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RAILWAY EXPANSION AND ITS IMPACT ON FORESTS IN COLONIAL INDIA, 1853-1884

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of the Ohio State University

By

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ABSTRACT

The role of the British colonial state in exploiting India’s resources and its impact on the environment is the topic of this dissertation. More specifically, I show that the colonial state in India by the 1840s played an important role in promoting resource extracting infrastructural projects such as the railways and that the latter led to deforestation.

There were two major mechanisms by which the railways caused deforestation. The railways needed wooden sleepers for their lines and firewood for their operation which were primarily obtained from India’s forests. I analyze these mechanisms both at the all-India level and at the provincial level in the Punjab for the period 1853-1884, by examining a variety of historical documents. These include colonial records, correspondence, contemporary journals, newspapers and books.

The deforestation led to timber scarcity for the railways in the early 1860s both at the all-India level and in the Punjab. This crisis threatened the continuous and cheap supply of timber for the railways. I analyze the role played by the state in addressing the timber crisis. In particular, I look at forest conservation measures taken by the state. I show that these measures were exploitative, i.e. they, through maintaining timber supplies for railways and other resource extraction projects, aided the efficient extraction of resources.
resources, rather than ecological. Consistent with this claim is the evidence I provide that the state implemented forest conservation only when a timber scarcity threatened to stop railway construction/expansion and operation. Also, when its conservation measures failed, the state obtained sleepers and firewood from outside British India in order to ensure the continuous operation of the railways.

There is an additional aspect of the timber crisis and the state's role in addressing it. For the state to implement forest conservation and other measures, deforestation had to be observed, measured and analyzed by scientists. I examine the extent to which and how one such scientist, Dr. Hugh Cleghorn was able to influence forest conservation policies.
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# TABLE OF CONTENTS

Abstract ........................................................................................................................................ iii

Acknowledgements ..................................................................................................................... v

Vita ............................................................................................................................................... v

List of Tables .............................................................................................................................. ix

List of Maps .................................................................................................................................. x

List of Abbreviations .................................................................................................................. xi

Chapters

1. Introduction ............................................................................................................................ 1  
   1.1 The Problem and the Context ......................................................................................... 1  
   1.2 The Historiographical Setting ....................................................................................... 2  
   1.3 Conceptual Framework ................................................................................................... 6  
   1.4 Summary and Chapter Organization ............................................................................ 11  
   1.5 Sources .......................................................................................................................... 14

2. Railways and Resource Extraction in Colonial India...................................................... 16  
   2.1 Introduction .................................................................................................................... 16  
   2.2 Railway Establishment as a Major Resource Extraction Project ............................... 17  
   2.3 Railway Construction and Expansion ......................................................................... 25  
   2.4 Railway Establishment and Expansion in the Punjab ................................................. 33  
   2.5 Conclusion .................................................................................................................... 49
3. Railways' Demand for Sleepers and Deforestation ............................................................ 55
   3.1 Introduction ......................................................................................................... 55
   3.2 Railways and the need for sleepers at the all-India level ............................. 56
   3.3 Railways and the need for sleepers in the Punjab ......................................... 71
   3.4 Conclusion .......................................................................................................... 93

4. The Forests and Railway Fuel Supply .............................................................................. 97
   4.1 Introduction ......................................................................................................... 97
   4.2 The Railway Fuel Situation and Forests in Colonial India ........................... 98
   4.3 The Railway Fuel Situation and Forests in the Punjab ............................... 104
   4.4 Conclusion ........................................................................................................ 129

5. Hugh Cleghorn and Forest Conservancy in India .......................................................... 134
   5.1 Introduction ....................................................................................................... 134
   5.2 Social and Intellectual Background .................................................................. 136
   5.3 Cleghorn's Contribution to Forest Conservation in India ........................... 145
   5.4 Conclusion ........................................................................................................ 163

6. Conclusion ......................................................................................................................... 165

Appendix A. Currency and Exchange Rates (1853-1884) ................................................. 175

Appendix B. Weights and Measures ..................................................................................... 176

Bibliography .............................................................................................................................. 177
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Investment in Railways in the Punjab</td>
<td>33</td>
</tr>
<tr>
<td>2.2</td>
<td>Railway Expansion in the Punjab</td>
<td>38</td>
</tr>
</tbody>
</table>
# LIST OF MAPS

<table>
<thead>
<tr>
<th>Map</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Railways and areas under wheat and cotton 1861</td>
<td>53</td>
</tr>
<tr>
<td>2</td>
<td>Railways and areas under wheat and cotton 1881</td>
<td>54</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Agri, Rev &amp; Comm</td>
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<td></td>
</tr>
<tr>
<td>FAR</td>
<td>Report on Forest Administration</td>
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</tr>
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<td>Governor General</td>
<td></td>
</tr>
<tr>
<td>Govt.</td>
<td>Government</td>
<td></td>
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<td>Home, Rev &amp; Agri</td>
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<td>IVR</td>
<td>Indus Valley Railway</td>
<td></td>
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<tr>
<td>NWP</td>
<td>North-Western Provinces</td>
<td></td>
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<tr>
<td>PAR</td>
<td>Punjab Administration Report</td>
<td></td>
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<td>PNR</td>
<td>Punjab Northern State Railway</td>
<td></td>
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<tr>
<td>Pol</td>
<td>Political</td>
<td></td>
</tr>
<tr>
<td>PP</td>
<td>Parliamentary Papers</td>
<td></td>
</tr>
<tr>
<td>Progs</td>
<td>Proceedings</td>
<td></td>
</tr>
<tr>
<td>Prog No.</td>
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<td>SP &amp; D R</td>
<td>Sind, Punjab and Delhi Railways</td>
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</tbody>
</table>
CHAPTER 1

INTRODUCTION

1.1 The Problem and the Context

Humankind has now reached a stage when we are beginning to realize that the environment cannot be taken for granted and that the natural resources now available such as forests are not inexhaustible. This growing concern about continuing environmental degradation in the world has led to studies on the causes of deforestation in several countries including India.

India, which once boasted a great wealth of natural resources, is now facing the problem of resource scarcity in the form of depleted forests. In 1980-82 forests covered only about 21 per cent of the total area in India (Haeuber 1993b: 485). A great deal of India’s deforestation can be traced to the colonial period (Bandopadhyay and Shiva 1988: 1223; Haeuber 1993b: 485).

One of the most important causes of deforestation was the building and expansion of railways, promoted by the colonial state\(^1\) in India, which was an arm of the British

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\(^1\) I use the term 'colonial state' rather than government. 'A state exists where there is a political apparatus (governmental institutions like a court, parliament, or congress, plus civil-service officials) ruling over a given territory, whose authority is backed by a legal system and by the capability to use force to implement its policies' (Giddens 1991: 378-379). Government is thus a part of the political apparatus of the state. It is through institutions such as government, judiciary, police, armed forces, bureaucracy, etc. that the state functions or exercises its powers. Because the colonial state functioned within the structure of colonial relations where the colony was subordinated economically and politically to the metropolis it acquired some features.
state. To what extent and how the expansion of railways between 1853 and 1884 led to deforestation at the all-India level and at the provincial level, i.e. in the Punjab, is the problem that this dissertation addresses. In addition, I examine the colonial state's response to deforestation.

1.2 The Historiographical Setting

In order to study the above problem I will build on three existing bodies of literature that examine the impact of colonialism at the global level and in the Indian context. These are: dependency theory, economic historiography on colonial India and studies on forests in colonial India.

Among the theories that deal with the impact of colonialism on both the colony and the colonizing country, dependency theory has been quite influential and has generated a lot of controversies (Brenner 1977; Brewer 1980; Jenkins 1984). Dependency theorists such as Frank argue that from the sixteenth century onwards capitalism spread from Western Europe (the metropole) to other parts of the world and that turned them into dependent satellites of the metropole (Wolf 1982: 22). The metropole monopolistically expropriated surplus from the satellite or the colony to meet its own requirements. Resources were appropriated through repatriation of profit, rent and interest from the colony to the metropole. This led to distorted development and underdevelopment in the satellite as a significant part of the surplus was unavailable in the satellite for reinvestment there (Isbister 1993: 44-45). Thus, the relation between the

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that were specific to it. For example, the colonial state was more powerful than modern democratic capitalist states (Chandra 1999: 13). It was also more statist compared to non-colonial states (Potter 2000:275, 283).
metropole and the colony was inherently exploitative. The value of the resources to be extracted from the colony and the mode of exploitation of the colony’s resources were determined by the metropole (Camoy 1984: 185).

For the transfer of resources to take place from the colony to the metropole a division of labor developed between the metropole or the core and the satellite or the periphery as Wallerstein has argued. The core produced high-wage, high-profit, high-capital intensive goods which were exchanged for low-wage, low-profit, low-capital intensive goods produced in the periphery (Wallerstein 1974: 351). It is through this unequal exchange that the core exploited the periphery. Wallerstein’s world-systems theory has strong parallels with Frank’s dependency theory with Wallerstein elaborating some of the actual mechanisms by which surplus transfer takes place.

Although the dependency theory highlights the economic exploitation of the satellite by the metropole, it tends to abstract from the physical and ecological conditions under which such exploitation takes place. Thus, it neglects environmental exploitation in the process. In order to extract resources, the resource-extracting mechanisms (e.g. railways) themselves entailed consumption of resources (e.g. timber) as raw materials. Since these raw materials are natural resources and cannot be produced by the market they get depleted.

Now I come to the second body of literature: the economic historiography of colonial India. Most of the scholars studying India’s colonial economy belong to one of
the two groups: imperialists\(^2\) and nationalists.\(^3\) Imperialists argue that British rule contributed to India's economic development, while nationalists argue that the British rule underdeveloped and impoverished India (Robb 1981: 509-510; Charlesworth 1985: 11-12). Both these approaches are united in their neglect of the environmental impact of colonialism.

This neglect of environmental impact and change in existing studies on colonial India is surprising given that in the period of high imperialism\(^4\) the colonial regime had great confidence in its ability to conquer nature through the use of technology such as railways (Arnold and Guha 1995: 12). Indeed, among the colonial state's technological interventions, railways have been widely studied (Thorner 1950; Prasad 1960; Hurd 1983; Kerr 1997). While these studies focus on government policy, management and financing,\(^5\) and on the economic impact of railways,\(^6\) they tend to have neglected\(^7\) its environmental


\(^4\) The second half of the nineteenth century i.e. from about 1857 until 1918 (Bose and Jalal 1999: 97).

\(^5\) Prasad 1960; Gadgil 1971

\(^6\) Harnett 1971; McAlpin 1975; Rao 1978

\(^7\) Exceptions are Tucker 1993 and Guha 1983.
impact. The introduction of new technologies such as railways by the colonial state led to unprecedented, significant, rapid and permanent transformation of India's environment, especially the forests (Pouchepadass 1995: 2061).  

I will now examine studies on forests of colonial India. Environmental historiography on colonial India has mainly focused on forests. This is because forests, by serving as homes and as sources of livelihood, of food, fuel and building materials for most of the people, have played a crucial part in the history of South Asia when compared to their role in Western cultures and ecosystems (Arnold and Guha 1995: 10). Studies on the forest history of colonial India can be broadly divided into (a) those on the causes and impacts of deforestation, and (b) those dealing with the nature of the state's forest interventions.

Among the studies dealing with the causes of deforestation and its impact, there have been a few studies that touch on the adverse impact of railways on forests. For example, Tucker discusses railway expansion as one among many causes of deforestation.

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8 This is not to deny that there was change in the forest cover in medieval and pre-colonial India (Rangarajan 1994: 149; Pouchepadass 1995: 2060). But the pre-colonial forest cover changes were reversible i.e. the forests often grew back or recovered from exhaustion. That is, in the pre-colonial period the forest line merely shifted but was not altered permanently (Rangarajan 1994: 149).


under British rule (1993). While Tucker’s and others’ studies examine railways’ impact on forests as a part of the wider phenomenon of deforestation under colonial rule, they do not offer any detailed historical analysis of the specific causal mechanisms linking railways to forests. Their work is largely based on secondary, not primary, sources. Also, a provincial analysis of the relation between deforestation and railways is lacking.

Among the few studies of the nature of the state’s forest intervention in colonial India Grove argues that deforestation induced famines and droughts, which threatened political stability and that the anxiety about political instability led to the implementation of forest conservation by the state (1995: 467-468). He specifically mentions the role of colonial scientists in shaping the state’s response to deforestation. Colonial scientists, he says, played on the above anxiety about political instability to push the state to adopt forest conservation. In overemphasizing the role and influence of the colonial scientists in the implementation of forest conservation, Grove, in my view, downplays the structural pressures on the colonial state to pursue forest conservation. In particular, the state’s economic interest -- extracting forest resources from the colony -- cannot be ignored when looking at the making of forest conservation policy. Indeed, Guha argues that colonial state forest policy was largely aimed at meeting the revenue and strategic needs of the empire (1989: 144).

1.3 Conceptual Framework

By building on and covering the gaps that I find in the existing literature I will use the following theoretical framework. Colonialism in India involved exploitation or
extraction of resources from India by Britain. The value of the resources in India and consequently the mode of exploiting these resources by Britain, to a large extent, depended on Britain's requirements. By the beginning of the nineteenth century, British industries had become very productive and required more and more markets for their products and more and more raw materials, for which Britain began to look in her colonies such as India. Hence, towards the second half of the nineteenth century, trade became the dominant mode of exploitation of India's resources by Britain (Robb 1988: 206; Cain and Hopkins 1993: 333).

