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The Railways and the Water Regime of the Eastern Bengal Delta, c1845–1943

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The railways in India drew considerable attention from two of the most influential thinkers of modern times, Karl Marx and Mahatma Gandhi. In the 1850s, Marx was a distant but passionate observer of the emergence of the railways in India and he was convinced that the new transport system would prepare the ground for a bourgeois civilization, precursor to socialist revolution, in India. Apparently informed by the nineteenth-century spirit of 'improvement', Marx linked the railways to industrialization, communication and formative intercourses among inhabitants of disparate villages, communities and castes across India. He also envisioned that the railways would lower the intensity of famine by mitigating the problem of means of exchange; and that the digging of tanks or borrow-pits for embanking the railways would lead to an extensive irrigation system which would contribute to agricultural development as well.[1] About half a century later, Mahatma Gandhi had a completely different view of the railways in India. He not only denounced the railway for its role in promoting British imperial penetration, but also for the transmission of plague germs and bringing of famine by draining local foodstuff in the hinterland of India. Gandhi also complained that the sanctity of holy places, which had hitherto been visited only by enduring real devotees, was lost due to the visits by rogues because of easy railway transportation.[2]

The apparently contradictory approaches of Marx and Gandhi towards the railways seem to have been informed by their different views of modernity. For Marx, modernization was imperative for India's dialectical advance towards materialistic progress; for Gandhi, modernity, or the 'disease'

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1 Karl Marx, 'The Future Results of British Rule in India', reprinted in Ian J. Kerr (ed.), *Themes in Indian History. Railways in Modern India,* Oxford: Oxford University Press, 2001, pp. 62–67.

2 M.K. Gandhi, 'The Condition of India: Railways', reprinted in Ian J. Kerr (ed.), *op. cit.*, pp. 77–80.

of civilization destroyed the inherently rhythmic and sacred autonomy of traditions. Throughout the twentieth century the historiography of railways in India seem to have either endorsed or contested the assumptions by both Marx and Gandhi. For the followers and critics of Marx, the building of railways has generally been considered an imperial scheme designed to mobilize capital, raw materials and troops for good or for worse. Its impact has been measured by the macroeconomic performance of India within the general pattern of industrialization, export and import.[3] On the other hand, a number of recent works have cast doubt on the modernization paradigm itself. A discourse of the 'civilizing mission' held that the railways were but imperial projects representing the cultural and technological superiority of the West.[4] Other research in this arena relates to how railways have spread diseases and even communalism.

Apart from these debates on politico-economic or socio-cultural issues, there has been a remarkable lack of study of the railways in conjunction with the landscape and the environment through which they ran. This 'third line' analysis began to emerge recently, in particular with the works of Ira Klein. Klein has convincingly revived the early twentieth-century arguments of CA Bentley, a colonial public health official, that the railways caused ecological deterioration and consequently increased malaria and morbidity.[5] The present essay departs from Bentley and Klein by extending the debates on links between the railway and diseases to the links between the railways and the water regime of the Bengal Delta. In doing so, I will examine two broadly related questions. First, in what ways the concept of modernity as expressed in the development of the railways excluded environmental considerations. Secondly, how the conflicting engagement between the railway and the water system of deltaic Bengal led to considerable deformation of the landscape

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3 Hena Mukherjee, *The Early History of the East Indian Railway 1845–1879*, Calcutta: Firma KLM, 1994; Mukul Mukherjhee, 'Railways and Their Impact on Bengal's Economy: 1870–1920', *Indian Economic and Social History Review* 17, 2 (1980), pp. 191-209; I.D. Derbyshire, 'Economic Change and the Railways in North India, 1860–1914', *Modern Asian Studies* 21, 3 (1987), pp. 521–45; Daniel Thorner, 'Capital Movement and Transportation: Great Britain and the Development of India's Railways', *The Journal of Economic History* 11, 4 (1951), pp. 389–402.

4 Ravi Ahuja, "'The Bridge-Builders': Some Notes on Railways, Pilgrimage and the British 'Civilizing Mission' in India", in Harald Fischer-Tine and Michael Mann (eds.), *Colonialism as Civilizing Mission. Cultural Ideology in British India,* London: Anthem Press, 2004, pp. 95–115; Laura Gbah Bear, 'Miscegenations of Modernity: Constructing European Respectability and Race in the Indian Railway Colony, 1857–1931', *Women's History Review* 3, 4 (1994), pp. 531–48.

5 Ira Klein, 'Malaria and Mortality in Bengal 1840–1921', *Indian Economic and Social History Review* 9, 2 (1972), pp. 132–60.

and destruction of the agrarian production process. In engaging these two questions, I would like to map the discursive space where 'modern' knowledge, colonial capital and Bengal's fluid landscape defined the railways.

The Bottle and the Funnel: Coming of the Railways to the Bengal Delta

After conducting a year-long survey of landscape, possible routes and profitability, Macdonald Stephenson, a Scottish engineer, proposed the first Indian railway scheme in 1845. In his scheme of 'triangulating India with railway' at a cost of about fifty million pounds, Stephenson presented an ambitious idea of setting up a vast railway network in order to connect Calcutta, Delhi, Bombay and Madras with other major towns in between. Doubt was cast on the practicality of such a huge project, but the debates that followed endorsed the necessity of railways in India. As far as the territorial breadth of the railways was concerned, both Stephenson as well as his early critics envisioned Calcutta as the easternmost terminal of the future railway network in India. Regions east of Calcutta or eastern Bengal, along with Assam, were excluded from the purview.[6]

The disadvantages of excluding eastern Bengal from the initial railway projects, however, were soon identified. A fifteen-page monograph, published in 1848 by a certain Transit, pointed to the relative merits of extending the railways into the Ganga Valley. He strongly criticized Stephenson's new East Indian Railway Company which was to connect Calcutta to Bihar and then to run through the Doab region via the short but circuitous route of the Rajmahal Hills. Transit thought that in this way, the projected line ignored the Bengal trade and would get 'out of Bengal as fast as it could into the hills.' In insisting that the trade of Bengal should be considered in the future expansion of the railways in India, Transit appeared to have been informed by a wider vision of the water regime of the lower Ganga Valley which provided the sole impetus for an extensive range of trade and commerce. Transit noted in a utilitarian vein:

> The Ganges Valley is your manufactory—your trading ground—your source of wealth. I look not to towns, to provinces, to districts, or to individuals; I

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6 'Railways in India. Bengal' – *The Colonial Magazine & East India Review* 16, 65 (1849), pp. 349–50; An Old Indian Postmaster, *Indian Railways; As Connected with the Power and Stability of the British Empire in the East etc.*, London: Thomas Cautley Newby, 1846; J.P. Kennedy, *A Railway Caution! Or Exposition of Changes Required in the Law & Practice of the British Empire etc.*, Calcutta: Messrs R.C. Lepage and Co., 1849.

