.[210] He has also carried out studies on the high incidence of cholera and cholera related mortality in India, with a strong focus on Bengal and its deltaic landscape. The worsening of cholera epidemics in Bengal is strongly suggestive of the fact that changing ecology of the delta for the worse was behind the spread of cholera. Klein noted. However, that erstwhile colonial medical authorities commented on the various causes of the dissemination of cholera without taking into account this ecological change factoring. Thus while Koch attributed the spread to widening 'railway traffic,' A.C. Banerjea attributed it to the association of cholera with pilgrimages, fairs, and festivals. Still, others placed blame on grossly polluted irrigation channels.[211]

According to Klein, apart from modernization and environmental change, the main factors in cholera dissemination and proliferation in the latter part of the nineteenth century

[210] The detailed treatment of how development in colonial India exacerbated malarial epidemics can be seen in the following works by Ira Klein, namely Klein, "Malaria and Mortality in Bengal, 1840-1921"; Klein, "Development and Death."

[211] Klein, "Imperialism, Ecology and Disease," 496.

were the longevity of the cholera bacillus in water, and its synergism with malnutrition, and that fact that the disease could be carried by many immune and lightly affected carriers.[212] While development projects such as railways led to the decay of rivers in the delta from the latter part of the nineteenth century, the increase in the population density in the eastern part of the Bengal Delta had further implications in the spread and propagation of cholera. The development projects in Bengal, due to the obstruction of rivers, led to cholera becoming hyperendemic to the region. The higher population density in the eastern region at the turn of the century was the result of lingering conditions of the fertility of the delta as described by Bentley, and the slow rise of new urban centers throughout eastern Bengal. However, the apathy of the administration towards medical infrastructure and sanitation in the eastern region of Bengal (discussed in detail in the previous chapter) led to increased crowding and sub-soil pollution, creating extremely unhealthy water supplies.[213]

Klein noted that the deltaic nature of the region and the monsoon climate usually meant that the stagnant water bodies, in which filth and waste accumulated during the drier months, were washed over by inundation and fast-flowing river currents, leading to dispersing of the cholera pathogens from human and organic waste, and dead bodies away from the urban centers downstream. However, the silting up of rivers due to the railroads and embankments meant reduced capacities of the water systems in flushing away these stagnant water bodies and pathogen laden waste. Moreover, traditional practices of waste disposal and hygiene by the people, such as throwing household waste and dumping human waste into the rivers and ponds exacerbated conditions for a high incidence of cholera. This deteriorating dynamic led to the gradual formation of hyper-endemic conditions for cholera in the Bengal Delta, including in formerly healthy parts in the eastern region such as the Dhaka district.[214]

A related development discussed earlier was the proliferation and spread of the water hyacinth in the water bodies of the Bengal Delta. Apart from the deleterious impact of the water hyacinth on the navigability of rivers and adverse impact on crop production, the weed was considered to be responsible for the spread of water-borne disease such as cholera, and vector-borne diseases such as malaria. The water hyacinth, by absorbing nutrients from the water, was

[212] Klein, 497–99.

[213] Klein, 499–500. While apathy of the colonial administration meant that urban centres like Dhaka were often filthy and extremely unhygienic, growth of population in such a place meant that certain practices made cholera related conditions worse - people often defecated into open waterways due to lack of latrines, uncollected and piling up sewage seeped into water supplies, and more dead bodies were thrown into the river from urban centres such as Dhaka (for those practicing Hindu rites) than in less populated areas.

[214] Klein, 511–13.

responsible for the depletion of fish stocks, which favored the growth of malarial larvae on the water surface. Moreover, it enhanced conditions for the proliferation of the cholera pathogens as well. Moreover, the proliferation of water hyacinth also impeded water flow and caused the stagnation of water, which led to favorable conditions for the growth and spread of pathogens for more extended periods, and prevented them from being washed away by water currents.[215]