Since the colonial state was the main instrument through which the colony's resources were appropriated, the state decided what strategies to pursue to expand trade between Britain and India. This, to a certain extent, also depended on economic and political conditions in the colony at that time. For example, after the 1857 Mutiny due to a depleted imperial exchequer, there was pressure on the colonial state to generate revenue. This extraction of revenue/surplus had to be done without provoking any rebellion. This could be done by boosting British trade with India rather than by increasing land tax or by territorial expansion (Cain and Hopkins 1993: 333).

11 The shaping of state-promoted projects in colonial India based on metropolitan requirements became more pronounced by the end of the 1860s. This was because improved communication and transportation tightened Britain's control over India with even minor decisions on Indian policy being made in Britain (Farmer et al. 1977: 559).

12 Contrary to Robb's (1988: 226) argument that direct state intervention in the Indian economy was seen only by the late nineteenth century I argue that state intervention in the Indian economy started in the 1840s, during Dalhousie's tenure as the Governor-General of India. However, the state intervention in the colonial economy, among other things, through the establishment of certain projects such as railways, canals etc. became dominant especially after the 1857 Mutiny.
To facilitate increased trade between Britain and India, there was huge British investment in infrastructural projects for transportation, irrigation etc. including the railways in which the state was actively involved. Between 1845 and 1875 alone, the colonial state encouraged an estimated private British investment of nearly 100 million pounds in railway guarantee loans in India (Charlesworth 1985: 20). The importance of railways for boosting British trade with India can be seen from the fact that between 1860 and 1910, a period of substantial railway expansion in India, India's trade\textsuperscript{14} with Britain (India's imports and exports combined) trebled. This was equal to the sum of British trade with China, South Africa, and Australia combined (Headrick 1988: 20).

Britain's exploitation of India's resources through trade by the early 1850s was mostly focused on increasing India's export surplus to meet the home charges which were transferred annually from India to Britain (Bose and Jalal 1999: 99). Between 1858 and 1898, India's remittances to Britain were about half of India's export surplus (Cain and Hopkins 1993: 341). Home charges included the cost of the secretary of state's India office in London, costs of war at home and abroad, purchase of military stores and pensions for British military and civilian officials. By 1900 the home charges amounted to between seventeen and eighteen million pounds sterling (Bose and Jalal, 1999: 99).

The railways facilitated the export of what Wallerstein calls low-wage, low-capital intensive goods such as agricultural commodities from India, in exchange for

\textsuperscript{13} A military mutiny and large scale civil uprising confined to the Indo-Gangetic Plain and to central India, which challenged the continuance of British rule in India.

\textsuperscript{14} This is not to deny that other factors such as the opening of the Suez canal were important in boosting the trade figures but the primary role of the railways in facilitating and promoting trade cannot be denied (Tomlinson 1993: 100).
high-wage, high capital-intensive goods such as textiles from Britain.\textsuperscript{15} In other words, railways in colonial India enabled efficient exploitation of India's resources through unequal exchange. This resulted in Britain always having a positive balance of trade with India, while India always had a trade deficit with Britain.

The colonial state therefore made efforts to boost India's export surplus through, among other things, railway expansion. Most of the railway lines built were export-oriented, connecting India's agricultural interior with the ports (Gadgil 1971: 133). India was transformed into an exporter of agricultural products such as cotton, jute, tea, coffee, wheat and oilseeds (Bose and Jalal 1999: 99). India's export values increased nearly five times between 1870 and 1914 with the export of jute, cotton, indigo and tea to Europe and rice and opium to the Far East. British export of manufactured goods to India, such as cotton textiles, increased from about eight per cent of total exports in the early 1870s to about 13 per cent in the early 1880s (Cain and Hopkins 1993: 333). The total transfer of payments to Britain from India including home charges, private remittances, exports surplus, profits in shipping, banking and insurance, was estimated at 5 to 6 per cent of India's total resources in the later half of the nineteenth century (Bose and Jalal 1999: 99). Thus, a potential investible surplus that could have contributed to India's economic development was drained away from India to Britain. And railways played an important role in this.

\textsuperscript{15} Textiles were high capital-intensive goods relative to agricultural commodities.
The railways needed land and raw materials such as wood, iron, ballast, firewood etc. for their construction and operation. These were obtained directly or indirectly from the environment. Of the above requirements, the railways directly depended on the forests for their sleeper\(^{16}\) and firewood supply. As railway construction and operation expanded to facilitate increased trade, the railways' timber demand on the forests increased causing deforestation. The construction and operation of railways which were primarily designed to enable efficient resource extraction from India, itself depleted the natural resources of India. Thus, the economic exploitation of the colony by the metropole had ecological costs in the form of deforestation which cannot be ignored. Indeed, as Guha says, the building of the railways was a crucial watershed in the history of Indian forestry (1983: 1883).

But colonial exploitation is a contradiction-prone process. Because of deforestation, a timber crisis for the railways developed that threatened to stop further expansion and operation of the railways in India. Because the colonial state was actively involved in promoting railway expansion to extract resources from India efficiently, it had to intervene in the forest arena through the adoption of forest conservation. The state's implementation of forest conservation policy was shaped primarily by its concern to maintain railway timber supply so that railway expansion and operation would continue rather than by ecological or social concerns. For the colonial state, the forests

\(^{16}\) Sleepers are also known as ties.
were merely resources to meet the raw material and fuel needs of the railways (and of other colonial projects). The state, thus, had a very instrumentalist conception of the forests.

To make the state perceive an ecological crisis such as deforestation, the crisis had to be first observed, measured and analyzed by scientists (Grove 1995: 7). Grove (1995: 12; 1997: 84) argues that many of the colonial scientists held ecological views that were opposed to the colonial state's overwhelmingly economic interest in forests. They were able to use these views successfully to make the state implement forest conservation. Given the political and economic context in which the colonial state and the scientists operated, especially in the second half of the nineteenth century, Grove's argument is misleading in my view. I argue that the colonial scientists were able to influence the state in the sphere of forest conservation and other forest policies only when their suggestions were in tune with the long-term resource extraction interest of the state.

1.4 Summary and Chapter Organization

To summarize my arguments. Given that trade became Britain's dominant mode of exploiting India's resources towards the middle of the nineteenth century, the colonial state instituted or encouraged certain infrastructural projects to extract resources from India efficiently. These projects included the establishment of railways and large-scale irrigation systems. In its drive to extract more and more resources from the colony, especially by boosting agricultural exports from India, the colonial state started promoting the expansion of railways. Because the building and operation of the railways required
raw materials directly or indirectly from the environment, their expansion made huge demands on the environment. One part of the environment that the railway expansion affected were the forests. Given the limits to natural resource extraction, the huge and incessant timber demand of the railways on the forests led to deforestation. The deforestation in turn threatened to stop the expansion and operation of the railways and therefore undermine the strategy of colonial exploitation.

Because the state was actively involved in the promotion of railways it had to intervene in the forest arena in order to maintain raw material and fuel supplies to the railways. This intervention took the form of implementation of forest conservation by the state. The state’s response to the deforestation crisis was mediated by specific colonial actors such as scientists. Because these scientists acted within the structure of colonial relations their influence on environmental, or more specifically, on forest policy was limited. The colonial actors were able to influence forest policies only when their suggestions were in tune with the state’s long-term interest of continued resource extraction from the colony.

Given the dominance of railways, both in terms of the capital invested and in their impact on trade when compared to the other public works, the railways make an excellent window for examining the nature of colonial state intervention in India’s economy. I will focus on the period between 1853 and 1884, when most of the major railways lines were established and opened in India. The role played by the colonial state in modifying India’s environment becomes especially significant in the second half of the nineteenth century. This is because at this time the state was predominantly pursuing the establishment of
efficient resource-extraction projects such as railways which adversely affected the forests. More specifically, the Punjab will be taken as a case study to analyze the impact of railway expansion on the forests at the provincial level. This is because the Punjab was one of the provinces in British India where the state and private enterprises made huge investments in railways, among other projects.

I examine in chapter two whether and to what extent the colonial state intervention in the Indian economy, through infrastructural projects such as railways, was geared to extract resources from India efficiently. How increase in trade, especially of agricultural exports from India, became the dominant motive behind railway establishment and expansion is examined. More specifically, I examine this motive in the laying and orientation of the railway lines at the all-India level and in the Punjab.

The railways needed raw materials such as sleepers for their construction and firewood for their operation, both of which were obtained from the forests. As the railways expanded, their timber demand on the forests increased. In chapters three and four of this dissertation I attempt to analyze to what extent and how the expansion of the railways affected the forests of colonial India, especially in the Punjab. More specifically, I examine how the need for railway sleepers and firewood in the railway industry created a demand for timber. To what extent did this demand for timber cause deforestation? The deforestation in turn resulted in a timber supply shortage for the railways, necessitating state intervention in the forests arena. An important research question that I attempt to

13
answer in this study is why and how the state responded to the exhaustion of forests when the railways expanded in the second part of the nineteenth century. Chapters three and four also deal with this question.

In chapter five I examine to what extent and how colonial scientists were able to influence forest policies, especially in the context of railway expansion. I do this by taking the case of Dr. Hugh Cleghorn, one of colonial India’s earliest forest conservators.

In chapter six I summarize the results of my research and bring out its significance. I also discuss some possible questions that the dissertation opens up for further research.

1.5 Sources

I have based my research on official documents and correspondence located in the National Archives of India and in the India Office Records Collection of the British Library in London. These sources yield much information about the impact of railways as a resource extraction project on the forests. Because the railways were under state control and supervision, and also because of the importance the state attached to them, the state maintained extensive and detailed records on railways. As railway construction and operation became dependent on the forests, the state generated a lot of records on the forests both before and after the formation of an Imperial Forest Department in India in 1865. The use of official documents has also enabled me to examine the state’s economic and ecological interventions.

14
For analyzing whether and to what extent the establishment of railways was a state-led strategy of resource extraction from the colony I have specifically looked at railway despatches and letters from and to the Court of Directors of the East India Company (prior to 1858) or the Secretary of State for India (after 1858). In addition, I have consulted railway annual reports and statistics along with Railway Proceedings and Consultations, and pamphlets and books pertaining to the railways.

Also of use were Forest Department Proceedings and Consultations, and annual reports, and contemporary forestry journals, books and some newspapers. In order to find out how railway expansion affected forests in the British Punjab, I have also consulted the provincial archives of Delhi, Haryana, Himachal Pradesh and the Punjab. The primary sources that I have used are the annual Punjab Administration Reports from 1854 to 1885, Punjab Forest Reports and the Punjab Provincial Gazetteer.

In order to examine the role played by Dr. Hugh Cleghorn in highlighting the deforestation crisis to the colonial state that led to the implementation of forest conservation, I consulted his private papers, correspondence, books, and contemporary botanical and forestry journals. These documents are located in the Special Collections of the St. Andrews University Library, University of Edinburgh Library and in the library of the Royal Botanical Gardens of Edinburgh.

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17 The historical documents and books related to the British Punjab have been dispersed in the above archives after Indian independence when the above provinces were carved out from the British Punjab. The western half of the British Punjab became a part of what is now Pakistan.
CHAPTER 2

RAILWAYS AND RESOURCE EXTRACTION IN COLONIAL INDIA

2.1 Introduction

We have seen that the colonial state’s interventions in the Indian economy took the form of infrastructural projects which largely facilitated resource extraction from India. This became dominant towards the middle of the nineteenth century. The state interventions through the infrastructural projects had environmental consequences and were, in turn, influenced by the environmental conditions in India. This was especially so in the case of the railway establishment in mid-nineteenth century India. But before examining to what extent the railways affected or were affected by the forests in colonial India, it will be first necessary to examine whether or not the establishment of railways and their expansion enabled efficient resource extraction by the colonial state. This is the focus of the present chapter.

The rest of the chapter is divided into four sections. In the first section, I provide evidence for the predominantly economic motives of the colonial state in railways establishment at the all-India level. In doing so, I show the single-minded devotion of the colonial state to efficient resource extraction from India through the establishment of railways. The next section examines to what extent and how the dominant resource extraction motive made the state actively involved in railway construction and expansion.
This is examined in the actual laying of the railway lines and their expansion. In the third section, I analyze how the dominant resource extraction objective of the colonial state in railway establishment/expansion was played out at the provincial level taking the case of the Punjab. The final section summarizes the research findings of the chapter. This chapter sets the empirical context for my analysis of the consequences of railways establishment/expansion as a largely resource extraction project of the colonial state for the forests of colonial India and of the Punjab in particular, in the next chapter.

2.2 Railway Establishment as a Major Resource Extraction Project

Among the colonial railway networks, India had the largest and most advanced railway network by the end of the nineteenth century. The total number of railway miles grew from 20 in 1853 to 23,627 in 1900 (Morris and Dudley 1975: 194-195). India's share of the world's track length grew from 1.3 percent in 1860 to 5.3 percent in 1900 (Headrick 1988: 15).

The establishment of railways involved large-scale movement of private capital to India between 1845 and 1873, which was the largest single unit of international investment in the nineteenth century. Of the 271 million pounds of British capital exported to India around 200 million pounds were invested in railways (Thorner 1951: 391). Thus the British invested heavily in the establishment and expansion of railways in India, making it one of the most extensive colonial railways in the world. The question is why?
There were several inter-linked motives -- economic/material, cultural, political/strategic -- behind the establishment of railways in India. Some of the promoters and visionaries emphasized the role of the railways in the spread of English culture among Indians. Others saw the railways as monuments of British rule (Wolpert 1982: 229). Another important motive was the strategic value to the colonizers of being able to move troops quickly from one part of the country to another (Headrick 1981: 40; Rothermund 1988: 25). The economic motive of railway establishment was primary for many promoters including the state. The railways were expected to open up new areas of settlement and enable the penetration of older ones and develop commerce (Headrick 1988: 12).