> look not to transporting sepoys, or cannon, or gunpowder, or arms...not to Manchester twist, or Welsh iron, or Swansea copper, or French brandy, or Burton ale; I look not to Purneah indigo, Patna opium, Benares sugar, or Chuppar saltpeter, Mirzapore cotton, or the grain of the chete; but, on the broad principle of the greatest benefit of the greatest number, I say, that by the Ganges you catch the whole. [7]

Transit suggested that the resources of northeastern India could be better tapped by connecting Calcutta by the railway to the 'nearest permanent spot' on the bank of the lower Ganga Valley. He found the starting point of the Bengal Delta, where the Kosi river meets the Ganga near Malda, to be an ideal terminus for a railway from Calcutta. He argued that the whole accumulated trade of the Ganga Valley, comprising an area of one hundred and fifty thousands square miles and containing a population of forty million, was obliged to pass through this 'narrow neck' of the country, not more than five miles in width. Transit compared the lower Ganga Valley to a funnel whose apex was the starting point of the Delta and he viewed Calcutta as a bottle which would draw the trade of the Ganga Valley through the funnel where the proposed railways would work like a pipe. Transit's scheme was significant in view of the proposed railway's contact with the highly fluvial nature of the Bengal Delta. He did not consider railway routes further down the Ganga Valley. Though the huge commercial prospect for the eastern Bengal Delta was present in his mind, Transit did not even want the railways between Calcutta and the Kosi-Ganga bank to have branches: 'You should put a pipe to the apex of the funnel, and its lower end in the bottle, not to climb up the side and take a drink at the edge, or to make furtive hole in the side by which you will only drain it half-way'.

In insisting on a single principal line, Transit seemed to have considered that the 'richest land would be found near the base of the drainage'. He considered the Ganga trade route of the pre-colonial period, but only to the point at which the trade flow could be diverted to Calcutta by train. Thus, according to Transit's scheme, though the resources and trade of entire northeastern India could be tapped, the physical presence of the railways into the 'base of drainage', or the eastern Bengal Delta, was not proposed. Transit's idea of the railways as a means of tapping the resources of the Delta was perhaps influenced by the strength of the Delta's water regime which ensured enormous raw materials, trade and commerce. According to Transit's scheme, therefore, the railways were supposed to have a complementary rather than confrontational relationship with the lower Ganga or eastern Bengal Delta.

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[7] Transit, *A Letter to the Shareholders of the East Indian Railway and to the Commercial Capitalists of England and India,* London: Smith, Elder & Co., 1848, p.8.

There were, however, other opposing views which considered the Ganga as a competitor to the railways. If the expansion of the railways in Bengal in the following decades were examined in relation to Transit's scheme, it would appear that the commercial importance of the Bengal Delta as pointed out by Transit was fully taken into consideration; but there was a fundamental difference between his scheme and the railway projects that were actually carried out. Unlike Transit's scheme, these railways engaged with the Ganga Delta through its fluvial heart, not via the 'neck' and in consequence they began to contest rather than complement the water regimes of the Delta. With a view to eventually connecting Calcutta with Dhaka, the first railway line was opened from Calcutta to the lower Ganga bank in Kushtia in September 1862. In 1871, this line was extended southward to the Goalundo bank of the Ganga. With its many branches extending along both banks of the lower Ganga, it came to be known as the Eastern Bengal Railway (henceforth EBR). Between 1874 and 1879 the Northern Bengal State Railway, extending from Sara to Sirajganj, was constructed and many of its branches extended to Dinajpur in the west and Parbatipur the east. In July 1884 the government acquired the EBR and amalgamated it with the Northern Bengal State Railway in 1887. The entire Eastern Bengal Railway (the word 'State' was dropped in 1915) was situated on the west bank of the Brahmaputra except for the Bahadurabad-Dhaka-Narayanganj line. The first section of the Assam-Bengal Railway (henceforth ABR) was opened between Chittagong and Comilla in 1895. The line was constructed to meet the demand of the tea companies in Assam which wanted railway facilities for the export of tea via the Port of Chittagong. This line lay on the left bank of the Ganga and both banks of the Brahmaputra. It served the Province of Assam, and the districts of Dhaka, Mymensingh, Chittagong, Noakhali and Comilla. In 1942, the ABR was taken over by the state and was amalgamated with the EBR to form the Bengal and Assam Railway. The expansion of the railways was such that by 1933 Bengal had more railways on the basis of area than any province except the United Provinces.[8]

The root of the problem appears to lie not in the erection of the railway itself but in the fact that the government and different railway companies, while encouraging the construction of the railways, failed to appreciate the relative importance of inland waterways. In eastern Bengal, waterways were often seen as rivals to the railways as means of transport and there was a

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[8] K.G. Mitchell and L.H. Kirkness, *Report on the Present State of Road and Railways Competition and the Possibilities of their Future Co-ordination and Development, and Cognate Matters, in Governors Provinces*, Calcutta: Government of India, 1933, p. 6. The Bengal and Assam Railway comprised 3,485 miles on 31 March 1945. See M.B.K. Malik, *Hundred Years of Pakistan Railways,* Karachi: Government of Pakistan, 1962, p.18.

feeling that with the completion of the railway networks, the transport and communication systems would be faster and more reliable at the expense of the 'slower' mode of water transports. The question of the railways in eastern Bengal was brought to the attention of the government as early as 1852, well before the experimental line of the East Indian Railway Company from Calcutta to Raniganj coal field was tried out. In 1856, the merit of the rail line project, between Calcutta and Dhaka via Jessore, was 'tested' on the London money market and the avidity with which the shares were brought was 'perfectly astonishing'. The capital for the first section of the line was estimated at one million Sterling, but the applications actually made were worth more than fifteen million Sterling. By the end of the 1850s the EBR took up the ambitious project of construction of at least 600 miles of railways. It was given a concession to construct lines from Calcutta to the river Ganga at Kushtia and ultimately to Dhaka, together with a branch to Jessore. At the same time the Company was empowered under an Act of incorporation to increase its capital to £6,000,000. So important was this project of the EBR to the government that the whole project was laid before the Home Government in the utmost possible detail so that there was hardly any room for disputes between the Company executives and the government officers.[9] By the beginning of the twentieth century the patronage of and enthusiasm for the railways turned full circle. On the other hand, efforts to improve the waterways were relatively feeble as reflected in the fact that whereas total expenditure on the improvement of navigation facilities was in the area of £5,000,000 during the last three decades of the nineteenth century, expenditure on the railways during the same period had exceeded £200,000,000.[10] The Government of India was specifically enthusiastic about the railways in eastern Bengal. By 1928 it was reported that the EBR had been treated rather more generously than some lines and had received about two-thirds of the total sum asked for in the year 1925-30, while other lines had received less than half their demands.[11] Though conditions in Bengal were 'more favourable for the improvement and extension of such navigation facilities than in any country in the world,' the bias towards railways in eastern Bengal continued. When the construction of the eastern

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9 *A Sketch of Eastern Bengal with Reference to Its Railways and Government Control,* Calcutta: Thacker, Spink and Co., 1861, pp. 13, 21–22, 49.

10 O.C. Lees, *Waterways in Bengal: Their Economic Value and the Methods Employed for Their Improvement,* Calcutta: Bengal Secretariat Book Depot, 1906, p. 9.

