



# Coal, Firewood and Plant Stalks: Availability of Fuel and Development of Industries in Early Nineteenth-Century Bengal

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# Coal, Firewood and Plant Stalks: Availability of Fuel and Development of Industries in Early Nineteenth-Century Bengal\*

Sayako Kanda\*\*

## I. Introduction

This study is part of my research project, which is a historical analysis of India's industrial development in terms of energy between 1800 and 1950. As Morris David Morris pointed out, the extremely high price of energy,<sup>1</sup> and energy constraints, was one hindrance to India's industrialisation. Despite the importance of energy use and availability, previous studies on the industrialisation of colonial India have paid little attention to energy.<sup>2</sup> Colonial policies (or lack of policy) on energy imposed restrictions on India's industrialisation, and it has been observed that this was one of the major causes of India's 'underdevelopment'. However, if we overemphasise colonial rule, we will only obscure the actual process of industrialisation that has led to India's strong economic performance today. In fact, India had a severe fuel problem—scarcity of forest products due to large scale deforestation—long before the advent of British colonial rule.<sup>3</sup> For instance, even in the seventeenth century, Bombay was notorious for its high fuel prices. British rule itself did not create the problem, although it did intensify it. Neither the emergence of the coal industry in Eastern India, nor the extension of the railways, ever fully integrated India's energy market.

My research project will suggest that regional differences, and the co-existence of different energy sources in a particular regional market, were two distinct features of India's energy market, and that these features supported the existence of regionally different industries, and the industries of various sizes in one region. Such diversity still characterises industrial development and the use of energy in India today. Importantly, these features developed over a long span of time, with the result that local ecological

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<sup>1</sup> Morris D. Morris, 'The growth of large-scale industry to 1947', in Dharma Kumar (ed.), *The Cambridge economic history of India*, vol.2 (Cambridge: Cambridge University Press, 1983), pp.599-600.

<sup>2</sup> Rajat Ray referred to the motorisation of modern industries in early twentieth century India. See his *Industrialization in India: growth and conflict in the private corporate sector 1914-47* (Delhi: Oxford University Press, 1979), Chapter 3.

<sup>3</sup> For example, Sumit Guha, *Environment and ethnicity in India 1200-1991* (Cambridge: Cambridge University Press, 1999); C. A. Bayly, *Indian society and the making of the British Empire* (Cambridge: Cambridge University Press, 1988).

conditions determined the direction of industrial development. In other words, industries developed a particular mechanism of survival, and adjusted themselves to the environment and its changes.

To understand these features on an empirical basis, this study takes Eastern India in the early nineteenth century as a case study. At that time, this area faced serious fuel shortages brought about by rapid economic development and ‘modern’ industries. This study will first show how the fuel crisis made it necessary to create markets for various fuels—coal, firewood and various low-calorie plant stalks—probably for the first time in history. Second, it examines how indigenous industries adjusted themselves to such difficult conditions, by entering the salt industry—one of the major fuel-consuming industries.

## II. Energy Constraints in Colonial India—An Overview

Before examining the emergence of a regional fuel market in Eastern India in the early nineteenth century, we set out the overall structure of the energy market and its problems. Since coal was the most important source of industrial energy in colonial India, the availability of coal influenced the structure and direction of the energy market as well as the speed and quality of India’s industrialisation.

As **Figure 1** shows, until the late 1890s, about half the coal supply in India came from foreign imports. Stimulated by the growth of heavy industries, particularly the iron and steel industry, India’s coal production increased rapidly in the early twentieth century, after a century of slow development. Considering India’s rapid industrialisation in the late nineteenth century, led by the jute and cotton industries, it is most likely that such a slow increase in coal supply prevented greater growth in these industries and its economic ramifications.

The site of coalmines also influenced the direction of industrialisation. Coalmines were located mainly in Eastern India, in Bengal and its adjacent states. **Figure 2** shows how Bengal dominated coal production throughout the period, and the increase in production in the twentieth century depended solely on the development and expansion of coalmines in Eastern India. In 1907, sixty-four coal companies were registered in Bengal, but only two in Madras and one in Bombay.<sup>4</sup> This implies that provinces or cities that had poor access to coalmines in Eastern India faced a grave disadvantage in securing sources of power for industries. Extensive railway networks that had covered much of the subcontinent did not mitigate a scarcity of coal in coal poor regions, since the long-distance rail transport of bulk coal greatly increased its price. Unlike Bengal,

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<sup>4</sup> Commercial Intelligence Department, India, *Note on the production and consumption of coal in India up to the year 1907* (Calcutta: Superintendent Government Printing, India, 1908), pp.26-28.

Bombay and Madras had to secure other sources of supply, to ensure that such a geographical disadvantage did not cause industrialisation to stagnate. In Bombay and Madras, there was a large market for Welsh coal until the late nineteenth century.

In the early nineteenth century, steamships were the dominant consumer of coal. As a result of the extension of railways after the 1860s, followed by the development of such modern industries as the jute industry in Calcutta and the cotton industry in Bombay, the consumption of both domestic and foreign coal increased. **Figure 3** illustrates the distribution and consumption of coal in 1907, which represents the trend of the late nineteenth and the early twentieth centuries. Various transport industries were the leading consumers. After World War I, the main consumers in the later period gradually became manufacturing industries rather than transport. The growth of heavy industries such as iron and steel increased their share of coal consumption, which stimulated further development of the coal mining industries. Since the coalmines were mainly owned by British managing agencies, coal, especially that of good quality, was preferentially allocated to British-owned modern large-scale industries. In the early twentieth century, the rapid development of heavy industries, including Indian-owned ones, gradually reduced such discrimination in distribution. On the other hand, very little coal was allocated to indigenous or small-scale industries.