Two points need to be made here. First, the intertwined nature of the motives meant that sometimes certain motives were disguised under other motives. For example, the more rapid movement of troops from one part of India to another would result in the reduction of the army size. Hence, some of the money allocated for military expenditure by the colonial state could be diverted to other public works, which in turn would lead to development of resources (See Home (Public) Proceedings 1853). The strategic/political motive could also be an economic motive. Thorner argues that because the East India Company had lost its trading privileges with India, economic motives for railway establishment could not be used by the railway promoters to argue with the Company successfully (1950: 10). Therefore, the political and strategic motives for railway establishment were used by the railway promoters. Second, not all motives were equally
important. In the final instance, given the enormous power wielded by the colonial state, it was what the colonial state conceived to be the economic benefits from railways that really mattered.

Certain conditions in both Britain and India led to the economic motive becoming primary for the state in railway establishment. Economics, of course, was at the root of the whole colonial enterprise. By the beginning of the nineteenth century British industries such as the textile industry showed increased productivity. As the productivity increased, more and more markets had to be found to sell British manufactured products. India had, therefore, to be transformed from being predominantly a tribute provider to being largely a market for the British manufactured products (Stokes 1959: 30). In order to bring about this transformation, social, political and economic reforms were carried out between 1813 and 1857, but failed to make India into a market for British goods (Chandra 1980: 276; Stokes 1959: 30).

Some conditions in India too resulted in the economic motive becoming important for the introduction of railways. These included the economic and political conditions after the 1857 Mutiny. Cain and Hopkins argue that the main dilemma of imperial policy in India, especially after the Mutiny, was to extract as much revenue as possible from India without provoking any rebellion that would further deplete the imperial exchequer (1993: 333). Because of the Mutiny, earlier methods of revenue extraction such as military expeditions or increases in land tax could no longer be used for fear of social protests. Another way in which sufficient revenue could be extracted was by promoting foreign trade. Whether the push for increasing India’s foreign trade came from British
industries, as Stokes argues, or from the need to maintain revenue flow in the face of changing economic-political circumstances after the Mutiny, the second half of the nineteenth century was characterized increasingly by colonial revenue extraction through India’s foreign trade (Chandra 1980: 277).

In order to expand British trade with India, the colonial state became actively involved in projects such as irrigation works and communication systems (Cain and Hopkins 1993: 336; Islam 1997: 27). However, there was a disproportionately large British investment in railways compared to other projects. For example, between 1865 and 1894, irrigation and other public works accounted for only 9.2 per cent of the total British investments in India while railways accounted for 77 per cent (Rao 1978: 386). This was because railways served the needs of the metropolis better by facilitating more of an increase in British trade with India than other public works did.

The economic importance of the railways for the colonial state is evident from the views of Governor-General Dalhousie18, during whose tenure (1848-1856) railways were first established in India. Prior to his tenure in India Dalhousie had served as the President of the Board of Trade in Britain. This position had given him ample experience in railway matters in Britain (Kerr 1997: 26). Therefore, Dalhousie clearly understood the economic benefits that would accrue to Britain from Indian railways. Pointing out the connection

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18 The establishment and development of railways was to some extent motivated by Dalhousie’s zeal for “modernizing” India given his belief in the superiority of western science and technology. However, ideas and/or zeal are not sufficient for the implementation of policies. Especially in the colonial scenario the economic-political context of policy implementation cannot be ignored.
between railways and resource development, he said in his famous minute of 29 April, 1853:

It cannot be necessary for me to insist upon the importance of a speedy and wide introduction of railway communication throughout the length and breadth of the Indian empire....[T]he economic and social advantages which India would derive from their establishment are, I truly believe, beyond all present calculation. ... It needs but little reflexion [sic] on such facts to lead us to the conclusion that the establishment of a system of railways in India, judiciously selected and formed, would surely and rapidly give rise within this Empire to the same encouragement of enterprise, the same multiplication of produce, the same discovery of latent resource, to the same increase of national wealth and to some similar progress in social improvement, that have marked the introduction of improved and extended communication in various kingdoms of the western world. (Home (Public) Proceedings, April 1853: 814, 816; italics mine).

Dalhousie further added:

Great tracts are teeming with produce they cannot dispose of. Others are scantily bearing what they would carry in abundance, if only it could be conveyed whither it is needed.... Every increase of facilities for trade has been attended,..., with an increased demand for articles of European produce in the most distant markets of India; and we have yet to learn the extent and value of the interchange which may be established with people beyond our present frontier, and which is yearly and rapidly increasing. Ships from every part of the world crowd our ports in search of produce which we have, or could obtain in the interior, but which at present we cannot profitably fetch to them; and new markets are opening to us on this side of the globe, under circumstances which defy the foresight of the wisest to estimate their probable value or calculate their future extent (Home (Pub) Progs, April 1853: 815-816).

Dalhousie believed that railways would encourage enterprise, increase agricultural and mineral production and help in the discovery of hidden resources in India. These changes in turn would increase the export of raw materials from India and expand the market for British manufactured goods as the second excerpt shows. In other words, as Dalhousie
clearly pointed out above, railways would lead to an increase of trade between Britain and India. This economic motive behind railway establishment was in fact seen in the laying of the main railway lines (originally sketched by Dalhousie) in India which is discussed later.

The Court of Directors of the East India Company too, in a letter to Dalhousie from London, agreed with him about the resource increasing capacity of railways in India. However, they were more forthright than Dalhousie about the economic benefits that would accrue to Britain due to railway establishment in India. In particular, they expected the railways to increase the supply of raw cotton from India to Britain as the following excerpt shows:

[W]e cordially concur in the opinion of the Governor General as to the great political, economic, and social advantages, which must ensue from an extensive and well devised system of Railways in India. The effects are not perhaps within the range of calculation nor would they be confined to India alone. The benefits resulting from the development of the resources of the country, and more especially from the extended growth and supply of cotton, would, we conceive be very sensibly felt in this country (Railway Letters from Court of Directors, 1852-53: 382-383; italics added).

Thus it was largely the need to expand India’s trade with Britain — that is, her import of manufactured goods to, and export of raw materials such as cotton, from Britain — that led to the establishment of railways in India in the second half of the nineteenth century.

As far as India’s trade with Britain was concerned, it was the import of cotton textiles and the export of cotton that were a crucial consideration in railway policy. The sale of cotton textiles in India by the British preceded their purchase of cotton. Although
the Charter Act of 1833 ended the East India Company's monopoly over trade with India, the British textile trade with India did not achieve the level expected of it (Thorner 1951: 389). The Manchester Chamber of Commerce\(^9\) pointed out in a report:

India now takes nearly one-eighth of our total exports, in value from five to seven millions sterling per annum... While the export of our cotton manufactures to India generally amounts to nearly 8d. [pence] per head per annum, that to the parts of the interior of India which are geographically connected to Bombay, is only 3d.; a difference clearly traceable to the impossibility of transporting sufficient quantities of produce from the interior to the coast for exportation in payment.... (Manchester Chamber of Commerce 1848: iv-v; italics added).

The lack of high level of exports to India was attributed to the inadequacy of the existing transport facilities in India, where even proper roads were absent by the beginning of the nineteenth century (Manchester Chamber of Commerce 1848: v; Rao 1978: 373). Hence, British capitalists, especially the cotton industrialists, began to lobby for the construction of railways during the 1840s. Their initial motive was to sell their manufactured cloth not only in the major port towns but also in the interior parts of India.

In addition to securing markets for their manufactured cotton goods in India, the cotton textile manufacturers were aware of the potential supply of cotton from India and the lack of proper transport facilities, especially from the interior parts of India. A report of the Manchester Chamber of Commerce noted:

India now supplies about one-eighth of our consumption of cotton; but could easily supply a vastly greater amount.... The chief cause of the smallness of the present supply is the cost of conveying the cotton to the coast from the interior, where it is grown in large quantities, and may be grown in still larger. To this is

\(^{9}\) A representative body of the industrialists in the Midlands.
added the uncertainty of even this costly carriage, and the damage to which the cotton is exposed on the route (1848: iii - iv).

In 1848 India exported only 18 million rupees worth of raw cotton (Mitchell 1995: 635). Also, at this time the textile manufacturers were dependent on a single source for most of their cotton supply, i.e. the United States, which was quite risky (Andrew 1857: 174).

Dalhousie also noted the importance of the railways in providing an efficient transportation system for the raw cotton produced in India. Emphasizing the impact of railways in increasing the production and supply of cotton for the British textile manufacturers he said:

"England is crying aloud for the cotton which India does already produce in some degree, and would produce sufficient in quality and plentiful in quantity if only there were provided the fitting means of conveyance for it from distant plains to the several ports adapted for its shipment (Home (Pub) Progs April 1853: 815)."

In other words, the pressure to establish railways came from the colonial economic relation involving the classical colonial pattern of the colony importing manufactured goods from the metropolis and exporting raw materials to the metropolis.

Although the colonial state was under structural pressure to establish railways – the pressure coming from the structure of colonial economic relations there was also political lobbying by specific British industrialists, such as the cotton textile manufacturers, for railways. These were able to exercise their influence on imperial

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20 The export of raw cotton from India, however, became important in giving an impetus to railway expansion only in the 1860s after the outbreak of the American Civil War cut off cotton supplies from America to England. This is discussed later in the chapter.
development policy only in moments of crisis. For example, when the cotton supply to Britain was cut off from America in the 1860s due to the outbreak of the Civil War, the Manchester cotton lobby, supported by the Members of the Parliament, and by the industrialists from Lancashire and the Midlands, was able to push for the expansion of railways in India (Headrick 1981: 30; Cain and Hopkins 1993: 334).

2.3 Railway Construction and Expansion

The decision to start construction was taken only in 1849\(^{21}\) after a lot of discussion about how to finance the enterprise. Would they be constructed by the colonial state or by private railway companies? In Dalhousie’s opinion the construction of railways was not the duty of the state as can be seen in the following excerpt:

But the conduct of an enterprise [the railways] which is undertaken mainly for commercial purposes, and which private parties are willing to engage for, does not fall within the proper function of any government. Least of all should it be taken as any part of the business of Government of India (Extract from a Minute of Dalhousie dated 20 April, 1853 as Enclosure D to Railway letter No. 1 in L/PWD/3/57).

The reason why Dalhousie favored railway construction by private companies rather than by the state was that English capital could be profitably invested in railways as the following excerpt shows.

One of the greatest drawbacks to the advance of this country [India] in material prosperity has been the total dependence upon the government, in which the community has placed itself, and its apparent utter helplessness to do anything for

\(^{21}\) The details of how the campaign for railways proceeded, up to the sanctioning of railway construction in India is discussed in Thomer 1950.

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itself.... [The state should not take up railway construction especially] when the spirit of enterprise still shows so feebly in India; when the employment of English capital on a great scale within the interior of this country is so rare, and when there is such good reason to anticipate the best effects from its profitable investment in any one branch of Indian undertakings....(Extract from a Minute of Dalhousie dated 20 April, 1853 as Enclosure D to Railway letter No. 1 in L/PWD/3/57)

Dalhousie’s support for private construction of railways was largely stimulated by the growth in the British capital market. By 1843\(^2\) capital became so abundant in Britain that it began to seek places of investment both inside and outside the British empire (Rao 1978: 377).

The Court of Directors agreed with Dalhousie and decided that the railways in India would be built by the private companies rather than by the state directly as the following excerpt shows:

We now come to the important question of the agency by which the lines shall severally be constructed. On this point, the Governor General is decidedly of opinion, that the construction of the Works by a Railway Company under the supervision and control of Government is the best system which is open for our adoption. And we concur in the views which he has expressed on the subject (Railway Letters from Court of Directors, 1852-53: 398-400).

It was thus decided that the private companies would invest in and construct the railways but under state supervision and control. In other words, the state would decide where the railway lines were to be laid and when.

\(^2\) When railway construction negotiations were about to start. The negotiations on railway establishment started in 1844 between the railway promoters and the East India Company (Rao 1978: 377).
In return for the supervisory and controlling powers over the railways the state guaranteed a return of 5% on the investment by the companies (Davidson 1868: 50). This guarantee of interest, Dalhousie felt, was what the state had to spend to encourage and give aid to English capital in India as indicated by the following excerpt.

I submit, on the contrary, that all the money and time which the Honourable Court [Court of Directors, East India Company] may contemplate being able to save thereby [by state construction of railways], would be well expended on securing the introduction at this time of a large amount of English capital and English energy, so as to encourage, a more extensive employment of similar capital and similar efforts hereafter, in connection with the products and trade of India (Extract from a Minute of Dalhousie dated 20 April, 1853 as Enclosure D to Railway letter No. 1 in L/PWD/3/57).

On closely reading the above excerpt we can see that Dalhousie wanted to encourage English capital investment in railways so that British trade with India would improve. By thus providing financial support to the private railway companies, involved in the construction of railways, the colonial state created favorable conditions for attracting private investment in railways. The railway promoters and investors too were shrewd enough to take advantage of the colonial state’s need for railways to convert India into a source of raw materials and a market for British manufactured goods. Hence, they bargained for a guaranteed interest on their investment in railways (Thorner 1950: 20).