11 N. Pearce, Agent, Eastern Bengal Railway to G.G. Day, Chief Engineer to the Government of Bengal, Communication, Building and Irrigation (henceforth CBI) Dept. (Railway), 30 October 1928, bundle 1, unrecorded files, file 7, National Archives of Bangladesh (henceforth, NAB), Dhaka.

Bengal Railway was projected, the computations concerning the amount of tonnage it was likely to carry were based on the returns of the Eastern Canals.[12] It was calculated that more than one million tons of produce were transported annually to the Port of Calcutta from the districts of eastern Bengal and that at least forty thousand tons of imports were distributed over the same territory as return cargo.[13] However, it was the EBR, not the Eastern Canals, which began to receive patronage. The relationship between the railways and the ever-changing deltaic landscape could be fruitfully examined keeping the above context in mind.

The Water Bodies and the Railways: Range of Contestations

In Britain, the first and foremost challenge to the emerging railway system came from those who saw waterways, specially canals, as ideal routes for commodity transport. As the proponents of the railways listed various possible important outcomes of the establishment of railways, so did the opponents point to what the railways could not possibly deliver, particularly in comparison to canals. For instance, one set of arguments in favour of the railways was published in the *Edinburgh Review* in October 1834 in which the author identified at least fourteen sectors of the national economy where he thought the railways could play a pivotal role. In the following year, all these arguments were refuted by one R. Cort, who seemed to be convinced by the enormous advantages of continuing with traditional waterways.[14] In the context of conflicting interests between two different modes of transportation, railways and canals, Cort even asked whether there was 'nothing wrong in spreading a false system of conveyance in every quarter of the globe, as well as deserting the ancient thoroughfares of the kingdom?' It became apparent, however, that conflicts between the railway and canal establishments rested largely on the issue of capitalist interests. Cort revealed that the amount of capital invested in the internal navigation of Britain was no less than £30,000,000 and he demanded that, in the unavoidable case of expansion of the railways, the canal interests should be protected by a legislation of Parliament.[15] Since Parliament itself had safeguarded the invest-

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[12] Eastern Canals comprised several natural and artificial waterways which connected eastern Bengal to Kolkata Port.

[13] *A Sketch of Eastern Bengal*, pp. 10–11.

[14] For details of the arguments and counter-arguments, see R. Cort, *The Anti-Rail-Road Journal; or, Rail-Road Impositions Detected*, London: W. Lake, 1835.

[15] *Ibid.*, pp. 51–56.

ments made in the development and maintenance of canals, it was under compulsion to see to the canal interests. On the other hand, the wonder and prospects of new steam technology were drawing fresh attention from numerous capitalists. When the Railway Consolidation Act of 1845 was passed, Parliament was probably confronted with this dilemma. This Act proposed that railway companies could alter or divert the course of any rivers, brooks, streams or water courses and any branch of a river for the purpose of constructing tunnels, bridges, and other passages as the companies thought proper. However, the Act divided the different water-bodies into 'navigable' and 'non-navigable' and the railway companies were given full liberty to deal with non-navigable water bodies only. The navigable water bodies did not come under the jurisdiction of the railway companies.[16] The water regime of Britain was thus conveniently shared by both the railway and canal interests.

The capitalist interests representing canals and the railways were apparently given a fair share of security of investment, but in the process the ecological regime of water as a whole was undermined, since 'navigability', rather than the intrinsic value of water as an ecological phenomenon, provided the context for a solution. It appears that the legal implications of the tensions between the two major modes of transport in Britain had a bearing on the way the railways and waterways were seen in relation to each other in Bengal. Yet, the impact of the railways on the water regime of Britain seemed to be trifling compared to that of the Bengal Delta precisely because of the nature of the landscape and fluvial conditions of Bengal on the one hand and the political and economic conditions on the other. In Bengal there was hardly any question of private investment in maintaining canals and similar waterways. Water bodies of different length and width were so lavishly spread across the Delta that it was not possible to envisage corporate investment maintaining them. Therefore, when the railways were being spread across the Delta, they faced no great opposition as was the case in Britain. The absence of a rival capitalist interest in Bengal with an equal degree of influence made the railway establishment the sole arbiter of the way in which they wanted to operate. In the context of capitalist monopoly of the railways, which drew obsessive approval from both metropolitan and colonial administration, the Bengal Delta saw the railways interfering not only with 'non-navigable' water bodies, but also with 'navigable' water bodies, unlike in the case of Britain. Within ten years of the coming of the railways in the Delta, the Bengal Government legislated that it was lawful for the Lieutenant Governor of Bengal to order the blocking of any navigable chan-

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[16] *Railway Consolidation Act, 1845*, MSS Eur F290/33, India Office Records, British Library, London, p. 360.

nel.[17] It was also enacted that Canal Officers could close any channels for 'public purposes'. Diversion of rivers was also stipulated in connection with the building of the railways.[18]

The influence of capitalist enterprises with respect to railway constructions was felt in the way the railway engineers related the water regime of the region to their world-view and their scheme of professional knowledge. The position of the engineers can be examined by looking at how they worked through the twin realities of safeguarding financial investment and constructing the railways in a very fluvial landscape. Some of these issues were raised in the lectures given by senior engineeers to the engineering students at Sibpur Engineering College. In his series of lectures, S. Finney, a Manager of the EBR, noted that the operation of laying out a railway line in some parts of India was troublesome, but in Lower Bengal it was an extremely simple matter, so easy in fact that occasionally men were tempted to think that the work could be done 'without proper care'. This statement seemed rather surprising as the rivers and innumerable waterways should have posed considerable difficulties to the construction of the railways.[19] What considerations led the engineers to think that the railway construction in the Bengal Delta was a 'simple matter'? Apparently, most of the engineers seemed to have regarded engineeering expertise as secondary to commercial interest. The preference of an engineer in selecting a site for constructing a railway line was subject to modifications by the needs of trade and administration. Finney told his students at the Sibpur Engineering College that the choice of route would depend upon traffic prospects, and afterwards upon economy in the construction and operation. He reminded them that the best engineering was not that which made the most splendid or even the most perfect work but that which made a work that answered 'the purpose

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[17] Act V of 1864 (The Bengal Canal Act, clauses 3–4) thus reads: 'It shall be lawfull for the Lieuteant Governor of Bengal...to authorize...to make and open any navigable channels, or to clear and deepen any navigable channel and to stop any nagivable channel....no action or suit shall be brought against the State in respect to any injuries or damage caused by or resulting from any act done.' Quoted in B.B. Mitra, *Laws of Land and Water in Bengal and Bihar,* Calcutta: Eastern Law House, 1934, p. 250.

[18] *Rules for the Preparation of Railway Projects with Notes.* In Railway Department, Technical Paper no. 192: G. Richards, Chief Engineer with the Railway Board of India, in enclosure to letter no. 65, 3 February 1919, p. 16.