As stated above, regional and sectoral divisions characterised the coal market of colonial India, and this character of the coal market had an impact on overall energy use. There was a clear regional difference in energy use, and the railways did not fully integrate the energy market. As noted, Eastern India had a distinct advantage over the West and South. In the early twentieth century, scores of hydroelectric power plants were constructed in coal-poor Western and Southern India, to supply industries with cheaper power.<sup>5</sup> This eased, to some extent, energy shortages in Bombay and other places, but the price of hydroelectricity in India was very high due to the cost of constructing water tanks that had to be large enough to accumulate torrential rain.<sup>6</sup> In addition to coal and hydroelectricity, varieties of biomass fuels, such as firewood, charcoal and various dried plant stalks, were developed and exploited for industrial purposes. Even in coal-rich Eastern India, the abundance of coal stimulated the further development of modern industries, but this intensified the constraints on fuel availability in other industries, particularly indigenous industries, as will be examined in the next section.

Not until 1944, did the government intervene in the energy market to mitigate serious energy shortages, except for some power plant schemes in South India. Nor were there any systematic industrial policies to allocate energy resources efficiently. The private sector had to deal with the energy problem, and this required a huge sum of

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<sup>5</sup> Whitcombe, 'Irrigation', Kumar (ed.), *The Cambridge economic history*, pp.731-734; Ray, *Industrialization*, pp.65-66.

<sup>6</sup> Morris, 'The growth of large-scale industry', p.600.

money. For example, Tata financed the first hydroelectric power plant in Bombay.

The situation under British rule, including colonial policies and the development of resource-intensive modern industries, affected the speed, direction and quality of industrialisation. At the same time however, the indigenous industries had survived by adjusting themselves to such poor fuel availability, and they had developed slowly for centuries, before colonial rule. This pattern of development appears to have influenced the direction of industrialisation in modern India.

### **III. Emergence of Fuel Markets in Eastern India in the Early Nineteenth Century**

In the early nineteenth century, serious fuel scarcity occurred in Eastern India. The crisis was brought about by the following three factors. First, the already tight supply-demand situation for coal became even tighter. There was an increasing demand for coal by the steamships introduced on the Ganges in the 1820s, and by the motorised factories, such as foundries and flourmills, in and around Calcutta. Although the commercial production of coal began in Bengal in 1815, the amount produced was unable to meet the demand. Second, there was a growing demand for straw as a building material, as a result of vigorous economic activity, particularly in and around Calcutta; this created a market for straw. Straw was used both as a building material and as a fuel. Peasants began to sell straw in the market for immediate cash, and this meant that indigenous industries lost their customary right to gather straw after the harvest, and had to compete with other buyers. Third, the *jalpai*, or fuel lands—wastelands on which indigenous industries depended for fuel—began to disappear in Lower Bengal. The loss was largely a result of the reclamation of wastelands and of ecological changes, especially the diversion of river courses and soil erosion.

The shortage of coal, straw and grass encouraged the commodification of biomass. Wood began to be utilised as an alternative fuel to coal, particularly in steamships. Being dependent on biomass fuels, indigenous fuel-consuming industries had to deal with this new situation. Such industries had relied for fuel on their respective local ecological conditions and the local society, in which they were given customary rights to collect fuels, but they began to depend more on the market for their fuel.

When the first shaft mine opened in 1815, at Raniganj, the English East India Company (hereafter the Company) took on the development of Burdwan Coalfield and the Damodar Valley.<sup>7</sup> Raniganj became a going concern after Alexander and Co., one of

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<sup>7</sup> The Company first advanced William Jones, an entrepreneur, 40,000 Rupees, with Alexander and Co., one of the largest agency houses of Calcutta, as his surety. Jones leased coal-bearing land from a prominent landholder in Burdwan, and named it 'Raniganj'. Blair B. Kling, *Partner in empire: Dwarkanath Tagore and the age of enterprise in eastern India* (Calcutta: Firma KLM Private, 1981), pp.94-121.

the major agency houses in Calcutta, entered colliery management in 1824. The output of the Raniganj coalmines in 1824 was about 149 tons, which gradually increased to 7,721 tons in 1827, and to about 15,000 tons in 1832, at which time the agency house became bankrupt. Charge of the Raniganj coalmines was given to Carr, Tagore and Co., in 1836. The firm had been established during the economic recession in the early 1830s by Dwarkanath Tagore, in partnership with William Carr, William Prinsep and others.<sup>8</sup> The growing demand of coal for steamboats around that time led to the expansion of the coal mining industry in Burdwan District.

Most coalmines were located in the Damodar Valley, around the Raniganj Coalfield. Other mines, including Naraincoory, Chinacoory and Barakar, were also situated near Raniganj. Barakar coal was considered as the highest quality among the rest. Carr, Tagore and Co. owned the Raniganj and Chinacoory mines, while Nraincoory and Barakar belonged to Gilmore and Homfray and Co. These two firms jointly established the Bengal Coal Company in 1843.

The largest consumer of coal was the Company, which owned a number of river steamers. After the steamer Hugli successfully navigated the river Ganges in 1828, the Company introduced nine additional steamboats by 1840, four of which were river steamers<sup>9</sup>, and in total, they had a capacity of 600 horsepower. On the assumption that a steamboat would sail fifteen hours per week, four river steamboats would consume 7,500 tons of coal per annum, an amount equivalent to thirty per cent of the total output of Carr, Tagore and Co. By 1849, the Company's total number of steamboats had increased to nineteen, of which ten were for river navigation. In addition, there were fifteen privately owned steamships. The supply of domestic coal was still too small to meet such rapidly growing demand, and the shortage was supplemented by English coal.

In addition to the production capacity in Bengal, domestic coal had the following two disadvantages: quality and price. Burdwan coal was inferior in quality due to its higher content of ash and water, and the market preferred foreign coal, especially New Castle and other North of England varieties. In 1842, the price of Burdwan coal was 0.5 Rupees per maund (about 37.3 kilograms), which was only slightly lower than that of superior English coal, which sold at the rate of 0.5625 Rupees.