5.4. Loss of ecology, scarcity, and disease: Towards the Great Famine of 1943 in eastern Bengal

Earlier, it was discussed that there are two ways in which the loss of ecology in the Bengal Delta influenced the dynamics of epidemic disease. How the loss of ecology directly influenced the spread of epidemic diseases such as malaria and cholera have been explored. However, another way in which disease-affected populations in the early decades of the twentieth century was mainly through its association with the problem of nutrition and nourishment. It stemmed from a growing mismatch between food availability and food needs for a growing population. In this section, the ecological causes behind the large scale famine in 1943 will be explored, in which severe malnourishment alongside the scourge of epidemic disease was responsible for high mortality. However, one should be wary of challenges that present themselves in this regard – for example; it is difficult to empirically quantify deaths due to starvation and deaths due to epidemic diseases in a famine situation. Moreover, it is still not clear as to how famine mortality should be understood, whether as a function of a synergistic relationship between disease and malnutrition, or whether in terms of phases such as death due to immediate starvation, followed a protracted phase in which epidemic disease plays a part.[216] Klein's study on mortality in colonial India as a function of both epidemic diseases such as cholera and famine mortality allows him to make a synergistic connection between malnourishment and cholera, although this does not entail an epidemiological connection between cholera and malnutrition.[217] For the sake of this study, however, it is clear that this not a challenge since our focus in this section is not in challenging inherent assumptions regarding dynamics of famine mortality, but on understanding the role of epidemic disease as a subset of health, and how ecological changes adversely impacting diet, nutrition, and nourishment of the people in

[215] Iqbal, "Fighting with a Weed: The Water Hyacinth, the State and the Public Square," 145–46.
[216] Arnold, "Social Crisis and Epidemic Disease in the Famines of Nineteenth-Century India," 385–86.
[217] Klein, "Imperialism, Ecology and Disease," 497.

the region allowed hyper-endemic epidemic disease such as cholera and malaria to aggravate famine related mortality in eastern Bengal in the 1940s.

Bentley in 1925 mentioned that among the various regions of the Bengal Delta, eastern Bengal was the most fertile region since it was the active part of the delta, received yearly inundations which ensured the fertility of the land such that there was practically no fallow land in the region, and importantly was the least developed in terms of railroad communications which had adversely impacted ecology in the other regions of Bengal. Moreover, Bentley noted that the fertility of eastern Bengal was directly associated with food availability and health benefits, people in eastern Bengal had more food to eat, and suffered from less diseases, the impact of which was a much higher population growth rate as compared to the other regions of Bengal, such as the western regions of Nadia, Jessore and 24 Pargannahs, which suffered from malarial epidemics and very low population growths at the turn of the century. One of the prime concerns shown by Bentley in his work was in preserving the healthy and fertile conditions of eastern Bengal by preventing the extension of malaria into it since he believed that the ruin of eastern Bengal would entail the economic ruin of British India. This, he suggested, could be done by, among other steps, through the prohibition of further railroad embankments and the improvement of existing water channels.[218] However, as noted earlier from Iqbal's work on railways and the water regime in eastern Bengal, the suggestions of Bentley were not adopted by the colonial administration, and vested commercial interests of the empire were instead given precedence in an ecologically destructive manner of extension of the railroads and their embankments.

In connection with the observation of Bentley regarding the fertility of the eastern delta region, it is essential to note that while instances of famine and food shortage were regularly observed in western Bengal in the late nineteenth century, it was not observed in eastern Bengal before the beginning of the twentieth century. The reasons for this can be understood from various angles – firstly eastern Bengal Delta as a 'zone of anomaly' began to effectively end with the introduction of railroads throughout the latter part of the nineteenth century and the first decades of the twentieth century, secondly the ecological toll of the introduction of railroads, embankments and the proliferation of the water hyacinth from the 1920s choked the fluidity of the Bengal Delta and contributed to a decline in its fertility, thirdly, the cumulative toll of this agricultural decline through the period up to the 1940s was exacerbated by the rising

[218] Bentley, *Malaria and Agriculture in Bengal: How to Reduce Malaria in Bengal by Irrigation*, 65–67.

instance of epidemic malarial fever and cholera amongst the population of eastern Bengal, whether as a function of the loss of ecology or loss of health from starvation.