[19] One of the reasons why the East India Company was initially hesitant over constructing the railways was the apprehension that periodical inundation, among other 'Indian problems', would pose a particular threat to the stability of the same. See 'Indian Railways', *The Times*, 13 August 1846, p.8.

well at the least cost'.[20] The secondary position of engineering expertise in constructing railways was further clarified in another lecture by engineer H.W. Joyce: 'Railway is purely a business investment constructed to pay dividend, and to satisfy them in regard to the likelihood of a projected line to furnish these dividends or not is one of the duties of the Engineer'.[21]

As engineering sophistication became secondary to investment portfolios and commercial schemes, and as the water regime of the Delta lay within the jurisdiction of the railway companies, the simple solution appeared to be massive extension of embankments on which the railways were to run. As Finney told his students, practically all railways in Lower Bengal were built on embankments.[22] Accordingly, the 3,500 miles of railways that traversed the Ganga-Brahmaputra watershed represented an almost similar length of embankments. But how easy was it to erect and manage these embankments on Bengal's deltaic landscape with rivers draining in a myriad of directions? To what extent, for instance, did the waterways and embankments co-exist and clash? How did engineers justify their claims that railway construction in the plains of the Delta was easier than other places as embankments appeared to solve many of the problems associated with railway constructions?

One of the issues that vexed the engineers was how many passages should be provided through embankments for free flow of water. Finney thought that the number of waterways to be provided must depend on the importance of the traffic. If the line in question was of 'first class importance' and the traffic was heavy, then an interruption of communication was calamitous, and liberal waterways must be supplied, since the flood could breach the embankment and the loss from an interruption could be enormous. If, on the other hand, a branch line was being constructed where the traffic was small, 'some risk of an occasional interruption' was 'justifiable'. Another related question of whether the waterways should provide for ordinary floods or for abnormal ones occurring at long intervals also depended on the importance of the traffic, Finney suggested.[23] These questions of providing 'waterways' or 'openings' through the railway embankments took a philosophical turn when Joyce explained the merit of a 'rational' instead of 'empirical' method in determining the width of culverts for passing water.

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[20] S. Finney, *Railway Construction in Bengal. Three Lectures Delivered at the Sibpur Engineering College in January-February 1896*, Calcutta: The Bengal Secretariat Press, 1896, p. 5.

[21] H.W. Joyce, *Five Lectures on Indian Railway Construction and One Lecture in Management Control*, Calcutta: The Bengal Secretariat Press, 1905, p. 20.

[22] S. Finney, *op. cit.*, p. 8.

[23] *Ibid.*, p. 10.

He criticized the prevailing methods of 'off-hand judgment' or guess work by engineers in mapping the adjacent water-bodies before configuring the size of the culverts. Joyce thought that these 'hopelessly unscientific and extravagant' methodologies could easily lead to the construction of unnecessarily large culverts.[24] In his 'rational' scheme of measuring the required space for waterways in small culverts, he considered the following issues: the area of the basin the culvert must drain; the maximum rainfall to be expected in the locality and the time of its continuance; the velocity of the flow; and the portion of the water falling on the drainage area that would reach the culvert, commonly called 'run-off'. Joyce noted that the notion that maximum runoff must be provided for somewhat simplified the problem. He remarked that varying conditions of soil, surface and seasons caused the run-off to vary in different years and at different times. Considering the case of small areas with a surface rendered impervious by considerable previous rainfall and other causes, Joyce assumed that 90% of the total rainfall would pass through the culvert. But in a larger area, where the extreme distance between the watershed and the culvert might be as much as three miles, a study of the available data seemed to indicate that not more than 60% of the rainfall would reach the culvert. Therefore, Joyce thought that the empirical formula commonly used to determine the size of sewers did not seem applicable to determining the run-off in the case of culverts, as the conditions in the two cases were quite different. After thus ascertaining the maximum quantity of water to be accommodated, Joyce went on to determine the size of the culvert by 'well-known methods, modified by conditions encountered at each location', and by such a factor of safety as the Engineer thought prudent. The priority of the 'safety' of the railways over ecological concerns was made particularly clear by the following statement of Joyce:

> There must be some limit where the expenditure of money to provide for remote contingencies becomes unwise. No one doubts the possibility of earthquakes in any locality, but in most places the contingency is so remote that we do not consider it advisable to build our houses to resist earthquake shocks. The wisdom of designing railroad culverts of such size that they will pass floods that are only likely to occur in each 25 or 30 years may well be questioned.[25]

Given the 'rationalist' order of engineering expertise, it was not surprising that in 1938, for instance, at Dhulia in Murshidabad the authorities resisted the appeal by local people to cut the embankment for draining out stagnant water through the railway line. The local rail authorities insisted on 'modern' knowledge and noted that whatever the old people of the locality might

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[24] H.W. Joyce, *op. cit.*, p. 55.

[25] *Ibid.*, pp. 59–60.

believe, more railway openings could not be the solution.[26] On another occasion, a government executive engineer remarked that the local inhabitants were neither accurate nor keen observers, being uneducated men and that the educated classes were so biased against preconceived ideas that these were mostly unacceptable. He remarked that the only trained observers were railway officials but their evidence could not be accepted as conclusive because their main object had been 'to a defence of the railway.'[27]

Conflicts between 'rational' and 'traditional' knowledge about deltaic landscape were further highlighted by the apprehension that excessive waterways around the railways posed a threat to the latter. In the early 1920s, the Government of India addressed the Government of Bengal (hereafter GoB) on the subject of the influence of railway construction on public health and advised the appointment of a committee to consider the sanitary conditions of any line to be constructed. A circular was issued by the GoB asking the railway authorities to keep the government informed about the proposed time for construction of any rail line. At the same time, on the suggestion of the Public Health Department with respect to the existing lines, it was decided to appoint ten surveyors under the direction of the Chief Engineer of Public Health Department and the Railway Board was requested to ask the railway authorities to render necessary assistance for the proposed survey. But before sanctioning the proposed survey and the appointment of the surveyors, the Irrigation Secretary opposed the proposal on the ground that the only way to drain accumulated water in the borrow pits was to join them by water channels to the nearest rivers and, when deep, such channels would be dangerous to the lines. The file was then sent to the Department of Public Health which ultimately failed to press the authority to carry out the project on health grounds. Meanwhile, the prospective engineers were reminded by Finney to avoid cutting deep pits as far as possible and that under no circumstances were they to be continuous. Finney told his students that a substantial buffer 'must remain between every pair of pits, or you will cause great risk and danger later on by a flow of water parallel to your embankment'.[28] It remained true that the idea of 'saving' a railway line from the rush of water was most important for 'modern' railway engineers. It was,

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[26] P.C. Roy, Superintendent Engineer to Chief Engineer, Communication and Works Dept., 14 March 1940, in CBI Dept. (Railway), bundle 1, list 70, file 1W-4/1939, NAB, Dhaka.

[27] *Report on the Hydraulic Conditions of the Area Affected by the North Bengal Floods*, Proceedings of the Irrigation Dept., April–June 1927, NAB, Dhaka.