The following factors contributed to the high price of Bengal coal. First, Carr, Tagore and Co. monopolised the market in both imported and domestic coal. Second, there was a temporal factor: in the early 1840s, production declined sharply, due to the devastating floods that hit the coalfields in Burdwan District. Third, the outbreak of the Opium War created a sudden and large demand for coal for use in war vessels. Finally,

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<sup>8</sup> About the firm, see Kling, *Partner in empire*.

<sup>9</sup> Kling, *Partner in empire*, p.99. For the details of steamboats, see Henry T. Bernstein, *Steamboats on the Ganges: An exploration in the history of India's modernization through science and technology* (Hyderabad: Orient Longman, 1960).



the high cost of transport from Burdwan Coalfield to Calcutta raised the price of coal. Most Burdwan coal was first conveyed to the Amta coal depot via the Damodar, and then transported to Calcutta via the Hugli.<sup>10</sup> Though the Damodar was one of the most important trade routes, the transport of coal on it was limited to ten days during the rainy season, between July and September, when the water level was sufficiently high.<sup>11</sup> During this period, coal boats plied between Burdwan and Amta. Such constraints on water transport cost the firm a great deal. First, when the depth of water was insufficient for a coal boat to proceed, it had to abandon some of its cargo. Second, the firm had to secure boats and boatmen well in advance, by paying extra charterage. In the early nineteenth century, there was fierce competition for boats and boatmen, because of the expansion of the internal market and brisk trading activity.

Since most coal consumed in Eastern India was for steamers, several coal depots were established along the main river routes between Calcutta and Allahabad, and between Calcutta and Assam. These coal depots were Rajmahal, Monghyr, Dinapur, Ghazipur; Mirzapur and Allahabad on the Ganges; and Katoya, Kalna and Baharampur on the Bhagirathi. These depots were open only during the rainy season, but Khulna, Kumarkhali and Sarda, on the Sundarbans route, continued functioning even during the dry season. These depots were also long-established major commercial centres, and included the Company's factories, as well as large wholesale markets for commodities such as cotton, silk and food grain.

The Company, as the largest consumer of coal, procured coal by the system of contract. The Company invited a tender every season to choose one or two contractors. Successful contractors, who secured coal on hand or purchased coal in advance from the coal-mining companies, would supply the Company's coal depots with the stipulated amount of coal within the stipulated period of time. In the 1830s, there were several British contractors: H. T. Stewart, a merchant residing at Mirzapur, and James Cullen and Charles Betts, who were merchants, and agents of Cruttenden, Mackillop and Co. These merchants appear to have had long experience of dealing in coal.

By the late 1830s, Juggernath Doss had become a dominant contractor. He was a merchant in Barabazaar, the financial and commercial centre of Calcutta. He had been the doyen of coal interests in Eastern India, because, even before he himself became a contractor, he stood as surety for other British contractors, and was also believed to be an 'actual' contractor.<sup>12</sup> He towered over other contractors because of his experience and creditworthiness as a merchant. When the government tried to utilise Sylhet coal for steamboats in 1838, Juggernath was the only person who was given permission by the

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<sup>10</sup> Some Burdwan coal, especially Rajhara coal produced in the northwestern part of Burdwan District, found its way directly to Patna on the Ganges via the Koel and the Son, but the amount was still small.

<sup>11</sup> Kling, *Partner in empire*, p.98.

<sup>12</sup> BSP (IOR P/173/17), 13 Feb 1837, No.2.

Raja of Sylhet, to use the Cherrapoonjee, Burrapoonjee and Burrumpoojee coalmines and coal *ghats*, or river ports.<sup>13</sup>

Although Juggernath Doss had proved a reliable contractor, at the tender in May 1839, the government chose a new contractor, Cabb Wiliams. This was because Cabb Williams had ‘a guarantee from Messrs Carr, Tagore & Co for the supply of all the coal he would require. Messrs Carr Tagore & Co were also prepared to become his sureties with the government for the due fulfilment of his contracts’.<sup>14</sup> Since Carr, Tagore and Co. had more than a seventy per cent share in coal production in the early nineteenth century, full support from this company was the reason why the government, whose priority was to obtain a regular and stable supply of coal, chose an unknown person. Juggernath Doss failed to satisfy the government requirement, because he was largely dependent for his coal on new coalmines.

The Company’s contract system, however, did not work well, and there were many cases of contract failure, due to a scarcity of coal and wood. When contractors failed to secure coal, they had to procure wood instead, at the rate of five maunds of wood as the equivalent of one maund of coal, or pay penalties. However, firewood too was scarce in the market. Facing such unexpected difficulties, the Company itself launched an extensive survey of the availability of firewood, and tried to secure as much wood as possible for stable and regular steam navigation.

The Company’s records on the procurement of firewood for steamers provide a picture of the state of the firewood market in Eastern India. When coal contractors failed to supply the coal depots with coal or wood, the Controller of Government Steam Vessels himself had to collect firewood for steamers, through District Collectors and Magistrates. There had been a brisk trade in wood as a building material. However, the trade in wood as fuel seems to have begun only after the commencement of the Company rule, and was limited to supplying the Company’s troops and its silk filatures.<sup>15</sup> W. Swarman of the Dhaka Commissariat Office, who had been requested to procure firewood for the Jamalpur coal depot on the Brahmaputra in Eastern Bengal, stated the following:

... I beg to apprise you, that if any further supply of firewood will be required at Jemaulpore [Jamalpur] or the vicinity, it will be necessary that same previous notice would be given to me. The wood in use in that district is procured from the hills in the neighbourhood, and the supply, which has now been accomplished at the station, was obtained from the stock in the hands of the merchants, who had stored it for consumption by the troops. The inhabitants of the district, it appears, make use of brushwood, reeds, &ca,

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<sup>13</sup> BSP (IOR P/173/24), 28 Jan 1839, No.14. Sylhet coal was superior in quality, and the use of this coal was thought to reduce the cost and time of transportation to several coal depots in Lower Bengal.

<sup>14</sup> BSP (IOR P/173/24), 6 May 1839, No.22.