Even if the railways proved to be unprofitable, the colonial state backed construction with the guaranteed interest of 5% on the capital investment. Thus, the railways were, what Thorner refers to as “private enterprises at public risk” (1950: 178). In other words, while the investment for railways was from private British capital, the risk
(i.e. when the railways suffered from losses) was borne by the Indians whose taxes paid for the difference between the 5% guarantee and the losses incurred by the railway companies. All the profit was “private,” but if the railways proved to be unprofitable then the companies could withdraw leaving the colonial state with the unprofitable railways.

The question arises, could the railways have been built without involving non-state economic enterprises, i.e. by the state itself? In fact the state did take over the construction of railways between 1869 and 1882 adding 2,175 miles (Headrick 1981: 25). But it could not continue to do so due to lack of funds because of famines, costly wars etc. The state construction of railways also proved to be inefficient, making reversion to private companies for railway construction desirable.\(^{23}\)

No matter who actually built the railways, their establishment and expansion were characterized by intensive state involvement and supervision. The colonial state’s strong supervision and control over the management and expenditure of the railways can be seen from the fact that official sanction was required even for minor transactions (Hughes 1964: 241). Also, the detailed and extensive railway records maintained by the state through the second half of the nineteenth century and after show the extent to which it was strongly involved in railway establishment and expansion in India. The state’s active involvement in the building of the railways is also reflected in the enormous amount of

\(^{23}\) After 1882, railways were constructed by private companies under the modified guarantee system.
correspondence between the Directors of the East India Company and later by the Secretary of State for India and the Indian Government and the managers of the railway companies in India.

The active involvement of the colonial state in the building of the railways could also be seen in the laying of particular lines such as the trunk lines. In fact, Dalhousie personally sketched the routes for the trunk or the main lines and they were to a large extent constructed according to his plans (Gadgil 1971: 131). On the importance of the construction of trunk lines first, Dalhousie said

I conceive that my present business is to advise the Hon'ble Court as to those great trunk lines which are of primary importance, not only as being most immediately required, but as forming the main channels which future lines shall be able to take advantage of, as the best and readiest means of communication with other portions of the Indian empire (Home (Pub) Progs 29 April 1853: 820).

Earlier, Dalhousie's advisor Major Kennedy had emphasized the importance of laying the trunk lines first, and the principle on which their laying should be based. This can be seen in the following extract.

The first object must be to lay down the Great Trunk Lines with a view to the broadest future ramifications and on a principle that shall insure the most profitable permanent working of the lines generally, bearing at once upon the internal intercourse of India itself, as well as upon the intercourse of India with Europe etc. (Railway Letters from Court of Directors, September 1852; italics added).

Thus, the main objective behind the laying of the trunk lines was their long-term profitability in augmenting trade between Britain and India.
In deciding about the location of the trunk lines, the principle adopted by the state was that these lines were to be the ones that could: a) connect India’s agricultural interior to her ports so that these resources could be accessed and b) connect different parts of the empire and form the *basis* for future railway lines. The state’s decision on the location of the trunk lines reflected its attempt to lay the foundation for the *long-term* extraction of resources from different parts of the empire rather than focus on localized or feeder lines which would not serve this purpose. Among the trunk lines, Dalhousie prioritized the line connecting Calcutta with Lahore passing through the agriculturally rich Ganges valley and the North-Western Provinces. The other trunk lines suggested by him were to join Bombay with Calcutta and Madras, and then Madras city to the western parts of the Madras Presidency (Kerr 1997: 28).

After the trunk lines were established, to what extent was the pattern of railway expansion by the colonial state based on the motive of efficient resource extraction? When it came to the expansion of railway lines the state had to make a choice between lines fulfilling economic or political purposes. In most cases the state chose the economic over the political, especially up to the late 1870s, in part, to strike a balance

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24 Trunk lines were constructed first.

25 These lines included: a) remunerative lines which added directly to the public revenue by enabling efficient resource extraction; b) non-remunerative lines which would at least provide conditions for efficient resource extraction and therefore would contribute eventually to public revenue. These were indirectly remunerative lines.

26 These lines served strategic/military goals and might not be remunerative, directly or otherwise.

27 The political/strategic lines were pursued in a big way only after the Afghan War of 1878 (Ministry of Railways 1953: 22).
between its expenditure and its revenue. To maximize the revenue from railways, the colonial state prioritized the construction of those lines that were remunerative and postponed the construction of 'purely political' lines. This is seen in the following extract from the Railway Report of 1867.

In a country like India, it would be difficult to fix upon any line of communication 200 miles in length which did not, to some extent, combine economic with political and military advantages. Some lines would, of course, fulfill both objects to a greater degree than others, and, unless there were paramount reasons for a purely military road, it must be admitted that one which would connect existing marts, or open new sources of trade, should be preferred, as more likely to be remunerative. So long as State assistance is necessary, it should be borne in mind that every million expended on one work delays another. The revenue is not so elastic as to bear an unlimited amount of capital (PP 1867 [c.3856]: 5-6; italics added)

Whether the railway lines were directly or indirectly remunerative, the state’s main objective in promoting railway expansion was to obtain increased revenue. This can be seen in the following excerpt taken from the Railway report for 1872-73:

In the present circumstances of railway enterprise in India, it is not surprising that the policy of Government in regard to future extensions should be marked by caution. ... The improvement of the material prosperity of the country is the end aimed at through all such works. But if the revenue of the country will not be increased, directly, by remunerative profits from the new lines themselves, or indirectly, by augmented receipts from existing lines, by saving the national expenditure or by improving the national resources, the Government naturally pauses before encouraging fresh works (PP 1873 [c. 838]: 7).

Because of the depleted imperial exchequer after the Mutiny, the state was under pressure to generate revenue while at the same time reduce its expenditure. Also, all the administrative expenses of the colony i.e. India had to be generated by the colony itself including the Home Charges.
Even when the railway lines were laid specifically for political/strategic purposes, especially after the 1878 Afghan War, the economic benefits that would be obtained from these lines was not lost sight of by the state. This can be seen in the following excerpt taken from a Government of India resolution on the rapid progress of the Kandahar line in the North-West Frontier:

While fulfilling the primary object of a strategical work, it must not be overlooked that a line which penetrates a country where safe and regular communication has never been known will stimulate trade and agricultural industry and thus serve important commercial as well as political purposes (PP 1880 [c.2683]: 4).

An example of the remunerative lines were those connecting the cotton-growing areas with the ports of colonial India, especially from the Civil War on. Most of the railway lines constructed and opened in the 1860s were the cotton lines (Prasad 1960: 47; see Map 1), a period during which railways in India expanded by about 469%. Accordingly, cotton exports from India expanded from 179,000 metric tons to 262,000 metric tons, showing an increase of 46% in the 1860s (Mitchell 1995: 331). Therefore, cotton export was an important impetus to railway expansion in the 1860s. In fact, in the 1860s in many areas cotton lines were given priority over other lines. For example, before 1870 the railway lines were built from Bombay to Ahmedabad and the Gujarat cotton tract, and to Nagpur which was in turn connected to the Khandesh and Berar cotton tract and Sholapur and the Karnatic cotton tract (Gadgil 1971: 131). However, the Karnatic cotton tract was not connected by railways to important local towns such as Belgaum, Dharwar and Hubli until the late 1880s (Gadgil 1971: 132).
An example of non-remunerative lines which rapidly expanded after 1879 were lines built to lessen famines. Between 1874 and 1879, a number of famines affected the Madras, Bombay and Mysore regions. However, the railways proved inadequate to move grain in the Madras Presidency during the famine of 1876-78 (Rao 1978: 402), decreased the population\textsuperscript{29} of the Ceded Districts in the Madras Presidency (McAlpin 1974: 681). The impact of the railway, established in 1871, had been an increase in cultivation of both food and cash crops and the abandonment by Indian peasants of traditional methods of storing grains as insurance against food-grain shortages. The colonial state had permitted food-grain exports even under shortage situation. For example, in Bengal during the famine of 1873-74 as much as 222,576 tons of rice was allowed to be exported from Calcutta alone (Rao 1978: 402). Hence, the railways served to exacerbate rather than alleviate famines through increasing market-oriented agriculture.

2.4 Railway Establishment and Expansion in the Punjab

The long-term goal of the colonial state in the establishment and expansion of railways, as noted before, was to exploit India’s resources efficiently in the second half of the nineteenth century. The state’s exploitation or extraction of resources was predominantly through trade.\textsuperscript{30} Although efficient resource extraction through trade was the general motive of the colonial state to establish railways both at the all-India level and

\textsuperscript{29} The average population decrease in the four Ceded Districts during the famine was 20.5\% (Calculated from McAlpin 1974: 681).

\textsuperscript{30} It was the dominant form of surplus appropriation by the state through most of the nineteenth century in colonial India. However, other forms of surplus appropriation such as collection of land revenue also continued.
in the Punjab, there were certain conditions in the Punjab that put further pressure on the establishment of infrastructural projects including the railways. These conditions included: (a) although it was a fertile province its productivity potential had not been tapped; (b) it was a chief recruiting ground for British army; and (c) there was a lack of proper transport to export its surplus agricultural production.

Although the Punjab was an agriculturally fertile province, it did not provide commensurate revenue to the colonial state. The annexation of the fertile Punjab in 1849 increased the revenue of the colonial state by £1,500,000 sterling (PP 1856 [c.105], Dalhousie’s minute). However, despite this addition of revenue, there was deficiency in the colonial state’s budget. This deficiency had to be compensated for by making fertile regions such as the Punjab more agriculturally productive. In order to increase the Punjab’s agricultural productivity, the PAR for 1849-50 and 1850-51 noted the following measures.

[T]he resources of the country [the Punjab] were to be developed. Trade, agriculture, and commerce were to be fostered. Canals were to be cut, levels taken, roads constructed. The mineral resources of the Alpine regions bordering on the Himalayas were to be explored. River navigation was to be promoted. One main object of this report will be to show how the principles then inculcated have been carried out.... (PP 1854[c. 0.5]: 455)

The same report had a section titled ‘Development of Resources’ which dealt with the establishment of public works in the Punjab so that its resources could be exploited.

Another reason for the vigorous pursuit of public works in the Punjab was that in the aftermath of the Mutiny, because of the loyalty shown by the Punjab during the crisis,
it became one of the chief recruiting grounds for the British Indian army (Talbot 1991: 207). To reward these chief recruiting grounds, the colonial state favored the Punjab when decisions for productive investments, such as public works were made\(^1\) (Bose and Jalal 1999: 98). For example, in 1859-60 investment in public works in the Punjab formed 12.4 per cent of the total investment at the all-India level in public works. This increased to 15 per cent by 1883-84. From 1859-60 to 1883-84 investment in public works in the NWP\(^2\) decreased from 19 per cent to 6.57 per cent.\(^3\)

Among the public works, the establishment of railways was very important for the extraction of resources in the Punjab as the following table shows:

\(^1\) The idea was to provide the necessary favorable conditions for agricultural growth and trade through the establishment of irrigation canals, railways etc. so that the people of the Punjab would benefit from these works.

\(^2\) In which many of the major centers of the 1857 Mutiny were located.

\(^3\) Calculated from Statistical Abstracts Relating to British India for various years between 1845 and 1887 in the following Parliamentary Papers- 1867[c.3817]; 1875[c. 1350]; 1884[c. 4061]; 1887[c.5210].
Table 2.1: Investment in Railways in the Punjab (In Rupees). Source: PAR for the years 1858-1885.

From table 2.1 it can be seen that the capital invested in the railways as a percentage of the total capital invested in the public works in the Punjab increased by about twenty times over twenty-five years. This amounted to an increase of about 56 per cent between 1858 and 1884. Overall, the investment percentage in railways in the Punjab as a percentage of the total investment in other public works was on an average 51.4 per cent between 1859-60 and 1883-84. For the same period, the Madras Presidency showed an average railway investment of 37 per cent as a percentage of the total investment in other public works.\(^3\)\(^4\)

The chief reason why the British increasingly invested so highly in railways in the Punjab can be seen in the following extract of a letter from the Chief Commissioner of the Punjab to the department of Public Works, Government of India.

\(^{34}\) Ibid
Indeed these two ... viz the Railroad and the Steamers may be said with truth to be the crying wants of the Punjab in the department of Public works. ... [T]he commerce and produce of these territories will be turned to their due course viz. the Indus and its feeders and to their natural outlet viz. the Port of Kurrachee [Karachi].... The Chief Commissioner while deprecating any general extension of the Public works Department in the Punjab for the present would yet beg most earnestly to press these cardinal objects on the attention of the Government. He believes that if carried out they would effect more for the development of the resources of these territories than any other work or number of works that would be devised (Railway Letters from Court of Directors 1858: 310-311; italics added).

It is clear from the above excerpt that largely the main motive for railway establishment in the Punjab, as at the all-India level, was to facilitate and increase the export of raw materials. This would be done by connecting the Punjab's agricultural interior to the nearest port of Karachi through the railways.