Iqbal noted several instances of crop failure and destruction as a result of the embankments throughout the 1920s to the 1940s. The Sara-Sirajganj line of the EBR was responsible for speedy silting up of the Chalan Beel and the reduction of its water retention capacity. This caused frequent flooding of the crop fields in the region, such that the aman (autumn) paddy in Rajshahi, the chief staple crop of the district, was regularly severely affected. Moreover, the flooding meant that the fields did not dry up in time for the farmers to plant the rabi (winter) crops. The ABR line had similar consequences in eastern Bengal, as Iqbal notes that untimely flooding often damaged both young paddy and jute in Mymensingh. For example, 35 percent of the standing crops in Tangail, Mymensingh were destroyed in the floods of 1931-32 due to heavy rainfall in the Assam hills. Waterlogging was a major problem for cultivation in Comilla in general and Brahmanbaria, in particular, starting from 1910, since it led to food shortages and failure of crops. Iqbal talks of similar failures in Noakhali and Chittagong throughout the 1920's decade.[219] The problem of water hyacinth compounded the impact on the health of the people in the region. Water hyacinth was destructive for *beel* paddy that was abundant in the delta, although its most significant impact was adversely impacting public nutrition through depleting the freshwater fish population in Bengal. Moreover, the health of cattle in Bengal was adversely impacted by the consumption of water hyacinth. Overall, water hyacinth was disastrous for the agricultural production in eastern Bengal, since it proliferated rapidly and often invaded and destroyed crop fields during the floods,[220] which often kept scientific minds busy in trying to find ways to get rid of the plant.[221]

The combined adverse ecological impact of railroads, embankments, and the water hyacinth led to a decrease in the agricultural productivity of eastern Bengal. Quoting several studies on the subject, Iqbal notes that from 1906 to 1937, the average yield of aman rice, which was the staple crop of the region, showed a steady decline. For the 11 districts in eastern Bengal, including Barisal, Dhaka, Chittagong, Faridpur, Jessore, Khulna, Mymensingh, Noakhali, Pabna, Rajshahi and Tippera (Tripura), the average yield in lbs per acre for aman rice was

[219] Iqbal, "The Railways and the Water Regime," 130–34.

[220] Iqbal, "Fighting with a Weed: The Water Hyacinth, the State and the Public Square," 146; Panandikar, *The Wealth and Welfare of the Bengal Delta: Comprising the Districts of Mymensingh, Dacca, Bogra, Pabna, Faridpur, Bakarganj, Tippera and Noakhali*, 30.

[221] K. Biswas, "Some Foreign Weeds and Their Distribution in India and Burma," *Current Science* 2, no. 11 (1934): 423; Panandikar, *The Wealth and Welfare of the Bengal Delta: Comprising the Districts of Mymensingh, Dacca, Bogra, Pabna, Faridpur, Bakarganj, Tippera and Noakhali*, 299.

12,762 lbs during 1906-07, 10,932 lbs in 1921-22 and 10,241 lbs in 1936-37.[222] For the general observer, this decline in yield could appear as a paradox, since Iqbal noted that according to official statistics, the amount of cultivable wasteland in the same 11 districts of eastern Bengal had increased from 1,556,576 acres in 1900-01 to 1,682,175 acres (excluding Faridpur) in 1935-36.[223] While attempts have been made to attribute this decline in agricultural yield despite an increase in the availability of cultivable land to problems of labor practices and inefficient land management practices, the assessment of the ecological impact of development-related policies in the delta has often been ignored in such analyses. The ecological impact of agricultural decline was, as noted above, a combination of waterlogging, inadequate drainage, untimely flooding, drying up of rivers and other water bodies due to silting, and the deleterious effects of the water hyacinth. Iqbal is forceful in his assertion that instead of the worsening ecological conditions in Bengal, it is not surprising that the 'normal' deficit of rice a few years prior to the famine was 64,000 tonnes in Bengal, or that the net decline in Bengal during the seven years before the famine was 2.5 million tonnes – the long term decline in rice production, a strong indication of an ecologically induced food availability decline, must be factored in any analysis of causes of the famine.[224] It is mentionable that Iqbal's thesis of an ecologically-induced food availability decline challenges that of economist Amartya Sen, whose assertion was that food availability was mainly due to wartime mismanagement, malnutrition and epidemic disease such as malaria. Recent geological findings that the famine of 1943 was not linked directly to soil moisture drought and crop failures, unlike in previous major famines of British India seem to give credence to Sen's economics based theories of the famine.[225] However, a deep examination of Iqbal's thesis, as done above, makes it clear that these empirical findings do not negate Iqbal's observations that railway embankments caused increased flooding in croplands, or that water hyacinth was a major threat to agricultural activities and output.