<sup>15</sup> BSP (IOR P/173/25), 10 June 1839, No.6; BSP (IOR P/173/31), 16 Nov 1840, No.11.

as fuel, so that if any wood be again requisite, it must be brought from the place of growth.<sup>16</sup>

W. J. Allen, Joint Magistrate of Pabna Foujdary Adalat [Pabna District Criminal Court], made a similar statement:

... I am sorry to inform you in reply that I find it impossible to procure wood of the kind required for steamers. When the Commercolly [Kumarkhali] silk filatures were the property of government, their supply of wood was always obtained from the Soonderbunds [Sundarbans]. I consider that wood must be sent from that quarter for the steamers, as it is not procurable in this part of the country.<sup>17</sup>

Pabna was located on the Ganges in Central Bengal, in Rajshahi District. W. M. Dirom, the Collector of this district, managed to find wood suppliers for the coal depots at Boalia, Kumarkhali and Khulna. However, the price was much higher than the highest price of coal, so the Steam Board had to decline this offer.<sup>18</sup>

**Tables 1 and 2** compare firewood and coal prices in the late 1830s. Clearly, the price of firewood was much higher than that of coal, except in Barisal.<sup>19</sup> Coal prices were dependent on the distance from Calcutta, from where coal was distributed, whereas local availability seems to have determined the price of firewood.<sup>20</sup> The procurement of wood for steamboats was not a temporary exception during periods of coal scarcity. The mixed use of wood and coal to generate steam power continued well into the twentieth century. As **Figure 4** demonstrates, wood was extensively used in railways as fuel. In some places, an exhaustion of the wood reserve for making charcoal had a serious effect on the stable running of the railways.<sup>21</sup> The lack of coal in Eastern India in the early nineteenth century created a market for wood as an alternative fuel, and this market gradually expanded after the introduction of railways, to form regional firewood and charcoal markets.

In the early 1840s, the fuel shortage grew more serious. Coal prices surged due to the inundation caused by the Damodar flood, and a rise in demand from war vessels employed in the Opium War. Difficulties in procuring wood, as noted, did not ease the situation. Furthermore, the crisis was not confined to high calorie fuels, but also began to

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<sup>16</sup> BSP (IOR P/173/25), 10 June 1839, No.6.

<sup>17</sup> BSP (IOR P/173/31), 16 Nov 1840, No.11.

<sup>18</sup> BRP (IOR P/173/31). 9 Nov 1840, No.26.

<sup>19</sup> This was probably because Barisal was located in the vicinity of Nalchhiti—the largest wood market in Lower Bengal.

<sup>20</sup> Higher prices in Allahabad and other cities in North India strongly supported that the area along the Ganges had already suffered from massive deforestation, and wood, mainly for construction purposes, was brought from distant places (Bernstein, *Steamboats*, p.111).

<sup>21</sup> John M. Hurd, 'Railways', in Kumar (ed.), *The Cambridge economic history of India*, vol.2, p.749.

influence fuels of lower calorific value. **Figure 5** shows the price of straw in Tamluk, one of the centres of salt production in Bengal, which consumed a large amount of straw in the process of boiling brine. There were several reasons for the rise in straw prices. First, a straw market appeared in Calcutta, as straw began to be used extensively as a building material, as well as domestic fuel when mixed with cow dung. Straw was thus brought from neighbouring areas, such as Tamluk, to Calcutta to be sold, and this caused a serious scarcity of straw in those areas. Second, the loss of grasslands, by reclamation and soil erosion, reduced the amount of grass used in indigenous industries as fuel, and this accelerated the further growth of the straw market.

Further examination of the prices of different fuels is needed, but it seems likely that straw prices moved in accordance with coal prices. This suggests the emergence of a wider regional ‘fuel’ market.

#### **IV. Fuels and Indigenous Industries—A Case Study of Salt**

There were several kinds of fuel-consuming industries in Eastern India. **Table 3** shows the locations and fuels of those industries. Though a large amount of fuel was consumed, indigenous fuel markets developed only on a limited scale. Fuels were obtained locally: straw and grass for the salt industry, bagasse and brushwood for sugar, wood for silk and brick, and charcoal for iron, in most cases through non-market transactions. Since all the fuels consumed in indigenous industries were biomass, local vegetation influenced the choice of fuel, and industries adapted themselves to the use of local fuels. Since the quality of products was largely influenced by the calories in the fuel, any product that was manufactured using any particular local fuel seems to have become slowly embedded in that society as a ‘taste’.<sup>22</sup>

The fuel crisis triggered by the surge in coal demand damaged the fuel-consuming indigenous industries. Let us consider one of the major fuel-consuming industries in Eastern India: salt. Salt production was monopolised by the Company, and its policy in the early nineteenth century was to maximise salt revenues by raising salt prices. Unlike other regions of Coastal India, which manufactured salt by solar evaporation, Bengal produced a boiled variety. Bengal’s high humidity required the process of boiling the brine. Thus, the salt industry consumed a large amount of fuel, particularly fuels of low calorific value, such as straw and grass, which were abundantly available in close proximity of salt-producing districts along the Bay of Bengal. Manufacturers habitually procured fuel materials from rice fields and *jalpai* lands. Salt boiled by such low calorie

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<sup>22</sup> For details, see Sayako Kanda, ‘Energy in indigenous industries: re-considering the decline of the salt industry in mid-nineteenth century Bengal’, *Keio University Market Quality Research Project, Discussion Paper Series*, DP2006-025 (February 2007).

fuels slowly, and at a low temperature, was much finer and whiter than solar-evaporated salt, and therefore there was a strong preference in Eastern India for Bengal boiled salt. Bengal salt thus sold at a much higher price in the market. Since the high price of Bengal salt promised the Company higher salt revenues, the Company's salt monopoly incorporated this preference into the system.