In addition to facilitating export of raw materials from the Punjab, there was another reason why the establishment of railways became so important. In the first three years after annexation due to the extension of cultivated area, agricultural production exceeded consumption in the Punjab (PAR 1849-50 to 1850-51: 95). Hence there was a fall in prices of agricultural commodities resulting in low taxation levels. One effective solution for the above problematic situation was to establish and improve the means of export from the Punjab to Britain (PAR 1854-55 to 1855-56: 29). The PAR for 1854-55 and 1855-56 noted:

The most promising plan is to supply the means of exportation. The Punjab cannot export to the West or to the North, as those regions are poor; nor can it

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35 Due to the Punjabi soldiers becoming increasingly engaged in agriculture because of general peace in the Punjab (PAR 1849-50 to 1850-51: 94).
export to the East, as in that direction there is already abundance. It can only
export to the South, to Kurrachee [Karachi], the port destined by nature to be the
outlet for these Territories. Thence the produce can be shipped for Bombay or for
distant countries and colonies.... Already some 5,357 tons or 150,000 maunds per
annum of Punjab produce find their way with difficulty down the Indus [to
Karachi]....[I]t cannot be exported to Kurrachee [Karachi] unless the
communication shall be improved by steam or rail, or by both. (PAR 1854-55 to
1855-56: 29-30)

Thus, there was a need for improved means of transport to export the surplus agricultural
produce from the Punjab to the Karachi port as the existing means of transport were
inadequate.

The existing means of transportation of goods was by boats on the rivers of the
Punjab. However, transportation of goods by boats was quite inadequate and difficult as
the Punjab Administration Report for 1854-55 and 1855-56 noted:

[T]here is already a traffic of some magnitude between the Punjab and Kurrachee
[Karachi]. So strong is the tendency of trade towards the natural port and outlet,
that large quantities of indigenous produce creep and labor in clumsy native craft
down the Five Rivers.... The united traffic of the rivers up and down ... is not less
than 700,000 maunds or 35,000 tons per annum.... The present means of
navigation being wretched, and the rivers being difficult, the existing water traffic
would preferentially take the Railway.... (PAR 1854-55 to 1855-56: 54)

The establishment of railways in the Punjab would make the transportation of goods
easier and more efficient.

Overall, the state was confident that the establishment and expansion of railways
in the Punjab would lead to increased trade and in turn would make the Punjab more
prosperous as the following excerpt shows:
But if the arguments [supporting railway establishment] urged should (as it is fully believed they will) be supported by statistical facts and data, then it were superfluous to dilate on the importance of a scheme which will affect the trade of all North-Western India, will give birth to a new commerce yet undeveloped ... [and] will induce more than any other circumstance that could be named to the future prosperity of the Punjab (PAR 1854-55 to 1855-56: 38).

Railway construction began in 1859 in the Punjab. The construction and opening of the railways in the Punjab can be broadly divided into two phases. In the first phase, between 1859 and 1870, all the railway lines opened in the Punjab belonged to two private guaranteed railway companies-- the Punjab Railway and the Punjab & Delhi Railways. These lines were built by private railway companies but the state was actively involved in their construction by exercising supervision and control over them.

In the next phase of railway building, from 1871 to 1884, all the railway lines in the Punjab were built and operated directly by the state. These railways were the PNR, the IVR, the Rajputana State Railway and the Amritsar-Pathankot Railway. By the end of 1884, of the total railway mileage opened by all the above railways (private and state), about 1301.5 miles were within the provincial limits of the British Punjab (PAR 1884-85: 118). The total railway mileage constructed by the state directly was about 833 miles by 1884, or 64% of the total railway mileage in the Punjab. The high proportion of railway

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36 In 1870, the Punjab Railway, the Punjab & Delhi Railway, the Sind Railway and the Indus Steam Flotilla were amalgamated to form the Sind, Punjab & Delhi Railways that covered a distance of 468 miles in the Punjab (PAR 1884-85: 118). Henceforth, the Punjab & Delhi Railway will be referred to as Delhi Railway throughout the dissertation.

37 This was a state railway but was funded by the Punjab provincial government. In this chapter the construction and expansion of this line will not be discussed as it was only a feeder line.
lines constructed by the state is an indicator of the importance attached to railway establishment by the state in the Punjab. Table 2.2 shows the expansion of railways in the Punjab between 1860 and 1884.
<table>
<thead>
<tr>
<th>Year</th>
<th>Length opened in current year</th>
<th>Length under construction</th>
<th>Total length opened</th>
<th>Route of the Lines</th>
</tr>
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<tbody>
<tr>
<td>1860</td>
<td>0</td>
<td>32</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1861</td>
<td>0</td>
<td>43.5</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1862</td>
<td>32</td>
<td>27.5</td>
<td>32</td>
<td>Lahore -- Amritsar</td>
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<td>1863</td>
<td>11.5</td>
<td>214.75</td>
<td>43.5</td>
<td>Multan -- Shershah</td>
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<tr>
<td>1864</td>
<td>-</td>
<td>239</td>
<td>43.5</td>
<td></td>
</tr>
<tr>
<td>1865</td>
<td>209</td>
<td>158.5</td>
<td>252</td>
<td>Punjab Railway completed</td>
</tr>
<tr>
<td>1866</td>
<td>30</td>
<td>159</td>
<td>282</td>
<td>Meerut to Ghazeeabad</td>
</tr>
<tr>
<td>1867</td>
<td>24</td>
<td>251.5</td>
<td>306</td>
<td>Amritsar to Beas</td>
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<td>1868</td>
<td>120</td>
<td>206</td>
<td>426</td>
<td>Meerut to Umballa</td>
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<tr>
<td>1869</td>
<td>119.5</td>
<td>86.25</td>
<td>545.5</td>
<td>Ludhiana to Umballa, Beas to Jullundur, Jullundur to Phillour</td>
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<td>1870</td>
<td>26.5</td>
<td>13.25</td>
<td>572</td>
<td>Delhi Railway line completed</td>
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<td>1871</td>
<td>0</td>
<td>58</td>
<td>572</td>
<td>State Railways(Rajputana)</td>
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<td>0</td>
<td>58</td>
<td>572</td>
<td></td>
</tr>
<tr>
<td>1873</td>
<td>58</td>
<td>81</td>
<td>630</td>
<td>Delhi to Rewaree</td>
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<td>1874</td>
<td>0</td>
<td>103.25</td>
<td>630</td>
<td></td>
</tr>
<tr>
<td>1875</td>
<td>62</td>
<td>72.5</td>
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<td>1876</td>
<td>41.25</td>
<td>519.625</td>
<td>33.25</td>
<td>IVR</td>
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<td>1877</td>
<td>0</td>
<td>500</td>
<td>733.25</td>
<td></td>
</tr>
<tr>
<td>1878</td>
<td>499</td>
<td>125.5</td>
<td>1232.25</td>
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<td>1879</td>
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<tr>
<td>1880</td>
<td>125.69</td>
<td>402.31</td>
<td>1358.94</td>
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<td>1881</td>
<td>186.81</td>
<td>353.31</td>
<td>1545.85</td>
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<tr>
<td>1882</td>
<td>53.25</td>
<td>327.78</td>
<td>1599.10</td>
<td></td>
</tr>
<tr>
<td>1883</td>
<td>80.75</td>
<td>184.875</td>
<td>1679.85</td>
<td>Amritsar to Gurdaspur</td>
</tr>
<tr>
<td>1884</td>
<td>144.5</td>
<td>-</td>
<td>1824.35</td>
<td>Sirsa - Ferozepore (Rajputana) Gurdaspur to Pathankot</td>
</tr>
</tbody>
</table>

Table 2.2: Railway Expansion in the Punjab, 1860-1884 (In Miles). Sources: PAR (1859-1884); Railway Reports in PP (1859-1884).
Some specific examples are helpful to demonstrate how economic concerns of the colonial state played out at the local level. The first line to be laid was the Amritsar-Multan line via Lahore, a part of the trunk line connecting Calcutta with Lahore that Dalhousie had prioritized in his railway plan for India. As the state had done at the all-India level, in the Punjab too it prioritized the laying of such trunk lines with long-term profitability in mind. Similarly, at the completion of the survey of the railway line connecting Amritsar to Multan, the Court of Directors of the East India Company noted: "The military and political importance of this railway cannot be overestimated. It will be constructed at a very moderate expense, and from the great existing traffic, the Directors have every expectation that the line will prove most remunerative" (Railway Letters from Court of Directors 1858: 157). An additional importance of this line was that it connected the commercial capital Amritsar with the political capital Lahore of the Punjab (Railway Letter dated 4 March 1862 in L/PWD/3/61). Finally, the main purpose of the Multan-Lahore-Amritsar line was to connect the port of Karachi with the agriculturally rich plains of the Punjab (PAR 1854-55 to 1855-56: 52), as shown in this extract taken from Government of Punjab’s despatch on the Multan-Lahore-Amritsar railway line:

So far as the economic and material interests of the Punjab are concerned, there is a proposed line from the North-east [Amritsar] to South-West [Karachi], which is of greater consequence to the country than any public work, or any number of works that could be specified. ... At present however the major part of the commerce of the extreme North-West travels eastwards merely from the want of a more direct route. But if the great route of the Indus were to be thoroughly opened, this commerce would go straight to Kurrachee [Karachi]. To this port would then come the products from the North-Western India, and from the Central Asian countries beyond that frontier, and in exchange for these, the products of European countries. In the same direction there would also arrive the
vast quantities of government stores and material for the military and public establishments in that quarter.... (PAR 1854-55 to 1855-56: 157-158).

Then, to connect Multan with Karachi more efficiently, the line was extended from Multan to SherShah or Jullalpoor at the junction of the Chenab and Sutlej rivers (PAR 1862-63: 52). By doing so the obstacles to steamer navigation from Karachi to Multan, such as the sand banks at the junction of the Chenab with the Sutlej, would be avoided. This in turn would reduce the voyage time of the steamers from three to four days to about two hours (Enclosure to Railway Letter No. 83 of 1863 in L/PWD/3/62).

The next line sanctioned to be built was that of the Delhi Railway connecting Delhi\textsuperscript{38} with Amritsar. This was also a part of the trunk line connecting Calcutta with Lahore and finally with Karachi as can be seen in the following excerpt from the Lahore Chronicle shows:

The Delhi Railway, about 280 miles in length, will form the connecting link between Amritsur[Amritsar], the upper terminus of the Punjab Railway, and Delhi, the northern terminus of the East India Railway, and will connect the opposite sides of the Peninsula, having Calcutta for its eastern, and Kurrachee[Karachi] for its western or European port (Lahore Chronicle, July 26, 1862: 475).

Thus, the position of the Delhi Railway line relative to the two ports Calcutta and Karachi was highlighted.

Just as in the case of the laying of the Punjab railway line, here too, the commercial motive for the construction of the line was dominant, emphasizing the high

\textsuperscript{38} Which became a part of the British Punjab from 1858 onwards.
fertility and dense population of the region through which the Delhi Railway line would traverse was emphasized (June 14, 1862 Lahore Chronicle). The state chose to build a line through the agriculturally rich Jullundur Doab rather than through Ferozepoor (a military station).

As regards the western portion of the line, H.E. in C [His Excellency in Council – the Governor General] fully concurs with the Lieutenant Governor, and in the opinion which seems now indeed to be generally adopted, that the Railway should proceed from Umritsur[Amritsar] ... via Jullundur and Loodhana[Ludhiana] to Umballa. This line certainly best combines probability of giving a good return, convenience of traffic between the main centers of commerce and population, and regard to political and military requirements.... [A]nd in diminished revenues from the poorer country traversed [in the Ferozepoor area], the Government of India has had no difficulty in coming to a decision in favour of the line through the Jullundur Doab, and against the line through Ferozepoor (Railway Letter dated 8 October 1862 in L/PWD/3/61).

Similarly, for the eastern portion of the line between Umballa and Delhi, a commercially viable route was selected by the state as the following excerpt shows:

Orders were received last year that the Government of India had decided that the line between Umballa and Delhi should not be taken direct from Umballa via Kurnal to Delhi, but by the richer, more populous and more important districts of Seharunpore [Saharunpoor] and Meerut, and to join the East Indian Railway at Ghazeeooddeennugur [Ghaziabad]. This will cause a detour of about 34 miles, but offers a route in every point of view more desirable (PAR 1862-63: 54 in V/10/19)

Thus, the remunerativeness of the line due to increased trade, was to a large extent, the main factor that influenced the state’s decision on the particular routes which the Delhi Railway line would take. The concern was not with the improvement of underdeveloped areas, but rather with the exploitation of the wealth of already prosperous areas.
Overall, for the state both the Punjab and the Delhi Railways were important for exploiting the resources of the Punjab as the following excerpt indicates:

The successful working of the Lahore and Umritsur[Amritsar] Railway, and the progressive works on the Mooltan[Multan] line; the well nigh completed communication between Lahore and Peshawar, and the satisfactory experiments in opening up the main rivers of the Punjab, are distinct pledges that increased production will be met and assisted by increased facilities of transport, and afford an earnest of the desire of the Local Government for the material development of the resources of the Province (PAR 1862-63: 90 in V/10/19)

Although the state expected that the opening of the Punjab and to some extent the Delhi Railways, would lead to increase in production and trade, it did not happen. The Punjab Railways which started operating in 1865 did not show any growth in merchandise traffic even by 1869. In fact the Punjab Railways in its revenue account for the period from June to December 1869 showed a decrease in goods traffic. The auditor, George Finch, explained this decrease due to the following reason:

These results [decrease in goods traffic] may, to some extent, be attributed to the depression of trade; but I would be inclined to look for the true cause in the extension westward of the Delhi Railway, and the consequent opening of continuous railway communication between Calcutta and the districts lying to the East of the Sutlej. For commerce between the Punjab and the sea-ports, the present Indus route ... must be placed at a serious disadvantage in competing with the alternative route now offered from the Eastward without a break as far as Loodiana[Ludhiana].... [U]ntil the extremities of the Punjab and the Scinde Railway are connected by railway, the Indus route must inevitably fall more and more into disfavour (Enclosure No. 89 to Railway Letter in L/PWD/3/71: 1-2).