[28] S. Finney, *op. cit.*, p. 8.

therefore, not surprising that minor rivers or water courses were often blocked altogether during the constructions of the railways.[29]

As early as 1920s C.A. Bentley, Director of Public Health, Bengal, pointed out that due to the 'blind' way of buildings roads and railway embankments without adequate culverts, the country had been divided into 'innumerable compartments' and it was extremely difficult for rainwater to flow from one compartment to another. Every year, Bentley added, the floods increased in severity and he warned that unless remedial measures were adopted, the region would cease to exist as the richest rice producing area.[30] About the same time the report of the Royal Commission on Agriculture in India observed that embankments deteriorated rivers by heightening their beds. The report advised the government to set up a Provincial Waterway Board for Bengal. Its formation was announced in 1932 by the Government of Bengal. But the proposed Waterway Board, as a contemporary critic observed, represented only commercial interests and no provision was made for the representation of the Public Health Department, which had been keenly observing the adverse impact of embankments.

Case Study I: Eastern Bengal Railways (EBR)

The first railway line of eastern Bengal, running from Calcutta (Sealdah) to Goalundo, was constructed on the floodplain of the Ganga, which, along with its numerous branches and tributaries, flowed to the Bay of Bengal. Initially there were almost no outlets for the passing of water through the embankment on which this line was constructed. The necessity of outlets through the embankment was felt every time there was a flood. Eighty four, nine hundred and one thousand lineal feet of 'opening' were added in 1868, 1871 and 1885 respectively. After the floods of 1890, a further four hundred feet were added.[31] The north-western segment of the EBR contributed to the deterioration of the water regime of Northern Bengal by the way the railway

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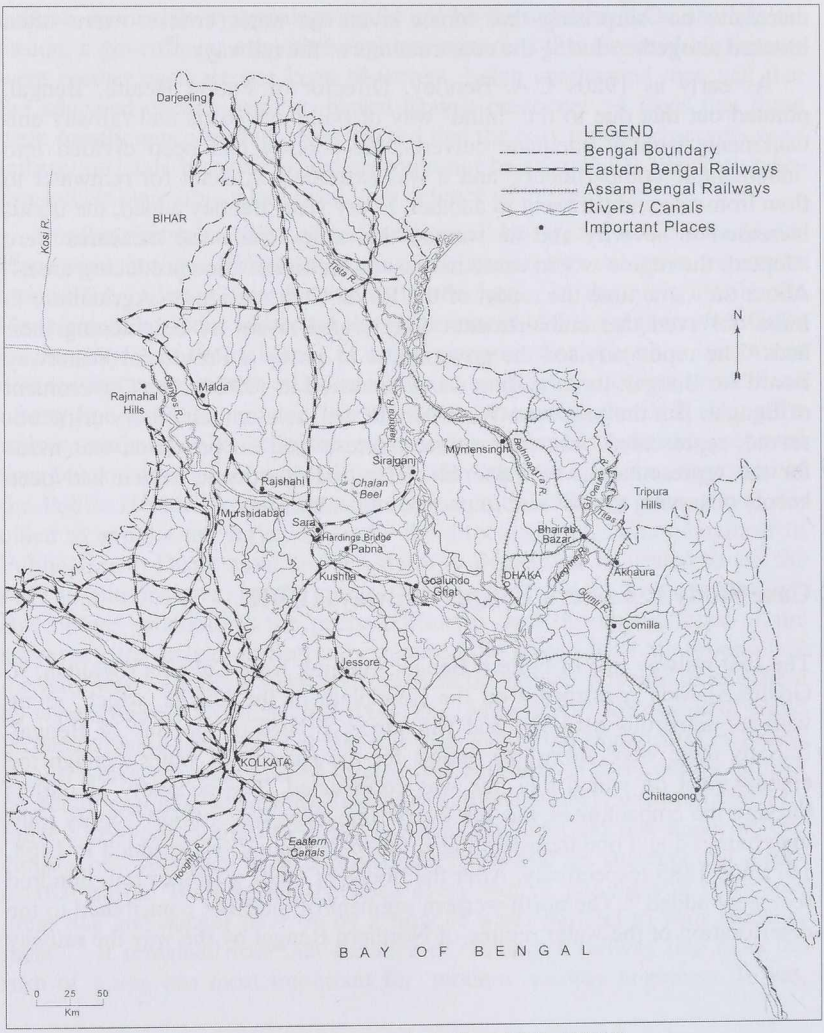
[29] For instance, the mouth of the Bamanidah river was closed by the embankment of the Eastern Bengal Railway. See Proceedings of Irrigation Dept., nos. 15–17, January–March 1930, file 13R-8, NAB, Dhaka.

[30] *The Times*, 13 October 1922, p. 11.

[31] S. Finney, *op. cit.*, p. 10.



Railways and Waterways in the Bengal Delta 1938-39

exposed itself to the Chalan *beel*.[32] The *Chalan beel* was a vast deep hollow with a watershed of about 1,547 square miles, lying in the districts of Rajshahi and Pabna, where a very large portion of the drainage from about 47 rivers of Northern Bengal converged.[33] Besides being a giant junction of numerous waterways, the *beel* also served as a springboard from which many rivers flowed further south and east to meet finally with Padma or Brahmaputra. With the waterways that converged in it from the north and north-west and with those that exited from it towards the east and south-east the Chalan *beel* formed a water regime that reserved and cleared the drainage of almost half of the active Bengal Delta.[34] By the beginning of the twentieth century the *beel* was surrounded by the EBR main line in the west and by the Santahar-Bogra line in the north. Since the *beel* filled from the north-west and south-west, the 'feeding' was intersected by the Bogra-Santahar Branch line and the EBR main line and since it drained in a south-easterly direction to the Brahmaputra, the drainage was intersected by the Sara-Sirajganj Branch line of the EBR.[35] The natural drainage of the water regime in this part of the Delta met with formidable obstacles since railways in these low lands had to be built on embankments. Such a situation was further aggravated by the reduction of the number of spans on the bridges of the EBR since the broad gauge line was constructed between Atrai and Santahar. In this area the total existing outlets in the early 1920s were reported to be 440 feet as compared with 967 when the line was first constructed.[36] In the case of the southern branches of the EBR, for instance, although the combined catchment area of the waterways was 1.5 square miles between the Dadshi and Pachuria railway stations in Khulna, there were only four openings. Although the government officials considered the openings 'adequate', the actual measurement of the four openings revealed that there were two pipe culverts each of 1.6 feet diameter and two girder bridges of 1x12=12.0 feet and 1x20=20.0 feet diameter for the

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32 Some geologists suggest that Chalan *beel* is an abandoned bed of the river Ganga (Padma). See, Bisheswar Bhattacharya, 'Bange Ganga' [The Ganga in Bengal], *Banga-bani* 3, 2 (1331 Bengali Year), p. 171.

33 M Abu Hanif Sheikh et al, *Chalan Beel Anchaler Nadimalar Shankyatattik Bissleshon* [Statistical analysis of the rivers of the Chalan *Beel*], *Institute of Bangladesh Studies Journal* 7, 1 (1406 Bengali Year), pp. 125, 129.