[222] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 163. Data taken from *Agricultural Statistics of Bengal, 1901–02 to 1942–43* (Calcutta)

[223] Iqbal, 163. Data taken from *Agricultural Statistics of Bengal, 1901–02 to 1942–43* (Calcutta), 28.

[224] Iqbal, 168.

[225] Vimal Mishra et al., "Drought and Famine in India, 1870–2016," *Geophysical Research Letters* 46, no. 4 (February 28, 2019): 6, https://doi.org/10.1029/2018GL081477.

5.5. Epidemic disease and the high mortality in the Great Famine of 1943

It has been mentioned earlier that the incidence of epidemic diseases such as cholera and malaria remained high throughout Bengal in the early decades of the twentieth century. The famine of 1943 hit the food deficient eastern Bengal region the hardest, especially the districts of Tipperah, Dhaka, Rangpur, Malda, and Chittagong, exacerbating an already bad situation.[226] The famine was associated with severe epidemics of malaria and cholera in the eastern regions of Bengal, which contributed to the high mortality rate. The famine report for the period mentions that from July to December 1943, and the first six months of 1944, the death rate from malaria was 125.1 percent and 126.1 percent higher than the five year average for malaria mortality. The most significant number of deaths from malaria were reported in Nadia, Murshidabad in western Bengal, and in Mymensingh, Faridpur, and Tippera in eastern Bengal, with the high percentage increase in malaria deaths in Dhaka. On the other hand, the total number of recorded deaths from cholera from July 1943 to June 1944 was 809.7 percent over the five-year average. The highest number of deaths from cholera were reported in the regions in eastern Bengal – Mymensingh, Dinajpur, Bakarganj, Tipperah, and Noakhali.[227]

The high mortality rate in eastern Bengal from scarcity and epidemic disease was very much a result of the breakdown in government and authority in the time of national crisis. According to Narayan, the areas in eastern Bengal hardest hit by the famine included Dhaka and Tippera. The high population of Dhaka at the time meant that the city and district needed to import food for most of the year for feeding its inhabitants. On the eve of the famine, the Bengal central government based in Calcutta failed to open up food stocks for the relief of the starving people in eastern Bengal, as a result of which the price of food grains such as rice shot up, and the death rate of famine-stricken people in Dhaka the middle of 1943 was at about 400 per week, which was eight times the standard death rate. High mortality from malignant malaria and cholera deaths accompanied the hordes of homeless and destitute people, who were also often inflicted with pneumonia due to their lack of clothing and shelter. Narayan notes that the worst affected areas of Dhaka at this time were Manikganj, Munshiganj, and to a lesser extent Narayanganj and the Sadar sub-divisions.[228]

[226] *Famine Enquiry Commission Report on Bengal* (New Delhi: Usha Publications, 1960), 112–15, https://archive.org/details/dli.bengal.10689.12651.

[227] *Famine Enquiry Commission Report on Bengal*, 119.

[228] T.G. Narayan, *Famine over Bengal* (Calcutta: The Book Company, ltd., 1944), 184–86.

5.6. Conclusion

This final chapter aimed towards answering crucial questions on the relationship between ecology, epidemic disease, and health in the eastern Bengal region. It attempted to map out the impact of ecology and changes to ecology on the incidence of epidemic disease in the Bengal Delta through the application of the ecological framework etched out in the first chapter. The main focus of this chapter was in charting the impact of human-induced ecological developments in the eastern section of the Bengal Delta in the latter part of the nineteenth-century and early twentieth century in terms of how the loss of ecology was strongly connected to the high incidence of epidemic disease. The connection between loss of ecology and decline in the health of the general populace was also explored at length, especially in the context of encroaching scarcity and famine in eastern Bengal the early decades of the twentieth century, leading to the Great Bengal Famine of 1943.