Based on reports such as the above, the state felt that the line from Multan to Kotri, near Karachi, should be extended so that trade on the Indus route and on the Punjab Railways would increase (PAR 1869-70: 93 in V/10/34).
The state therefore appointed two committees to collect information and report on two lines, the IVR line from Multan to Kotri and the PNR line from Lahore to Peshawar (PAR 1867-68: 80 in V/10/31). According to the PAR for 1868-69:

The reports of the two committees appointed to report on the various lines of railway, the early construction of which was considered most essential for the prosperity of the Punjab, were received during the year; both agreed in advocating the completion of the two main lines, viz., from Lahore to Peshawar, and from Multan to Kotri. The reports were concurred in generally by the Punjab Government, which earnestly advocated as a measure of vital importance to the future development of the Province, the construction of the Indus Valley Railway, as well as that of the Peshawar Railway [Punjab Northern] (PAR 1868-69: 93 in V/10/33).

In order to efficiently extract resources through trade in the Punjab, especially on the Indus route, the state took up the construction of the IVR which was an extension of the earlier built trunk line connecting Amritsar and Multan. By taking up the construction of the IVR line the state was not only actively but also directly involved in the efficient extraction of resources or at least providing the conditions for development in the Punjab.

The IVR opened about 500 miles of its line by the end of the 1870s. Its economic importance for the colonial state, especially in terms of trade, can be seen in the Punjab Provincial Gazetteer:

The importance of the Indus Valley State Railway as an outlet for the commerce of the Punjab has already been alluded to. Till this line was opened there was no seaport nearer than Bombay or Calcutta; before the Rajputana port was opened, the former port was 1,370 miles from Lahore and the latter 1280; now Bombay is brought within 1240 miles.... Kurrachee [Karachi] is only 820 miles from Lahore, and is the nearest port for every railway station in the Punjab up to and including Umballa. It is also 200 miles nearer to Aden than Bombay. The oil seeds and wheat and wool from the hill states, are all carried seawards to Kurrachee [Karachi]. Every city in the Punjab has its granaries stored with wheat,
whose owners watch keenly the slightest fluctuations of the London market and the weather reports of the United Kingdom; the instant a remunerative price is reached, endless trains of grain go down to Kurrachee[Karachi], where it is shipped off to England and various Continental ports (1889: 224)

Within about two to three years of its opening, the IVR became an economic success which was, in part, reflected in an increase in the weight of goods it carried.

The weight of goods carried in 1881 was 566,612 tons as against 505,919 tons in the preceding year, showing an increase of 60,693 tons. A very large trade on wheat to Kurrachee[Karachi] sprang up during the latter months of 1881, which came chiefly from the Punjab stations of the Sind, Punjab and Delhi Railway, though some of the stations of this line also received large quantities of grain (PAR 1881-82: 153).

The increase in weight of goods carried by the IVR was mainly due to the increase in wheat trade. In fact, by 1881-82 there was increase in exports from the Punjab due to the sudden expansion of the wheat trade (PAR 1881-82: 153).

The expansion of wheat trade was in part due to the state’s lowering of wheat carriage rates on the SP&D R and the IVR (PAR 1884-85). The PAR for 1882-83 noted that “Special concessions in favour of the grain and seed trade were made on the Indus Valley State railway during the year; the through rates for carriage were reduced from 5.4 pies to 4.32 pies per ton per mile”( PAR 1884: 199). Thus, the colonial state, in order to encourage the export of wheat, which was the main agricultural produce of the Punjab, lowered the railways’ wheat carriage rates, a successful ploy to maximize the railways’ use as a main channel for increasing Punjab’s trade with the rest of the world.

47

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In addition to the construction of the IVR, the state also took up the building of the PNR, which opened to traffic in 1875. Its railway lines were broadly divided, based on their main functions, into two sections:

... [O]ne from Lahore to Rawalpindi, including the Salt branch, which is classed as a “productive public work” and may be expected to give a fair return for the capital expended on it; and another from Rawalpindi to Peshawar, with a branch to Khusalgarh, which is a “frontier line,” constructed with a view rather to military potentialities than as an economic undertaking (Punjab Provincial Gazetteer 1889: 195).

The PNR was built mainly for strategic purposes though after 1882 it was successful commercially due to the expansion in wheat trade, as the following excerpt taken from the PAR for 1883-84 shows.

The introduction of a low rate for grain and seeds [on the PNR] of one-eighth pie per maund per mile ... together with a temporarily brisk demand for export, brought the Railway [the PNR] a large increase of outwards traffic in these staples.... The result was an increase of 44,706 tons of grains and seeds (PAR 1885: 118).

The PNR thus exemplified how a railway line laid specifically for political/strategic purposes was also commercially important.

Another important railway line that was built by the state in the Punjab was a part of the Rajputana State Railway line. The earliest constructed portion of this railway in the Punjab connected Delhi with Rewaree covered a distance of 58 miles and opened to traffic in 1873. This was a directly remunerative line built with the purpose of
transporting salt from the Farukhanagar\textsuperscript{39} (or Sooltanpur) Salt Works to Delhi and Agra (PAR 1873-74: 77). The following excerpt taken from a government despatch giving instructions for the survey of the line, clearly shows its economic importance:

The Government of India is desirous of obtaining complete information to show the exact line which will give the most convenient access to the principal salt sources at Sooltanpore [Sooltanpoor] and which will afford the greatest facilities for the transport of the salt to Delhi [Delhi]... Out of a total out-turn in 1868-69 of 7,11,932 maunds these works contributed rather more than 5,00,000. It is clear then that any line of railway constructed with a view to facilitate the transport of salt must take these works [into account] (Enclosure to Railway Despatch No. 44 dated 17th May 1869 in L/PWD/3/69).

In addition to the survey of the Delhi-Rewaree line, a Salt Committee was also appointed by the state to report on the potential salt yield of the Sooltanpoor salt mines (Enclosure to Railway Despatch No. 44 dated 17th May 1869 in L/PWD/3/69). The commercial success of this portion of the Rajputana Railways can be seen from the following figures. In 1873-74, the Rajputana Railway carried about 26,500 tons of goods which increased to 44,412 tons in 1874-75 and to 46,400 tons in 1876-77 (PAR 1873-74: 77, 1874-75: 81, 1876-77: 101).

\subsection{2.5 Conclusion}

The preceding discussion shows that the establishment of railways was a major resource extracting project of the colonial state in the latter half of nineteenth century in India. This was the case both at the all-India level and at the provincial scale, especially in the Punjab. To a large extent, the primary motive of the colonial state in establishing railways

\textsuperscript{39} One of the few sources of salt in the Upper Provinces (Railway Desptach No. 44, L/PWD/3/69).
was the exploitation of resources in India, the need largely determined by certain conditions both in the metropole i.e. Britain and in the colony i.e. India. Initially, certain conditions in Britain, such as the increasing productivity of her industries by early nineteenth century, gave the push for exploiting India’s resources through trade. British industries, such as the textile industries, saw India as a potential market for their manufactures. Hence, in order to transform the Indian economy, the colonial state carried out certain economic reforms which did not expand the market for the British goods in India significantly. The failed economic reforms and the attendant lack of growth in British textile exports to India was attributed to the lack of an efficient transportation system.

Another important push factor for railway establishment was Britain’s need for raw materials such as cotton from India. This factor became especially important during the Civil War in the 1860s. Here also, the lack of an efficient transportation system in India was seen as a barrier to transport raw materials such as cotton. Hence, the colonial state looked for and implemented a ‘technological fix’ in the form of railway establishment in India.

Certain conditions in India, especially after the 1857 Mutiny when the imperial exchequer was greatly depleted, also gave an impetus to the colonial state to exploit India’s resources through trade. One such important condition was the state’s need for revenue which could be obtained largely from India’s foreign trade as other sources of
revenue were no longer feasible in the existing political-economical conditions. To expand India’s trade with Britain and to increase colonial revenue from export tariffs railways were established in India. Internal development was not a goal.

The above discussed conditions in Britain and in India that led to railway establishment in India also influenced railway policy in India where Britain’s interest was promoted over India’s interest. This was seen especially in the railway guarantee and in the laying of the railway lines. To construct the railways, the state engaged private railway companies, who were guaranteed a return of 5% interest on their capital investment in railways. This interest was guaranteed to the railway companies even if the railways were unprofitable. The difference between the 5% guarantee and the losses incurred by the railway companies was borne by the Indian taxpayers.

Another instance of railway establishment being largely geared to meet Britain’s interest at the cost of India’s interest was in the laying of the railway lines directed by the colonial state. The state prioritized the laying of the trunk lines over that of the local feeder lines. The trunk lines were in turn laid in such a way that they encouraged trade between the agriculturally rich interior such as the cotton tracts and the big ports (See Map 1 and Map 2). Attention was not given to the development of internal trade through the construction of feeder lines locally. The largely export-oriented nature of the railway lines can also be seen from the fact that even when there was famine situation in certain areas, food-grains continued to be exported on a large-scale. Similarly, when it came to
the extension/expansion of lines the state prioritized the construction of economic/commercial lines over that of the political lines, where possible it tried to combine the two functions.

The colonial state’s aim of efficient resource exploitation or, at least, in laying the conditions for efficient resource exploitation through the railways was also seen in the agriculturally fertile provinces such as the Punjab, whose productivity could be further exploited by railway establishment and expansion. Here too, as in the case of the railway lines at the all-India level, the laying and direction of the lines reflected the resource extraction motive behind railway establishment in the Punjab.

The next chapters are concerned with the resources absorbed by the expansion of the railways: land, including forested land that needed to be cleared; and wood, which came primarily from India’s forests. The establishment/expansion of railways as a resource extraction enabling project in the history of colonial India had an ecological side to it, which has unfortunately remained an under-researched topic. I will investigate how the construction/operation of the railways was affected by, and also affected, India’s forests over time, at the all-India level and in the Punjab.
Map 1: Railway lines open and areas under wheat and cotton, 1861
Source: Kerr 1997: 39
Map 2: Railway lines open and areas under wheat and cotton, 1881
Source: Kerr 1997: 39
CHAPTER 3

RAILWAYS’ DEMAND FOR SLEEPERS AND DEFORESTATION

3.1 Introduction

In 1861 Major Ramsay, the District Commissioner of Kumaon in the NWP observed:

The Railway Contractors of late years have ruined a great part of the forests by felling trees, from which they cut only two sleepers, and left the remainder of the tree to rot.... [I]f the contract system were permitted a few years longer, there would be soon no trees in the Forests capable of yielding good sleepers (PWD Progs July 1861 Prog No. 44).

This denudation of the forests in Kumaon by the railway contractors was to meet the sleeper demand of the railways. There were similar reports of deforestation in the 1860s in the Punjab, the NWP, Central Provinces and in the Madras Presidency.

The previous chapter documented the colonial state’s increasing involvement in various resource-extraction-enabling infrastructural projects in India in the second half of the nineteenth century. Irrigation works and railway lines were also developed with the primary goal of extracting India’s resources. Constructing railways required machinery and raw materials, including locomotives, rails, sleepers, bricks, and so forth. Many of these items were imported from Britain, but materials such as wooden sleepers and bricks were obtained largely within India.
Wooden sleepers were obtained either from the local areas where the railways were built when these were unavailable or exhausted, from further away. For example, in the regions such as the North-Western Provinces and the Punjab which had extensive Himalayan forests, the railway sleepers were largely obtained locally, especially between 1860 and 1875. However, with the expansion of railways in the second half of the nineteenth century the demand for wooden sleepers resulted in denudation of their provincial forests.

This chapter is divided into three sections. The first section analyses how railway construction precipitated deforestation in colonial India between 1853 and 1884. More specifically it examines the conditions that facilitated the use of local timber for railway sleepers that led to the denudation of local forests. Given the state’s active involvement in railway establishment in India, its response to the deforestation crisis is also discussed in this section. The next section of the chapter looks at deforestation due to railway construction in one such province, i.e. Punjab, between 1860 and 1884, with particular attention to the temporal and spatial unevenness of deforestation. The concluding section summarises the main arguments put forth in the chapter and compares the impact of railway construction on the forests at the all-India level with that in the Punjab.

3.2 Railways and the need for sleepers at the all-India level

Just because the railways were built, deforestation did not have to take place. In other words, there is no necessary connection between the railways and the forests in a particular place. First, sleepers can be made of other materials such as metal or stone.
Second, if wooden sleepers are used then they need not be obtained from the local forests/area. Third and most importantly, if railway construction and expansion takes place within ecological limits\textsuperscript{40} then deforestation is not a necessary outcome. There were, however, in this case conditions that facilitated deforestation of the local forests due to the sleeper demand of the railways.

The first condition that affected deforestation due to railway expansion was the use of wooden sleepers on the railway lines. At the time of the construction of Indian railways, the use of wooden sleepers on the railway lines was the norm in Britain and in North America in the nineteenth and to some extent in the twentieth century, experiments with stone and metal having proved unsatisfactory (Simmons 1961: 90; Mills 1900: 209). Britain imported most of its wooden railway sleepers from the Baltic region. In order to prolong the life of the wooden sleepers, a number of experiments were carried out. Of these, the method of forcing liquid creosote\textsuperscript{41} under pressure into sleepers that were seasoned was widely used in Britain. Creosoted sleepers of Baltic wood lasted from twelve to eighteen years in Britain, while uncreosoted ones lasted six to seven years only (Mills 1900: 213).