34 For a description of the process, see *Report on the Hydraulic Conditions*.

35 *Ibid.*, pp. 6–7.

36 W.H. Nelson, *Final Report on the Survey and Settlement Operation in the District of Rajshahi, 1912–1922*, Calcutta: Bengal Secretariat Book Depot, 1923, p. 8.

entire catchment area.[37] Such inadequate openings were found in almost every culvert or railway bridge in the Delta.[38]

The main EBR line (Calcutta-Siliguri) ran across the Rajshahi plains, the natural slope of which was towards the east. Railway embankments interrupted the natural drainage of the country causing a blockage of a great volume of water, the effect of which was the complete destruction of *aman* (autumn) paddy, the only subsistence crop of the land, during rainy periods. The water took a long time to escape through the culverts and bridges which were very few in number. Again, its escape to the river Brahmaputra was obstructed by the Sara-Sirajganj embankment and consequently destroyed the crops of another area. A part of the line also passed close to the *Chalan beel* and thus prevented its flush water from draining to the Brahmaputra; the result of this interruption was the speedy silting up of the *beel* and the consequent reduction of its water-holding capacity. This reduction, according to a government official, was one of the factors underlying the frequent flooding following the construction of the Sara-Sirajganj Railway. The cultivators of the vast area to the north-west of the Sara-Sirajganj line had to forgo the cultivation of *rabi* (winter) crops as the fields did not dry up in time for cultivation. They now resorted to sowing seeds in the mud. 'Any one with an ounce of knowledge in Agriculture could', reported an official, 'easily imagine how a crop of mustard, lentil, wheat or barley fares if thus sown.' He continued to report that he was not speaking of years of abnormal rainfall, but of normal years.[39]

A devastating flood took place in Bogra and Rajshahi in 1918, beginning with excessive rainfall on 21 August in Bogra. The most affected area lay on both sides of the EBR between Hilli and the Nator rail station. The water east of the EBR banked up and was prevented from flowing away by the embankment of the Bogra line. Meanwhile, heavy rainfall took place in Rajshahi on 24 August and this added to the flood water draining from the

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[37] B.M. Mukherjee, Executive Engineer, Khulna Division, to Superintendent Engineer, Proceedings ('B') of the CBI Dept. (Railway), 21 June 1945, bundle 2, list 70, file 1W-1/(19)46, NAB, Dhaka.

[38] A long list of culverts and bridges with inadequate openings is provided in the Proceedings ('B') of the CBI Dept. (Railway), bundle 2, list 70, file 1W-1/(19) 46, NAB, Dhaka.

[39] Superintendent of Agriculture, Rajshahi Division, to Deputy Director of Agriculture, Northern Circle, Public Health Dept., 24 November 1922, in 'B' Proceedings, nos. 156–57, bundle 5, list 4, file P.H.4A-14/1925, NAB, Dhaka; For a description of the contribution of railway embankments to the 1918 flood, 'heaviest of all' of north-eastern Bengal, see *Final Report on the Flood of Rajshahi Division During the year 1922*, pp.1–2, in Proceedings of Revenue Dept., July 1925, NAB, Dhaka.

Bogra and Dinajpur districts in the upstream and caused the entire northern Bengal to be flooded. Here too the railway embankment prevented the flood water from draining off quickly. Between 1,300 and 1,400 square miles of land were affected in which more than 200 square miles of crops perished.[40] The Bogra line up to Bogra ran almost directly east blocking the natural flow of water of a part of the country which sloped from north to south. This caused damage to the only crop (*aman* variety of rice) of the tract since the water could not drain. But as the flood water slowly moved further down either through an insufficient number of culverts and bridges or by over-topping or breaching the embankment, it was again obstructed by a part of the Sara-Sirajganj Railway embankment. The same degree of devastation of crops occurred in these tracts until the water finally found its way into the Brahmaputra. [41]

Case Study II: Assam-Bengal Railways (ABR)

While the EBR ran mainly across the Ganga watersheds, the ABR covered the eastern half of the active Delta that was under the sway of the Brahmaputra and the joint flow of the Meghna and the Padma (Ganga). The ABR entered the plain of the Delta through Mymensingh and finally reached Chittagong, connecting parts of the Dhaka, Comilla and Noakhali Districts. The ABR line from Bhairab Bazar to Kishorganj crossed the spill of the Meghna over its right bank. The line gradually diverted towards the West and ran between the two rivers, the old Brahmaputra and the Ghorautra. The Ghorautra was a live effluent river of the Meghna and it carried almost the entire run-off of the southern slope of the Garo Hills. There were a few *beels*, which drained into the Ghorautra river through the openings in the railway line. It appeared that due to the obstruction in the spill of the Meghna, the spill of the Ghorautra river spread over the area and was obstructed by the railway.[42]

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[40] J.T. Rankin, Commissioner of Rajshahi, to Secretary to Government of Bengal, Revenue Dept., 25 November 1919, in 'A' Proceedings of Revenue Dept., nos. 9–10, wooden bundle 33, list 14, file 6-F-1/ 1919, NAB, Dhaka.

[41] Superintendent of Agriculture, Rajshahi Division, to Deputy Director of Agriculture, Public Health Dept., 24 November 1922, in Proceedings ('B') of Public Health Dept., nos. 156–7, list 4, bundle 5, file P.H.4A-14, NAB, Dhaka.

[42] 'Taking Afflux Observations on Bengal and Assam Railway Water Openings Between Kishorganj and Bhairab-Bazar', CBI Dept. (Railway), unrecorded files, bundle 1, list 70, file 122-5/1941, NAB, Dhaka.

It was reported that early and high flooding became an annual feature of the vast surrounding areas since the construction of the Mymensingh-Bhairab Bazar line. Untimely flooding damaged *bowa* and *jail* paddy as well as jute.[43] According to the Executive Engineer of the Mymensingh Division the drainage problem would be solved if the spans of the two Railway bridges along the main line (Chittagong-Akhaura Railway) were increased.[44] During 1931-2, on account of a heavy rainfall in the Assam Hills the areas on both sides of the Brahmaputra up to a distance of 20 miles from the river were submerged and consequently about 60%, 25% and 25% respectively of the standing crops of *aush* and *aman* paddy and jute were damaged. About 1300 square miles with a population of over 500,000 were affected. All the sub-divisions and almost all the *thanas* of Tangail suffered the loss or damage of standing crops.[45]

The situation in Comilla was more critical. The district was bounded on the east by the Tripura (Tippera) Hills and the fringe of lands on the west formed a gradual slope which had the Titas and Gumti rivers as its outfall. The ABR main line ran almost parallel to the Tripura Hills and cut through the extreme eastern boundary of the subdivision of Brahmanbaria where this portion of the railway existed like a ridge on the eastern slope, thus obstructing the surface water's free passage down the slopes which fell into the Titas and the Gumti rivers and other drainage canals lying to the west of the railway. A sub-divisional officer reported:

> The one physical fact that stands out in differentiating the present from the past is the branch railway line from Akkaura [Akhaura] through the Brahmanbaria to Ashuganj which passes through as many as six union boards. From 1910 (since the start of this line) there has been an appreciable deterioration in the agricultural condition and the health of the people in general. Malaria fever and kala-azar are found to be in prevalence in the villages situated alongside the railway lines. In normal years the difference in the water levels on the two sides of the branch and main lines is more than one cubit.[46]

The magnitude of the problem in the district of Comilla in general and Brahmanbaria subdivision in particular could be appreciated from the fact that these areas had to cope with a huge amount of the surface water that

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43 *Bengal Legislative Assembly Proceedings* (*BLAP*) 56, 4 (1940), pp. 92–93.