Salt production expanded under the Company's monopoly; however, by the mid-nineteenth century it had declined. It has been said that the influx of Liverpool salt in the mid-1850s destroyed the industry, but the industry had already lost competitiveness in the market, and declined, before the inflow of Liverpool salt.<sup>23</sup> One of the main reasons for the decline of the salt industry in Bengal was the fuel crisis, which increased the cost of production. As noted in the previous section, both straw and grass became scarce in and around the salt-producing districts, and manufacturers were forced to buy straw in the market at a higher rate, and this urged them to secure fuels from distant places. The Company was, however, reluctant to switch fuels. First, the price of all kinds of fuel was extremely high. Second, fuel conversion required new techniques and equipment fit for high calorie fuels such as firewood and coal, which would have cost the Company a lot. Third, since changes in fuel meant changes in quality, strong resistance from the market, which preferred Bengal boiled salt prepared using the 'traditional' method, was to be expected. The Company, whose policies incorporated such consumer preferences, had thus no incentive to change fuels.

Bengal salt had two competitors in the market before Liverpool salt—Coromandel and Orissa salt—both of which expanded production for the growing Eastern Indian market. Coromandel was a solar evaporated salt, and its consumption in Eastern India was initially limited, but it was gradually accepted, because of its higher quality. Orissa salt was a boiled variety, and its quality as salt was much higher than Bengal salt. It gradually increased its share in the boiled salt market in Eastern India, and led to a reduction in Bengal salt production. In the mid-nineteenth century, however, Liverpool salt drove both these varieties out of the market. Interestingly, Liverpool salt was also a boiled variety, like Bengal salt.

Clearly, there was severe regional competition in salt in Eastern India. Competition between Bengal salt and Coromandel salt depended only on the difference in taste. However, when they faced a scarcity of fuel, the more energy-efficient Coromandel salt increased its share in the market. The competition between Bengal and Orissa boiled salt was also a competition over taste and energy. Orissa salt was higher in salinity and more energy efficient, because the problem of fuel scarcity in the early nineteenth century was less serious in Orissa. In the case of Liverpool salt, the fuel used in the boiling process was coal produced in Lancashire. In terms of energy, the Cheshire salt industry had

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<sup>23</sup> Salt imported to Calcutta from the port of Liverpool was known as Liverpool salt, although it was produced mainly in Cheshire.

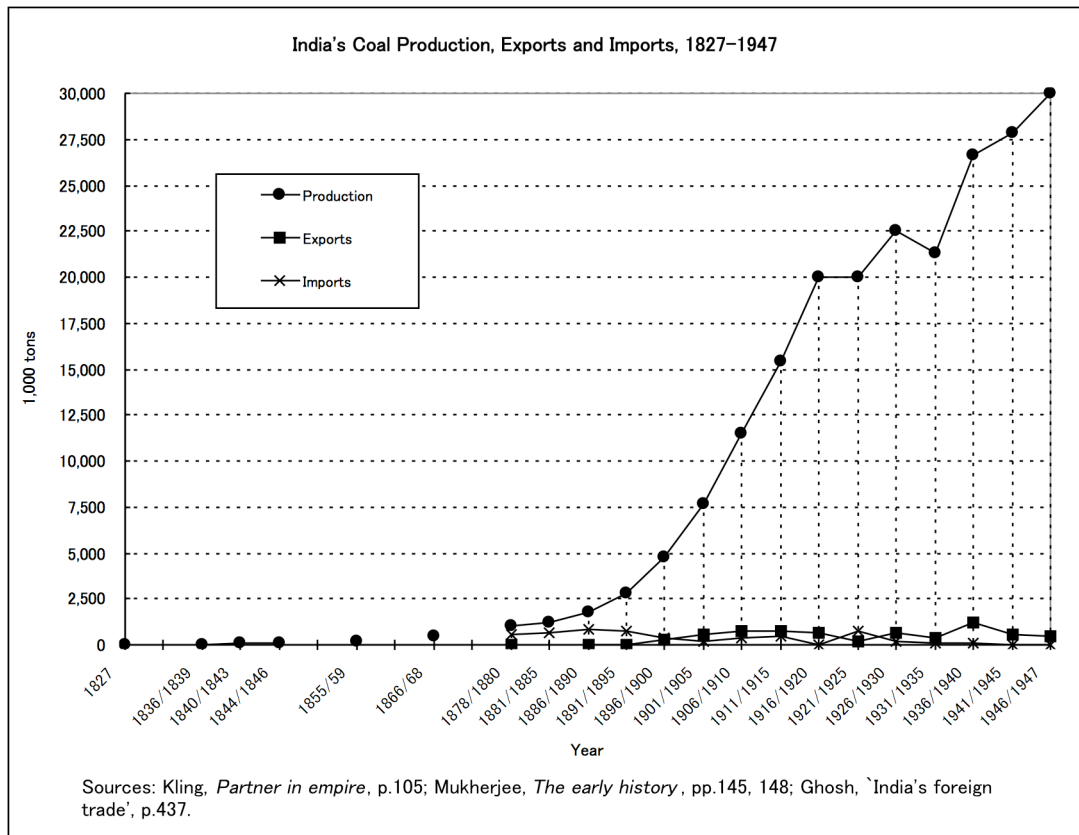
already developed a more efficient production system by concentrating capital and resources, and had increased its competitiveness in the world salt market.