The second condition that affected the denudation of the forests in India due to railway expansion was the shift in the procurement of wooden sleepers from Britain to

\textsuperscript{40} That is, within the forests' sustainability.

\textsuperscript{41} A dark, oily liquid distilled from coal tar.
India. For the construction of railways in India, especially in the 1850s, wooden sleepers\textsuperscript{42} were imported in the form of creosoted Baltic fir sleepers from Britain (Home (Pub) Progs July 1852). The process of sleeper procurement from Britain was cumbersome. It involved first the receipt of sleeper indents\textsuperscript{43} from the railway companies by the Court of Directors, East India Company\textsuperscript{44} or by the India Office.\textsuperscript{45} Then the indents had to be approved by the Court of Directors or by the India Office before being converted into contracts (Kerr 1997: 22). After the approval of the indents, the railway companies entered into contracts with British contractors for the supply of wooden sleepers. For example, British contractors in the 1850s obtained contracts for supplying from 40,000 to 100,000 creosoted sleepers for railway construction in India (Railway Letters from Court of Directors 1852-53: 281).

However, there were difficulties in obtaining creosoted sleepers from Britain, as this extract from R.M. Stephenson’s letter to the Consulting Engineer to Government of India shows.

\textsuperscript{42} Each mile of the railway line required sleepers varying from 1,906 per mile (for broad gauge) to about 2,000 per mile (for narrow gauge) depending on the gauge used in that line (Troup 1913: 73). The standard gauge adopted for the railway trunk lines in India was the broad gauge of 5 feet and 6 inches (Khosla 1988: 71).

\textsuperscript{43} Indents were statements showing the amount of construction material, construction personnel etc. that were to be supplied from Britain to India for railways and other public works.

\textsuperscript{44} Before 1858.

\textsuperscript{45} From 1858 onwards.
The delay in the arrival from England of Permanent way materials,\textsuperscript{46} owing to the
difficulty experienced in obtaining freight is already operating injuriously upon
the interests of the Railway Company.\textsuperscript{...}
The value of the materials is rapidly rising in England, and \textit{Timber has increased
both in the original cost and in the charges for freight to Calcutta very
considerably}. (Home (Pub) Progs March 1853: 377-378; italics added)

The rising costs of timber and of freight coupled with the difficulty of obtaining freight
for transporting them from Britain made railway construction more expensive\textsuperscript{47}. It was
difficult to obtain freight for sleepers because:

All the available freight is urgently required for the materials which must come
from England and it appears desirable for such materials as can be obtained in
India to procure as much as possible, thereby leaving the whole of the limited
shipping room for the Iron and Machinery.\textsuperscript{...} (Home (Pub) Progs March 1853:
377-378).

The priority given to the import of iron and machinery from Britain to India was a part of
the infamous stores purchase policy of the colonial state in the second half of the
nineteenth century in India. According to this policy, all iron and steel manufactured
goods including machinery had to be purchased by the Government of India from Britain
in sterling (Rao 1978: 404; Bose and Jalal 1999: 103). This payment for British
manufactured equipment was a part of the annual Home Charges remitted by the colonial
government from Indian revenue, i.e. part of colonial profits to the British government

\textsuperscript{46} Permanent way materials refers to the materials used on the railway track such as rails, sleepers (ties),
fish-plates, chairs, wooden keys, nuts and bolts (Kerr 1997: 149).

\textsuperscript{47} It was not until 1869 with the opening of the Suez Canal and with the simultaneous shift from sail to steam
transport on the sea route to India that the voyage time and the freight charges from Britain to India were
considerably reduced (Wolpert 1982: 243). This, as we shall see later, led to increased use of imported sleepers
on railways by 1876 especially in the Punjab.
and private companies. The substantial benefits that the British manufacturing industry would get by the sale of machine goods to the railway companies in India and its crippling effect on Indian industries have already been studied.\textsuperscript{48} Given the limited shipping room available for transporting materials from England, it was more profitable to transport British manufactured goods than raw materials such as wooden sleepers that could be obtained in India.

The Military Board\textsuperscript{49} was therefore asked to make enquiries about timber availability for the railways in India. It reported that "India possesses an abundant supply of valuable timber equal to the most extensive Railway demand." (Railway Letters to Court of Directors 1853: 189) Given the difficulties in importing sleepers and the abundant supply of timber in India, the use of native wood for sleepers was suggested (Mills 1900: 212). Therefore, experiments were carried out on different kinds of Indian wood in order to determine their suitability for sleepers. Among the Indian timbers, sal,\textsuperscript{50} teak and deodar\textsuperscript{51} were the most resilient to the attacks by insects and to the weather (Home (Pub) Progs 27 March 1852; Home (Pub) Progs August 1853). Sal had to be seasoned before its use as sleepers, while teak was expensive and deodar was found only in the higher elevations of the Himalayas.

\textsuperscript{48} Hurd 1982: 752; Charlesworth, 1985: 59

\textsuperscript{49} The department under which the railways were first placed before being put under the PWD.

\textsuperscript{50} Shorea robusta

\textsuperscript{51} A species of Cedar having the botanical name \textit{Cedrus deodara}.
Given the above limitations on the use of certain Indian timbers as railway sleepers, creosote and the creosoting equipment were initially imported from Britain to improve the longevity of sleepers of Indian wood other than the three types of wood mentioned above. However, there were a number of difficulties in importing creosote from Britain, especially in large quantities. Shipowners were reluctant to transport creosote in their ships owing to its inflammable nature. Also, the penetrating nature of the creosote, i.e. its tendency to penetrate its wooden container and leak, resulted in a loss of about 14% of the imported creosote (Home (Pub) Progs 27 March 1852). More and more emphasis was placed on using uncreosoted wooden sleepers obtained from India itself. Therefore, wooden sleepers obtained within India became a necessary part of the railway construction by the second half of the nineteenth century.

A third condition that affected deforestation in the context of railway expansion was the prevalence of the idea among the British that Indian forests were inexhaustible, an idea developed as a result of the early forest explorations in the Himalayas. Two surveys had been conducted by order of the Governor-General to find out the extent of timber resources available for barracks and bungalows for the British in the early 1850s in the Himalayan forests by Major Longden, a timber agent (Foreign (Political) Prog. No. 70, 28 November 1851; Foreign (Pol) Progs 17 March 1854; Calcutta Review 1867 xlv: 84). He reported that the hill forests of the Punjab were inexhaustible (Foreign (Pol) Progs 10 March 1854). This idea to a great extent prompted the large scale and reckless destruction of the Punjab Himalayan forests in the late 1850s and early 1860s. As the Calcutta Review noted about the Punjab hill forests “the chief evil resulting from this
confident acting on the phrase ‘inexhaustible’ has been felling on such a scale and in such a way as seriously to imperil the very existence of many of the forest-tracts....” (1867 xlv: 84).

Prior to the construction of the railways, in the 1840s and 1850s, the Himalayan forests of the NWP and the Punjab had been cut to meet the construction needs of the Gangetic region, to build military barracks and to meet the timber needs of cantonments. Private traders/contractors, both British and Indian, were involved in the felling of timber at that time. These contractors would buy or lease in tracts of forests from native states and fell them. They would often clear-cut entire forests resulting in irreversible damage to the forests (Tucker 1993: 177). The labor force recruited by the contractors for timber felling was primarily local in origin throughout the nineteenth century. Small peasants and landless laborers were mostly employed in the timber felling operations (Tucker 1993: 185). After 1860 British timber contractors were rare, the timber trade thereafter was in Indian hands. Also, after the formation of the Forest Department in 1864, as we shall see later, the method of timber harvesting was modified to some extent.

The timber trade that developed in the nineteenth century was mostly local and regional especially in the Western Himalayan region. The timber trade continued to be localised, even after the railways were built, well into the late nineteenth century. This was because the secondary railway lines to the mountainous regions were built towards the end of the nineteenth century. The timber from the Western Himalayas did not become an export commodity nor could it compete with the timber of south India (Tucker 1993: 180). The purchase and marketing of timber in the Western Himalayas, even at the
local/regional level, involved a lot of competition among the Indian merchant castes and communities (Tucker 1993: 184). To what extent and how the timber demand of the railways affected the timber trade and the trading communities would be an interesting research topic for future exploration.

The combination of these three conditions i.e. use of wooden sleepers, local procurement of wooden sleepers and the idea of inexhaustibility of India's forests, in the context of railway expansion led to uneven denudation of the local forests where the railways were built in colonial India, depending on the railway mileage under construction at a particular time in a particular place. I will now examine this uneven denudation of forests between 1853 and 1884 when massive railway establishment and expansion took place in India.

The periods of most intense railway construction between 1853 and 1884 were 1860 to 1861 and 1876 to 1885. In 1860-1861 about 1300 miles of railway lines were under construction. Among these lines, the East India Railways accounted for about 900 miles while the Madras Railways accounted for about 340 miles. A total of about 1150 miles was sanctioned for the construction of the Madras Railways by 1860. Cleghorn, the Conservator of forests in the Madras Presidency, calculated that each mile of railways required 1760 sleepers, which would last on an average for about eight years. Including the renewal of sleepers, the total requirement of sleepers was 22,000 per hundred miles annually (Cleghorn 1860: 33).
The Madras Railways opened about 130 miles of railway of its south-west line between 1856 and 1860. In order to meet the sleeper requirements of these railways, many of the forests were denuded as the following extract shows:

The progress of the railway has produced marvellous [drastic] changes on the face of the country as regards tree vegetation in some districts. I may specify Palghat, the Shevarai Hills, and the North Arcot Hills; in these the old woods have everywhere fallen, to meet the urgent demand for timber... The encircling hills, formerly crowned with timber, are now to a considerable degree laid bare. These changes, so far as I can learn, have been the gradual result of unrestricted cutting, but much aggravated, during the last few years, in connection with the enormous demand for railway sleepers, and for the department of public works (Cleghorn 1860: 3; italics mine)

The enormous demand for railway sleepers resulted in so much denudation of the hill forests that parts of the physical landscape, such as hills of the Western Ghats, were entirely transformed wherever the railway lines in the Madras Presidency were constructed. The denudation of the forests led to timber scarcity for sleepers for completion of the southwest line, especially in the Madurai district of the Madras Presidency, evident in the following excerpt. “Great difficulty has been experienced in getting sleepers for this District [Madurai], and about 20,000 are still required to complete it.” (Report of the Madras Railway Department for 1858: 30).

At around the same time the East India Railways built about 205 miles of railway lines connecting Allahabad with Kanpur and Kanpur with Etawah in the NWP. The average sleeper requirement of each mile of the East India Railway was 1800 (PWD Progs Jan 1867 Prog No. 108). These sleepers were obtained from the Himalayan forests of the NWP. As a result of the railway expansion in the NWP some of the densely
forested areas such as Kumaon were denuded by the railway timber contractors who cut
all the accessible timber, as this extract from the PWD Proceedings shows

*The whole of the Forests of this Province (Kumaon) have been most extensively
cut, ....Railway Contractors did ten times more mischief than all the other timber
merchants.... As all the easily accessible forests have been already cut too much,
it is now necessary to give these exhausted parts rest, and bring timber from more
difficult ground. Greater expense must be incurred on roads, because there are
now few forest tracts of extent. (PWD Progs (Agriculture) Feb 1862: 156-157)*
A Contractor who cuts at the most convenient [accessible] spots, and only takes
the part that can be sawn up cheaply, without reference to the injury he is doing to
the Forests and can of course supply sleepers cheaply.... (PWD Progs, July 1861
Prog No. 44)

Since by the early 1860s the more accessible forests of the NWP were already exhausted
by the railway contractors to obtain cheaper sleepers for railway construction, efforts were
then made to procure timber from interior forests. This entailed the construction of roads
to access the timber and added to the total cost of the sleepers, decreasing the cost-
effectiveness of railway construction. As railway construction proceeded, timber for
sleepers began to be cut from the inner forests leading to increased prices of timber as the
following extract shows:

*In the time before the Railway demand arose, I believe that the price of timber in
the forest never exceeded six or eight annas per cubic foot.... Now the limits of the
forests containing any timber trees have, I believe, receded, and perhaps that rate
would not be properly remunerative (PWD Progs July 1861 Prog No. 44).*

The deforestation of the accessible forests in the NWP, just as in the case of the Madras
Presidency, resulted in shortage of timber for the railway lines yet to be completed (PWD
(Railways) Progs Oct 18 1861 Prog No. 11). Thus, in its drive for economic development
through the expansion of railways, the state failed to see a primary ecological fallacy underlying the assumption of unlimited growth - the fact that natural resources including timber are finite.

Given the state’s active involvement in railway establishment and expansion and through which it wanted to develop India’s resources, it had to mediate to solve the timber scarcity problem for the railways. The state could maintain timber supply for the railways without exhausting the existing forests by adopting broadly two methods. One way was to increase the supply of timber relative to the railway demand and the other way was to decrease the timber demand on the local forests by using substitutes or by technologically improving the durability of the wood or by drawing timber from other sources. Depending on whether a particular method was cost-effective in supplying timber for the railway sleepers, the state adopted it.

One cost-effective method of increasing the timber supply relative to the railway demand was through the adoption of forest conservation. But before carrying out conservation the state first brought the forests under its control and restricted the existing use-rights of local communities (Gadgil and Guha 1989: 147; Haeuber 1993a: 53; Rangarajan 1994: 161; Sivaramakrishnan 1995: 16). Forest conservation mainly involved increasing the timber supply through the natural reproduction of the existing forests. This included all reproduction by means of seeds shed by trees in the forests or by coppicing\(^\text{52}\) from the roots of cut trees or by a combination of both (Ribbentrop 1873: 73).