44 'Extracts from notes and orders of Railway Branch', 3 September 1943, CBI Dept. (Railway), 'B' Proceedings, bundle 2, file 13C-6/194, NAB, Dhaka.

45 *Final Report on the Relief Operation in the District of Mymensigh During the Years 1931–1932*, Revenue Dept. (Land), 'A' Proceedings, bundle 1, list 90 (A), file 80-R-7H, NAB, Dhaka.

46 R.C. Sen, Subdivisional Officer, Brahmanbaria, to Collector, Tippera, in Proceedings of Irrigation Dept., no. 22, April–June 1926, NAB.

rushed from numerous sources apart from the rainfall in the district itself. These included world-record rainfall in Cherapunjee and Silchar, rainfall in Sylhet and Cachar, and rainfall in the Tripura Hills. Along with these sources, floods in the river Gumti and even the surface water of the tract on the border of the Meghna river flowed here. With a new railway line in place the accumulated water failed to drain or subside quickly, resulting in the failure of important crops. At the same time, the sowing and transplantation of other crops was delayed. The area had to face food shortages and distress in 1915 owing to the failure of crops due to high floods in May and June which destroyed three principal crops: *aush* and *aman* paddy and jute. In 1926, the low lands between the two railway lines were completely under high water for an unusually long time and the standing crops, mainly jute, were destroyed. The situation was further aggravated by an insufficient number of bridges on the ABR.[47]

The scenario in Noakhali and Chittagong, the south-eastern segment of the active Delta, was no different. It was reported, for instance, that the culvert just south of Baraiyadhala Railway Station was too narrow to allow the water of the Chittagong Hill streams to pass freely. The obstruction caused silt and gravel to deposit on the bed of the stream and the channel which was six to eight cubits deep became entirely filled. The water, therefore, ran over the neighbouring fields. As a result betel vine cultivation was damaged 'year after year' on account of fungus diseases due to submergence. The loss in the year 1922 amounted to several million rupees and had entirely deprived the *Barais* (local traders in betel) of the locality of their livelihood. In Noakhali, owing to the narrowness of the railway bridges, drainage was obstructed and thereby caused damage to the crops in the fields of Maizbaria, Gobindapur, Cheoria, Alakdia, Kalidhar and other villages. In 1915, some 20 square miles in the Feni subdivision were flooded with the result that the *aush* paddy was damaged and this, along with other factors, contributed to food shortage and starvation in the region.[48]

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[47] Superintendent of Agriculture, Chittagong, to Deputy Director of Agriculture, Proceedings ('B') of Public Health Dept., March 1925, nos. 156–157, bundle 5, list 4, file P.H.4A-14, NAB, Dhaka; *BLAP* 62, 1 (1942), p. 76.

[48] *Final Report on the Relief Operations in the District of Noakhali in 1915*, Proceedings ('A') of Agriculture Dept., bundle 29, list 14, file 95, NAB, Dhaka.

The Railway Bridge and its Ecological Implications: The Hardinge Bridge

The problem with railway embankments was not limited to inadequate openings through culverts. Larger bridges also posed a considerable menace to the water system of the region. As Bengal rivers carry a huge amount of silt, siltation takes place due to quite trivial causes, such as a fallen tree or a sunken boat. Since even such objects contributed to the deposition of silt and sand, a railway bridge with its pillars and piers easily played the role of a fallen tree or a sunken boat. The *pucca* floor of the Malachi bridge on the Boral river was termed 'very objectionable' as it tended to raise the bed of the river.[49] In addition, the obstructive action of culverts and bridges of a small span, whether on railway lines or on roads, helped to slacken the current and deposit silt.[50] There were also allegations that activities relating to the control of rivers for saving railway establishments contributed to the recurring problem of river-bank erosion. The stretch of continuous revetment at Pabna which had to bear the full force of the main stream did not prevent the river from cutting away large chunks of the bank immediately below. The great Goalundo spur, constructed in the 1920s at a cost of £120,000, did not save Goalundo: it rather caused a scour to the depth of 180 feet, got itself destroyed and failed to save the railway settlement it was meant to protect.[51] The Hardinge Bridge over the Ganga at Sara (on Sara-Sirajganj line) provided an ideal example of the problems associated with railway bridges. In fact, well before the opening of the bridge in 1915, the fishermen of the Ganga feared that it would arrest the current to a certain extent and lead to the deposition of silt and drying up of *beels* and inland fisheries.[52] But, how well-founded were these apprehensions?

The project of the Hardinge Bridge was formulated towards the close of the nineteenth century, but the actual construction started in 1911. The bridge was expected to cater to the need of connecting the most important jute-growing areas of the Delta with Calcutta as well as to avoid the double trans-shipment and delay on the Ganga. The line was also expected to lead to a large increase in the passenger traffic between Darjeeling and Shillong

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49 Proceedings of Irrigation Dept., no. 22, April–June 1926, p. 65.

50 Kiran Chandra De, *Report on the Fisheries of Eastern Bengal and Assam*, Shillong: Secretariat Printing Office, 1910, p. 71.

51 *Note by C. Addams Williams on the Lectures of Sir William Willcocks on the Irrigation in Bengal Together With a Reply by Sir William Willcocks*, Calcutta: Government of Bengal, 1931, p.10.

52 Kiran Chandra De, *op. cit.*, p. 71.

and Calcutta. The bridge was considered the 'most important engineering scheme' of the time in India and in some respects 'one of the most notable in any part of the world'. The difficulty that confronted the engineers during the construction did not relate to the question of how to span more than a mile of Ganga water but to the question of how to control the river which frequently changed its course. Therefore, the first thing the engineers attempted was to harness the strong current of the Ganga. Since the annual rise of the river in flood time was about 31 feet and a maximum flood discharge at the site of the bridge was 2,500,000 cusecs, the river control project appeared to be a gigantic one. A pair of guide banks was constructed at the bridge site to prevent further lateral movement of the river, and a revetment of the banks was built at the two ends of the projected bridge (one at Sara Ghat Station and another at Raita Ghat station). It was computed that the amount of stone used in 'pitching' these guide banks of sand and clay would fill a broad-gauge train extending from Calcutta to Darjeeling.[53] One of the noticeable features of the project was the approach work which alone cost 8.4 million rupees. On the left bank the approach was about 4 miles long and for 2,000 feet of that length the approach had the unusual height of 50 feet above the surrounding area. On the right bank the approach was three miles long with similar characteristics. The project sometimes employed as many as 25,000 coolies at a time. The bridge stood on 16 piers, 63 feet long and 37 feet wide, for which well foundations were dug 150 feet deep. The great depth of the wells, the deepest in the world at that time, was necessary in the context of the enormous scouring of the river. The piers were formed out of concrete blocks above the steel caissons, and steel trestles above the high flood level. The wells required 36,00,000 cubic feet of 1.50 stone ballast, 2,000,000 cubit feet of sand, 125,000 casks of cement and 7,906 tons of steel work.[54]