## **V. Conclusion**

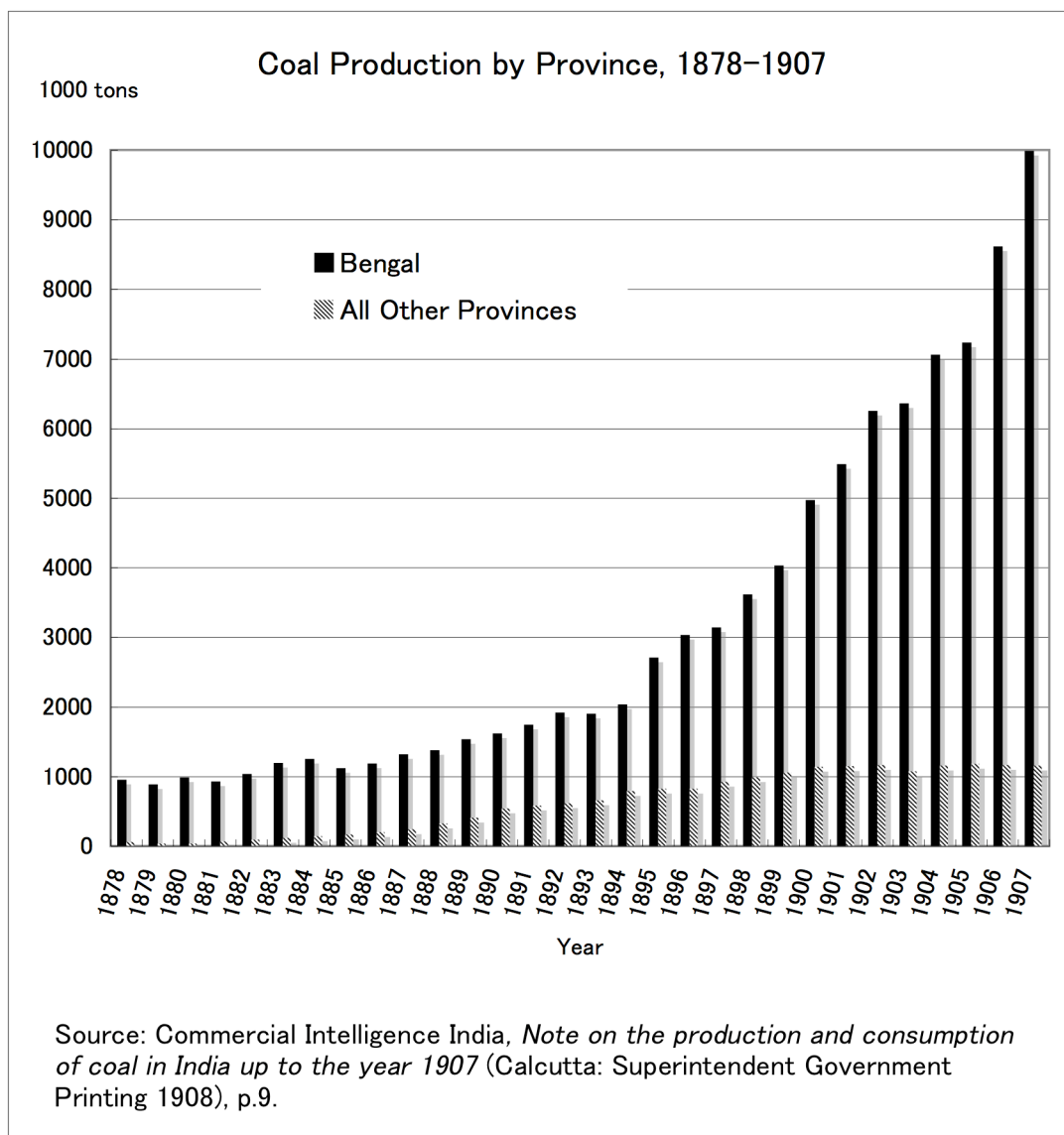
The energy problem was one of the hindrances to India's industrial development during the colonial period. Not only were energy prices high, but the market never became fully integrated, despite the development of the coal industry and the extension of the railways. The market was divided between geographical regions and industrial sectors. It is likely that the availability of energy sources, rather than capital, labour or raw materials, determined the location of both modern and traditional industries. Infrastructural and institutional development in nineteenth century India did not encourage the inter-regional movement of fuels as much as that of capital, labour or raw materials. This may have hindered the efficient allocation of resources necessary for industrial growth.

Such conditions did not necessarily appear under colonial rule. Many of the fuel-consuming industries in India had been coping with the problem of energy/fuel shortages long before British rule. The case study of salt in this paper may support the hypothesis that the existence of such severe regional competition appears to have encouraged the 'natural selection' of an industry, in which a region gave up an industry when it became less efficient in terms of fuel availability, rather than maintaining the industry by importing fuel materials, or changing fuels through technological innovation. Sophisticated commercial networks and trade institutions promoted such selection through intensive regional competition. Although further research is necessary to prove this hypothesis, this mechanism seems to be the key to understanding the evolution of industrial development in India, and the long-term relationship between industry, ecology and society.