Much of the sources cited in this chapter are secondary in nature, especially that of Iqbal and Ira Klein. This is mainly due to the fact that the ecological impact of railways in the eastern Bengal Delta is relatively new, even in the field of environmental studies. Moreover, Iqbal sometimes made empirically unsubstantiated claims in order to strengthen his theses, which allowed room for both criticism, as well as recommendation for improvement. It was shown in the chapter that there exists much room for improvement and inspection of empirically dependant claims, especially while dealing with newly emerging scholarship and empirical data from the ecological and geographical sciences .

CHAPTER VI

CONCLUSION AND DISCUSSION

Among timeless sayings in Bengali tradition is the notion of "*maache bhaate Bangali,"* or "(Consumption of) fish and rice make a Bengali." The wisdom inherent in the saying is a significant one for our study – rice represents the fertility of the land, and fish represents a free-flowing healthy water regime. Together, fish and rice represent the fact that for generations, the riverine system of the Bengal Delta has unfailingly provided the people of eastern Bengal with nutrition that has helped maintain the healthiness of the people. A prime reason that eastern Bengal was mostly free from famine throughout the nineteenth century was that laborers and poor people in eastern Bengal were always able to resort to the active rivers of the delta for feeding on an abundant variety of fish when other food was scarce.[229] As seen, however, human-induced changes in eastern Bengal such as embankments and the proliferation of water hyacinth at the turn of the century was responsible for the loss of ecology to the degree that rivers began to silt and dry up, fish began to decrease in number, and crops began to fail due to reduced water flows, stagnation, and untimely flooding. *Sonar Bangla* (Golden Bengal) eventually ceased to be a reality and became part of an active imagination of a golden past, which was desired continuously amidst the various expressions of folklore. While the above narrative may be challenged to be a declensionist one, our study has revealed that it was not untrue – scarcity and famine became a recurring theme in the lives of the people of eastern Bengal throughout the twentieth century, and the Great Famine of 1943 was certainly not the last famine to hit eastern Bengal, even though it was amongst one of the most deadly. These extreme ecological events accompanied recurring events of social and political upheaval in the region – eastern Bengal became part of Pakistan in 1947, and again was embroiled in a bloody nine-month war of separation that led to the formation of Bangladesh, an independent country in 1971.

[229] Iqbal, *The Bengal Delta: Ecology, State and Social Change, 1840- 1943*, 59–60.

This study on the epidemic disease in eastern Bengal can be considered to be an exercise of environmental history, where the study of epidemic disease is a subset of the discipline. The main questions of this thesis were to understand how the prevalence of epidemic disease was dependent on delta ecology, and why the colonial practices and policies related to medicine and public health in the late nineteenth and early twentieth centuries to combat epidemics failed. In answering these questions, the thesis study was mainly divided into four main chapters – Chapter 2 explored the suitability of the Bengal Delta as an ecological framework for the study of epidemic disease, Chapters 3 and 4 looked at the phenomenon of epidemic disease in Dhaka at the heart of the eastern section of the Bengal Delta, with a view towards understanding and evaluating the role of colonial medical and public health policies concerning combating epidemic disease, and Chapter 5 directly delved into questions of ecology, epidemic disease, and general health, exploring how human-induced changes leading to loss of ecology was directly connected to the higher incidence of epidemic disease and loss of health in the general populace, and exacerbated worsening conditions in more significant events of scarcity and famine.

It was stipulated that one's understanding of the Bengal Delta as an ecological framework for the study of epidemic disease in eastern Bengal may rest on two aspects, firstly the dynamic and fluid nature of the delta that helps one understand natural processes and human-induced ecological changes, and secondly the concept of the delta as a broader 'zone of anomaly' which helps one to understand the various anthropogenic activities in the eastern delta. Eastern Bengal as a 'zone of anomaly' was crucial for identifying why colonial authorities often considered large swathes of eastern Bengal as inaccessible forested wasteland and why state-led developments such as the railways and medical infrastructure, directed and managed by the colonial nerve center in Calcutta in western Bengal, came about later in the eastern part of the Bengal delta. Nineteenth-century miasma theories of disease helped colonial authorities explain that eastern districts in Bengal were more disease-ridden and malarious. Such notions often placed the blame on disease incidence on the climate and topography of the region. They fostered notions that the development of medical infrastructure in eastern Bengal was futile, and the low presence of European populations in eastern Bengal helped colonial authorities not to change their mind. The resulting inadequacy and disproportionate distribution of medical infrastructure in eastern Bengal have been discussed in detail in the case of Dhaka, the urban center of eastern Bengal. It was seen that the medical infrastructure was state-led and more developed in the urban centers of western Bengal. On the other hand, although the Dhaka