The modern bridge-building technology and engineering as exemplified by the Hardinge Bridge, however, came at a cost. The areas covering hundred of square miles around the bridge suffered in various ways. It was reported that the training works caused a 'complete upset in the Ganges below and above'. In July 1928, at Lalgola of Rajshahi, for instance, the Ganga cut away a strip of land 100 feet wide and 55 feet deep in one night: 'this erosion extended for a good many miles above, where the deep channel ran along the bank. Many spurs in this province were abandoned because of

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[53] *Hooghly to the Himalayas. Being An Illustrated Handbook to the Chief Places of Interest Reached by the Eastern Bengal State Railway*, Bombay: Times Press, 1913, p.25.

[54] *Ibid.*, pp. 26–26.

the damage they caused'.[55] Surprisingly, the effect of the bridge was felt as far north as Murshidabad. It was reported from Murshidabad, where a lot of *aush* paddy perished in a devastating flood in 1939, that the direct cause of the flood was the overflow of river water from Padma and its tributaries, i.e. Jalangi, and that the overflow was partly due to the 'heavy back-rush' of currents in the river caused by the obstruction at the Hardinge Bridge.[56] The damage to crops caused by the flood in Murshidabad was 90%, 25% and 75% for *aush* and *aman* paddy and jute respectively.[57] In 1941, cultivators complained that flood water had 'banked up' against the piers of the bridge and inundated the fields for miles around.[58] More alarmingly, the gigantic bridge-making work had an adverse impact on the water regime of the region in general. For instance, since the construction of the bridge, a few channels of the Dhaleswari river had unexpectedly flown into the neighbouring *beel*. The strong current of water along these channels regularly caused extensive damage to paddy crops cultivated in an area of about 20 to 30 square miles. At the same time, the bridge enormously contributed to the deterioration of the Ganga (Padma, as it is known in Bangladesh) by helping desposit silt. Over the years, siltation has occurred to such an extent that motor cars are seen plying under the Bridge in the dry seasons.

Conclusions

As discussed in this essay, the results of ecologically unsustainable development of the railways in the fluvial landscape of the Bengal Delta were disastrous for agrarian Bengal. It would perhaps be naïve to attribute agricultural decline in Bengal from the early twentieth century to the railways alone.[59] But there are indications that the railway embankments, by contributing to the deterioration, drying up and death of various types of water bodies, may well have indirectly contributed to the overall agrarian decline in Bengal. Cultivable waste land in the Bengal Delta increased over

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55 *Note by C. Addams Williams*, p.10.

56 *BLAP* 53, 2 (1937), p. 375.

57 *BLAP* 55, 4 (1939), pp. 142–3.

58 Seith Drucquer, 'On the Rivers in East Bengal', *The Geographical Magazine* 12, 5 (March 1941), p. 352.

59 A detailed account of environmental degradation in colonial Bengal is given in Iftekhar Iqbal, *Ecology, Economy and Society in the Eastern Bengal Delta*, unpublished PhD thesis, Cambridge, 2005.

the first few decades of the twentieth century, for instance.[60] In the case of western and central Bengal, an explanation of this might be found in the fact that these regions lost population due to the moribund state of the deltaic landscape and the spread of malaria. But, it is not explained by historians of Bengal why cultivable wasteland existed in eastern Bengal, where the growth rate of population was more than in other areas and where land was still comparatively more fertile. Deterioration in the water system led to flooding, failure of crops, water logging and loss of navigation and marketing facilities. Whereas eastern Bengal exported rice throughout the nineteenth century, by the beginning of the twentieth century, it had to import rice for subsistence, particularly from Burma. Historians have argued that one of the reasons for the Bengal Famine in 1943 was the stoppage of importation of rice from Burma during the Japanese occupation. But they have hardly enquired why, in the first instance, rice production declined in eastern Bengal. In this context, it might be assumed that the decline in the ecological regime led to a decline in both commercial and subsistence produce which, in combination with other factors, ultimately led to the famine. One needs to raise the question whether the railways with their long arms of embankments could partly be responsible.

The railways in Bengal in particular and India in general expanded amidst overwhelming approval from investors in London and colonial officials and an emerging middle class in Calcutta.[61] A positive perception of the railways was so wedded to the state-formation process that there was hardly any room for critical voices. An overt emphasis on the potential of the railway as a system and symbol of modernization met with a sharp reaction from those who were sceptical about modernity itself. But the emerging colonial knowledge of the railways—among advocates and opponents alike—failed to grasp the extent of the threat to the ecology of the region. Karl Marx hoped for an extensive irrigation system, emerging as a result of digging the soil for railway embankments, but he did not see the problem of drainage. On the other hand, Gandhi could well perceive the railways as carriers of fatal diseases like the plague, but he did not pay much attention to the capacity of the railways to create disease itself by destroying the environment. Surprisingly, a scientific approach to the problem of embankment in the deltaic landscape of Bengal came from a segment of the colonial of-

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60 H.S.M. Ishaque, *Agricultural Statistics by Plot to Plot Enumeration in Bengal 1944 and 1945*, part II, Alipore: West Bengal Government Press, 1947, pp. 8–9.

61 For a discussion of the elite and middle class approval of the railways see Iftekhar Iqbal, 'The Railway in Colonial India. Between Ideas and Impacts', in Roopa Srinivasan et al. (eds.), *Our Indian Railway. Themes in India's Railway History*, Delhi: Foundation Books, 2006, pp. 175, 180–83.

ficialdom. In 1846, a committee appointed to examine the problem of embankments in Bengal put forward some strong arguments against any barrier in the fluvial and flat landscape. Comprised of two engineers and a botanist, the committee proposed a 'return to that state of nature, which, in their opinion, ought never have been departed from.' To achieve this goal, the committee recommended the total removal of all existing flood embankments to allow the free flow of water. The proposed system, to be built in consonance with 'local experience', was tantamount to reversing the existing system of embankments by substituting them with drainage.[62] But this possibility had soon to give way to a solution favouring the construction of railways on high embankments—a clear reflection of the enthusiasm for modern technology and the interests of powerful capitalists. 'Science of tradition' was easily replaced by a 'science of the steam engine'. When CA Bentley reiterated his concern in the early twentieth century over the negative impact of the railway systems on the water regime of Bengal and on its ecology and agriculture, it was too late, for the railways had already become an integral part of public life.

62 Government of Bengal, *Report on the Embankments of the Rivers of Bengal.* Calcutta: W. Ridsdale, 1846, pp. 1–4.