Figure 1



**Figure 2**





**Figure 3**

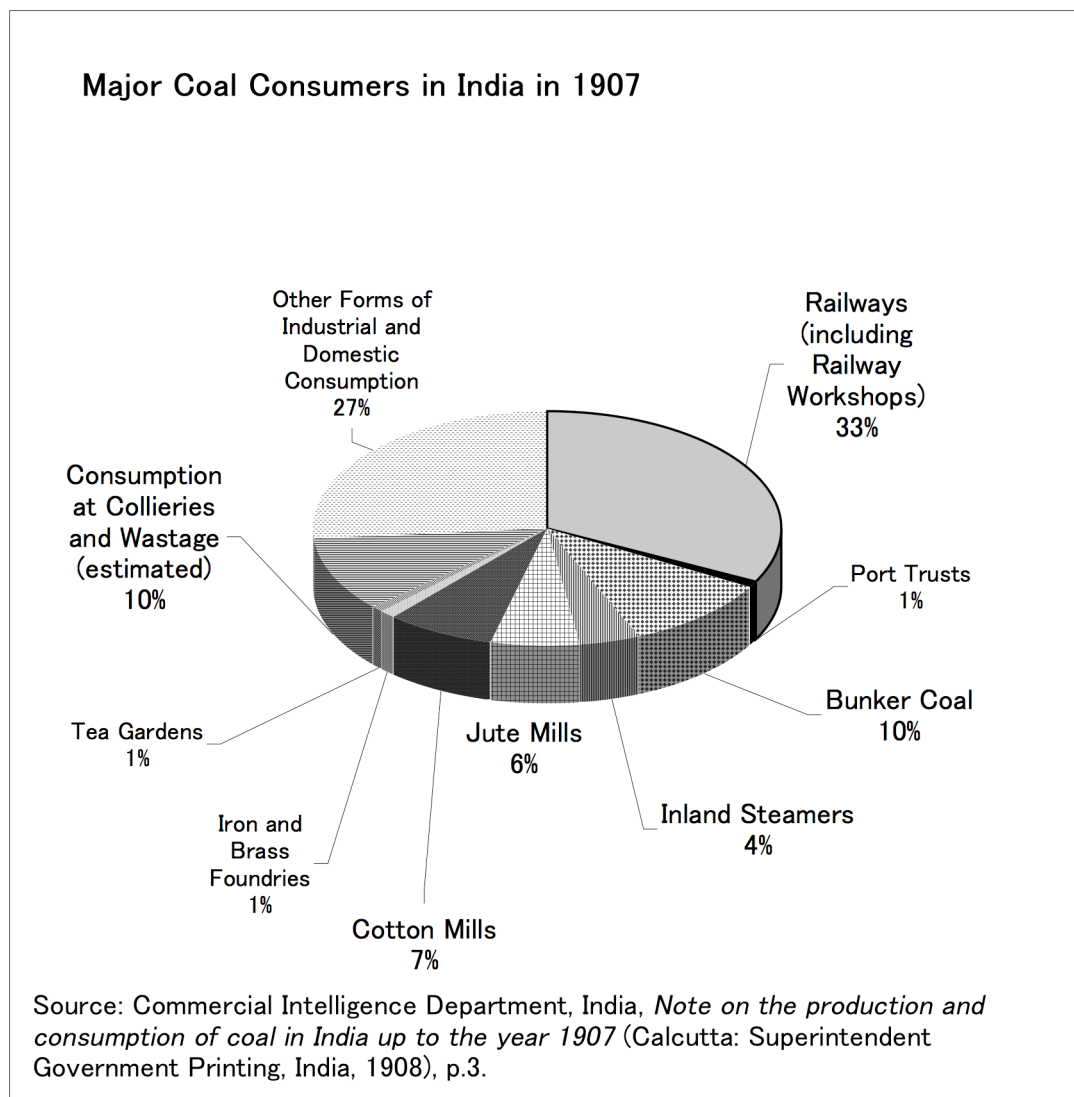
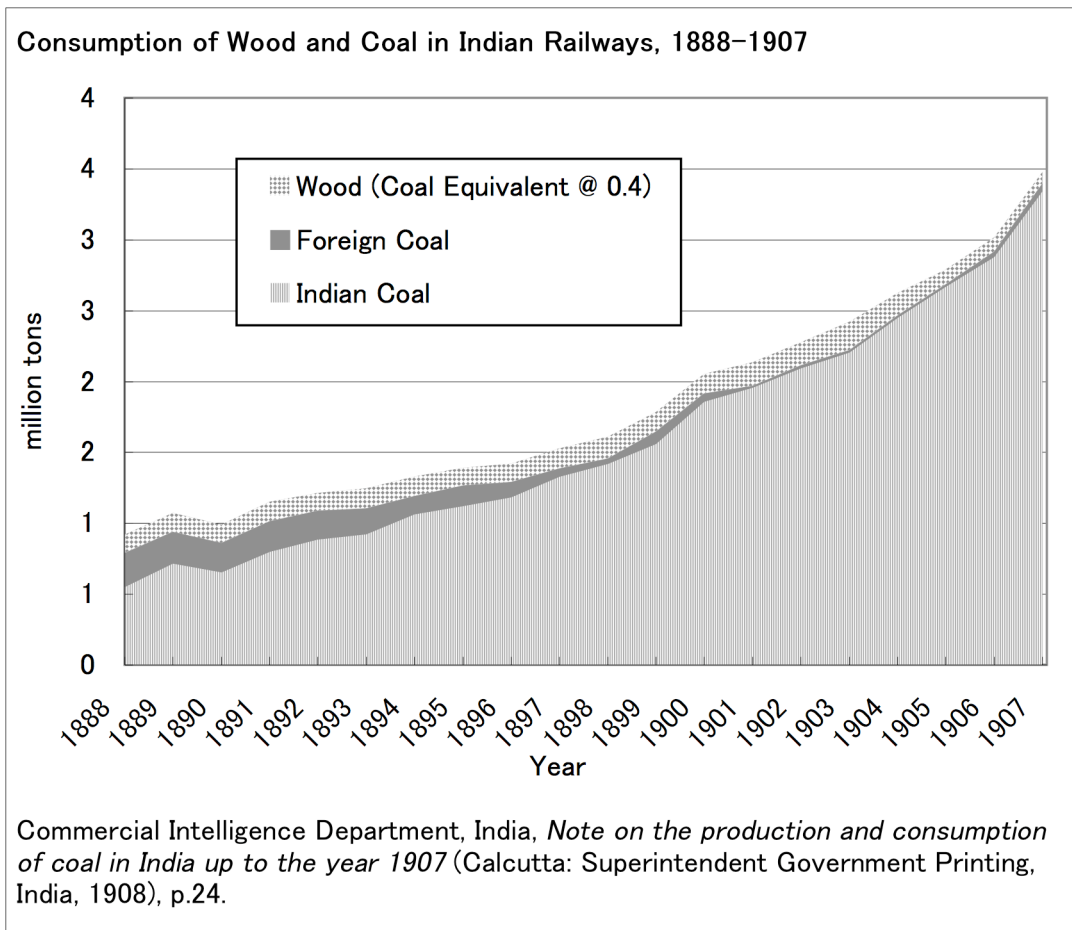
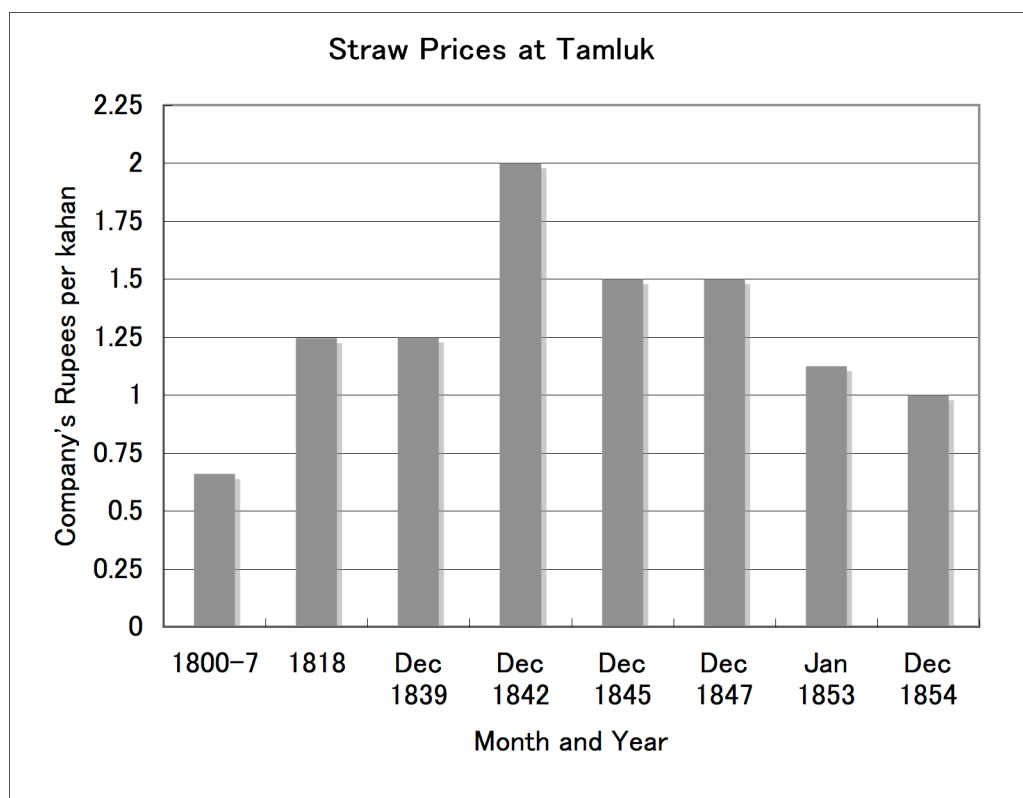