division was much more populous as compared to disctricts in western Bengal, philanthropy and the goodwill of the elite were much relied upon in building private medical institutions such as the Mitford hospital, which were then taken over by the state in 1920, quite late during the colonial rule. This inadequacy and disproportionate distribution were discussed in detail as being among one of the chief causes of failure of colonial policies to combat epidemic disease – institutions such as the Mitford hospital often were unable to deal with the high number of patients turning up, for there simply were not enough medical institutions to treat patients of epidemic disease in eastern Bengal satisfactorily.

The fluidity and dynamic nature of the Bengal Delta often did not factor in the estimates of the colonial administration, and when it did, the issue of fast-flowing rivers and siltation was seen as beasts to be tamed, a challenge to be conquered, rather than as aspect to be conserved or respected. As seen in the final chapter on ecology, development, and epidemic disease, railway embankments were often constructed in a manner that blocked the drainage system of the deltaic rivers and created problems of waterlogging and reduced water flow. The killing of water bodies and rivers crucial to the drainage system were considered acceptable by the colonial administration and the railway construction authorities for the sake of profit-seeking development enterprises. Lone voices from within the colonial administration calling for addressing the impact of development policies and projects upon riverine drainage and delta ecology, such as that of C.A. Bentley, the Director of Public Health in Bengal in the early decades of the twentieth century, went unheeded and ignored, and got lost in the general cacophony related to a future based on modernization and development efforts. As such, human-induced ecological changes such as the construction of railways and the introduction of foreign species of water weed were acutely responsible for the loss of ecology in the Bengal Delta. It, in turn, as discussed in detail, led to a higher incidence of epidemic disease and declining health in eastern Bengal.

Therefore, on the one hand, inadequate and disproportionate medical and public health infrastructure left the people of eastern Bengal vulnerable to the high incidence of epidemic disease. On the other hand, indiscriminate and ecologically adverse development projects carried out by the colonial administration directly caused a higher incidence of epidemic disease through fostering the hyper-endemicity of cholera and malaria, alongside a spike in mortality from encroaching scarcity and eventual famine. Together, these two crucial factors contributed to the failure of colonial health policies towards combating epidemic disease in eastern Bengal.

This study, despite the promising avenues it opens up for study of history of epidemic disease in the Bengal Delta, suffered from several limitations. The main limitation was the dependency on nineteenth and twentieth century British colonial sources of documentation, as a result of which scholarship in indigenous languages did not make much of a presence. This was mainly due to the unavailability of relevant archived material to the effect, such as local newspapers and journals. Another limitation was that the study was significantly dependent on secondary scholarship and analysis in some aspects such the relationship between ecology and epidemics, and that of health and nutrition in the Bengal Delta, due to the dearth of primary material towards this end. Moreover, the ecological framework of the Bengal Delta as worked out in the first chapter is still at an early stage, and needs more informed input and criticism before becoming fit for wider application.

Having said that, the study opens up promising new fields of study, both in temporal and spatial terms. In the temporal respect, both pre-colonial and post-colonial periods in the Bengal Delta can be studied using all or part of the ecological framework of the delta. In the spatial respect, one could ask how the incidence of epidemic disease in the Bengal Delta was similar or different to/from deltaic systems in the same geographic zone, such as the Nile delta system in Egypt, especially considering that Egypt was also under colonial British rule at the turn of the twentieth century. Moreover, this study also opens doors to writing urban and medical related environmental histories of the delta region, and it is sincerely hoped that scholars can take up their pens to pursue related avenues of research in the near future.

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