Figure 4



**Figure 5**



**Sources:** BCSO-Salt (P/106/9), 11 Feb 1840, no.10; BCSO-Salt (P/106/38), 9 Jan, no.17; BCSO-Salt (P/106/65), 2 Jan 1846, no.59; BCSO-Salt (P/109/28), 6 Jan 1848, no.14; BR-Salt (P/111/57), 14 Jan 1854, nos.33-34; BR-Salt (P/111/11), 17 Jan 1854, no.7; BRC-Salt (P/100/22), 2 Oct 1818, no.6.

**Table 1****The Price of Firewood at Various Places in Eastern India, 1836–1840**

(Company's Rupees per 300 Maunds)

Places	Month and Year	Prices*	Remarks
Mirzapur Allahabad	Late 1836 - Early 1837	156.0	
Allahabad	Aug 1839	110.7	
City of Benares	Feb 1839	76.5	
City of Benares	May 1839	77.4	
City of Benares	Jul 1839	76.5	
Ghazipur	May 1839	65.4	
Dinapur	Aug 1838	80.1	Contract
Monghyr	Aug 1838	80.1	Contract
Khulna	Aug 1838	80.1	Contract
Boalia	Nov 1840	54.3	
Kumarkhali	Nov 1840	60.0	
Barisal	Jul 1839	15.0	

Source: Bengal Steam Proceedings.

\*Three maunds of wood were equivalent to one maund of coal, and generated the same amount of heat.

**Table 2****The Price of Coal at Various Coal Depots in Eastern India**

(Company's Rupees per 100 Maunds)

Coal Depots	Month and Year	Prices	Remarks
Allahabad	Oct 1836–Feb 1837	109.8	J. Stewart Contract
Mirzapur	Oct 1836–Feb 1837	86.7	J. Stewart Contract
Ghazipur	Oct 1836–Feb 1837	80	J. Stewart Contract
Dinapur	Mar - Jul 1838	80	Juggernath Doss Contract
Monghyr	Mar - Jul 1838	74	Juggernath Doss Contract
Colgong	Mar - Jul 1838	70	Juggernath Doss Contract
Sarda	Mar - Jul 1838	70	Juggernath Doss Contract
Rajmahal	Mar - Jul 1838	67	Juggernath Doss Contract
Kumarkhali	Mar - Jul 1838	64	Juggernath Doss Contract
Burhampur	Mar - Jul 1838	56	Juggernath Doss Contract
Katwa	Mar - Jul 1838	55.5	Juggernath Doss Contract
Kalna	Mar - Jul 1838	54	Juggernath Doss Contract
Khulna	Mar - Jul 1838	54	Juggernath Doss Contract
Calcutta	Jun 1839	45	Carr, Tagore and Co. Contract Best Burdwan Coal

Source: Bengal Steam Proceedings.

**Table 3****Varieties of Fuel Used in Industries in Eastern India**

Names of Industry	Location of Production	Fuels
Salt	Coastal Area	Straw; Grass
Sugar	Plains	Dried Plant; Bagasse; Fallen Leaves; Brushwood; Shrub
Raw Silk	Plains	Firewood (the Company's Factories)
Iron (soft)	Hills (Sylhet; Birbhum)	Charcoal
Brick	Hills (Bihar)	Firewood; Charcoal

## Abbreviations

BR	Board of Revenue
BRC	Board of Revenue Consultations
BSOC	Board of Salt, Opium and Commercial
BSP	Bengal Steam Proceeding
IOR	India Office Record

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