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\(^{52}\) The process of cutting trees in such a way that the trunk portion remaining in the soil would develop shoots and grow into a tree.
For the cutting of trees, the German scientific forestry method was systematically adopted at the all-India level from 1864 onwards. This meant reduction in the number of trees cut in the various forest divisions by selective felling of mature trees and by rotation felling (Sivaramakrishnan 1995: 18). Forest conservation through scientific forestry was cheaper to adopt to maintain railway sleeper supply than the creation of new forests artificially by planting timber trees such as deodar53 (PWD (Forests) Progs 1866 No. 2).

The forest conservation policy was adopted mainly to meet the timber needs of the railways and other public works rather than for ecological reasons and this motive was reflected to a large extent in the way the hill forests were worked under the system of scientific forestry. Brandis, colonial India’s first conservator of forests, observed that, although natural reproduction of forests was the most important method of conserving India’s forests, it would have to be aided by silvicultural operations that would increase the proportion of more valuable kinds of trees (Saldanha 1996: 1268; italics added). Deodar, teak and sal were considered by the colonial state to be the most valuable trees since they were needed for railway construction and for other public works. However, these trees did not form pure forests but often grew with other species such as oak, which were used as fuel, fodder and small timber by the local people (Gadgil and Guha 1989: 147). Through silvicultural techniques such as barking or girdling which killed the less valuable trees such as oak, the forest department was able to convert the mixed oak-

53 Deodar trees took more than 100 years to mature and yield suitable timber for sleepers (Appendix to PWD Progs June 1865 Prog No. 26). Plantations of the commercially important trees were started only in the 1920s (Sivaramakrishnan 1995: 19). The only exception was Malabar where teak plantations were started by the 1850s itself (Rangarajan 1994: 157)
conifer forests to pure coniferous ones (Saldanha 1996: 1268; Gadgil and Guha 1989: 147 and Sivaramakrishnan 1995: 18). This conversion of mixed forests to monocultures not only affected the forest ecology, but also ran counter to the survival needs of the local people.

To maintain the timber supply for the railways not only in the present but also in the future the state took forest conservation seriously, as the following extract shows:

The very large demand for timber for the use of the Public Works Department and for Railway Purposes which has sprung up, and has been rapidly increasing during the past few years, has, in the absence of efficient means for conservancy and supervision, led to much indiscriminate and wasteful felling. As this demand is not likely to decrease, and as in some provinces the very possibility of maintaining a supply for future years would be threatened by the continued unrestricted, or imperfectly supervised operations of Contractors in the forests.... (PWD (Forests) Progs 1861 Prog No. 36; italics mine).

Initially forest conservation54 was implemented at the provincial level in the provinces such as Oudh; Saugor and Nerbudda territories in the Central Provinces and Kumaon, Garhwal, Dehra Dhoon in the NWP (PWD (Forests) Progs 1861 Prog No. 36). Thus, in those regions where denudation of the forests was experienced the earliest due to railway expansion, and where more railway lines were to be completed, forest conservation measures were adopted the earliest.

However, forest conservation at the provincial level was not implemented systematically and consistently, and the difficulties faced in obtaining sufficient timber

54 Before 1860, the earliest instances of forest conservancy establishment in colonial India were in 1847 in the Bombay Presidency and in 1856 in the Madras Presidency (Stebbing 1922, 1:219). However, forest conservancy in these provinces "hardly rose above the level of a revenue administration." (Ribbentrop 1900: 71).
for railway sleepers during the 1860-61 peak period of railway construction in many parts of India made the question of forest conservation at the all-India level urgent (PWD Progs November 1862). Forest conservation was finally implemented at the all-India level in 1864 with the establishment of an Imperial Forest Department and the passage of the Indian Forest Act in 1865. In a despatch to the Secretary of State, the Governor-General of India wrote:

It will be understood from this account [of earlier forest conservancy attempts] that until quite the last few years, no Forest administration has in truth existed.... [S]o long as the supply of timber has been steadily diminishing from want of proper conservation, the demand both for State and private purposes has been rapidly increasing, and the enormous requirements of the different railways for sleepers has especially brought the matter into very prominent notice, and has now made the subject of Forest conservancy an important administrative question....(PWD Progs November 1862: 5-6; italics added)

Thus, the diminishing supply of timber from the forests due to their depletion and the increasing demand of sleepers by the railways led to the adoption of forest conservation by the state at the all-India level.

When the forest conservation method involving the natural reproduction of the existing forests was not cost-effective in maintaining the railway sleeper supply, other methods were used to increase the sleeper supply. For example, in the Madras Presidency by the late 1850s it was found that the wooden sleepers obtained from the local forests in the Madras Presidency were not durable and had to be often replaced even before the railway lines of a particular district had been completed. This can be seen from the following excerpt.
At one time, it was thought that the forests of the south of India would furnish numerous timbers suitable for sleepers.... But these hopes have not been fulfilled; no timber has been found capable of resisting the combined effects of the heat and moisture of the south of India....

Iron sleepers were very soon very extensively in use on the Madras line. Taking an average of the various woods used on this line of rail road, the duration of its sleepers has been about 3 1/2 years and annually about 340 sleepers per mile were required to be replaced (Balfour 1862: 231)

The state therefore took up the second method of increasing timber supply: decreasing the timber demand on the local forests in the Madras Presidency. It did this initially by creosoting some locally available wooden sleepers so that their durability would increase. Like all technological fixes this too was a short-term solution to the deforestation problem (Smith 1992: 40). Although creosoted, wooden sleepers still decayed making them unsuitable for use as sleepers on the Madras Railways.

Substitutes for locally obtained wooden sleepers such as cast-iron sleepers were found to be more durable for the Madras Railways. In this case, the high cost of the cast-iron sleepers was offset by the very low durability of the local wooden sleepers. Therefore, the Madras Railways began to use cast-iron sleepers which, due to the lack of local manufacture, had to be imported from England. For example, for 401 miles of the Madras Railways iron sleepers were imported from England in 1862 (Railway Report for 1863 in PP 1863 [c. 3168]).

In addition to iron sleepers, Burmese pynkado or ironwood, and Australian jarrah sleepers were also imported and used on the railways in the Madras Presidency

55 Using creosote imported from England.
56 A species of eucalyptus found in Australia.
Given the scarcity of timber for sleepers relative to the railway demand and the lack of locally available durable timber, it was cost-effective to use imported wooden and iron sleepers on the railway lines in the Madras Presidency, unlike in other provinces of British India.

Similarly, in the second peak period of railway construction at the all-India level i.e. from 1876 to 1884, involving the South Indian Railway, the IVR, the PNR and the Rajputana Railway, either non-wooden substitutes and/or non-local wooden sleepers were used. Although in this period an average of about 1400 miles of railways were under construction\textsuperscript{57} per year unlike in 1860-61 there was no increased deforestation of the local forests in the railway construction areas. The extent to which the construction of the above state-built railways\textsuperscript{58} along with other railways in the Punjab affected the forests, especially in the British Punjab, will be discussed in the following section.

### 3.3 Railways and the need for sleepers in the Punjab

In a letter the Secretary to the Government of the Punjab wrote

*The prosecution of Railway works in the Punjab has been the means of creating a demand for timber which threatens a serious inroad upon our resources, and points to the urgent necessity for the exercise of such a control as may effectually prevent waste* (PWD Progs, June 28 1861; italics mine).

\textsuperscript{57} See Table 2.2.

\textsuperscript{58} Except South Indian Railway which was built in the Madras Presidency by a private company.
The exhausted state of the Punjab’s forests because of sleeper demand by the early 1860s was especially alarming to the state because only in the 1850s had Major Longden reported in his survey of the hill forests of Chumba on the Chenab that they were “almost inexhaustible, consequently the amount of timber, to be obtained from them is only limited by the number of hands employed....” Similarly, he observed that the higher portions of the Sutlej, the lower portions of the Ravee, the valleys of the Chandrabhaga or Chenab, and portions of the valleys of the Beas and Parbutti rivers in Kulu had abundant and accessible deodar in the hill forests of the Punjab (Foreign (Pol) Progs, 10 March 1854).

What was the extent and pace of railway construction and expansion in the Punjab and the corresponding demand for sleepers that it created? The pace and extent of railway expansion in the Punjab can be seen in Table 2.2., which shows that between 1860 and 1884 the average mileage of railways under construction in the Punjab per year was 186.58 miles. Based on average mileage of railway construction, the following peak periods of railway construction emerge, 1863-64, 1866-67, 1876-77 and 1879-82. Different railways and regions of the Punjab were involved in these peak periods of expansion. The Consulting Engineer to the Government of Punjab calculated the annual requirement of the Punjab Railway as follows:

[T]he enormous quantity of timber alone required for sleepers on the Mooltan[Multan] line,... supposing the line to be completed in three years, the estimate is for a monthly supply of 11 or 12,000 sleepers for 36 months, or half a million of cubic feet per annum.... Supposing a log to give on an average 40 cubic feet, we have here an annual demand for 12,500 logs ... or of 37,500 in three years for sleepers alone. Now for the Umritsur[Amritsar] line 32 miles long,
irrespective of stations, sidings, &c, 57,600 sleepers were required, and these are not yet all delivered, i.e. in about 18 months, and for that number about 5,000 trees only, yielding 40 cubic feet per log, were requisite....(PWD Progs Dec 1861 Prog No. 22)

From the above excerpt, it can be calculated that a deodar tree on an average yielded about 11-12 sleepers. Each sleeper contained about 3.5 cubic feet of wood. And each mile of the Punjab Railways required about 1800 sleepers.\(^9\) For the Delhi railways the total number of sleepers required per mile was 2000. The state-built railways such as the IVR and the PNR needed about 1900 sleepers per mile on an average, an enormous demand.

Certain conditions peculiar to the Punjab increased the pressure on the forests in the Punjab. The first condition was the aridity and distribution of flora in the Punjab. A survey report on the Punjab forests for the years 1859 and 1860 noted that:

...[O]wing to the general scarcity of trees in the plains, the wants of the Punjab have been chiefly supplied from the forests in the hills, and advantage has been taken of the water carriage afforded by the great rivers of the region to float down splendid logs of the Deodar (*Cedrus deodara*) by the route of the Jhelum, and the Chenab, and the Ravee.... (PWD Progs June 28 1861)

The second condition was the problem of timber transportation from the hills to the plains. Because the timber trees such as deodar were confined to the hill forests located at high altitudes\(^6\) the timber could be transported only by rivers flowing from the hills to the plains, making transportation dependent on heavy rains that helped float the logs of wood on the rivers down to the plains. This dependence on floods for the transportation of

\(^9\)Excluding those required for sidings, stations etc.
sleepers to supply the Punjab railway is exemplified in this extract from the Progress Report of the Punjab Railway

In fairness to the Contractors for sleepers and timber, it must be here stated that last year’s supply of timber from the forests was almost ‘nil,’ in consequence of a general deficiency of rain; owing to this the trees which had been felled by the Contractors in the Himalayan Forests in the dry season, were not as usual carried by the floods down into the large rivers that issue from the mountain ranges, and by which the timber is floated into the plains of the Punjab.... (PWD Progs November 1861: 866-871).

Because of the dependence of sleeper supply on floods, more trees had to be cut to make up for the dry seasons and also for the loss while transporting down the river. The losses in transportation are described in the following excerpt “These [deodar logs] are felled without any thought whether they will reach the river or not, and then they are hurled down in the most reckless way, some to be shattered to pieces by collision rocks [sic], and others to be suspended in clefts, where no hand can reach them.”(PWD Progs June 28 1861). Among the river valleys of the Punjab, the highest losses in transportation were seen on the Ravee and the Chenab. For example, in the logs launched on the Chenab, there was a loss of 25 % on an average between 1859 and 1864 (Forest Progs 1867 Prog No. 6).

The combination of the above two conditions soon began to affect the more accessible deodar hill forests by 1861 when railway construction was in the initial stages as the following extract shows.

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60 The deodar was generally found between 5,000 and 8,000 feet above the sea level (Punjab Imperial Gazetteer, I: 73).
It is found that the deodar timber is admirably adapted for railway sleepers, and every region in the hills, from the Indus to the Sutlej, is ransacked to provide the requisite supply. *The resources of the Jhelum and Chenab are almost exhausted*, and hitherto the forests on the Sutlej have been entirely neglected. ... The principal trader this year was Mr. Ter Arratoon, an Armenian and contractor for providing sleepers for the Punjab Railway.... *The forests close to the water edge have long since been cleared away, and it is only at a distance of a mile or more from the river base that trees are found* (PWD Progs June 28 1861; italics added).

Thus, the trees that were closest to the rivers were cut first, exhausting the accessible deodar forests. This was because it was cheaper and easier for the contractors to cut and launch the timber on the rivers (Calcutta Review 1867 xlv: 85).

This loss of accessible deodar hill forests had already affected the availability of timber for railways by the beginning of the 1860s, as this extract shows:

> For two years has this delay [of obtaining sleepers] been more or less experienced, and for some years I fear there will be similar disappointment, as the demand for timber increases.... But in this place we have to consider the *sleeper supply* as that so directly concerns the completion of the Railway....(PWD Progs Dec 1861 Prog No. 22)

Given the denuded state of the accessible forests, the difficulties faced by the railways to procure wood for sleepers in time, and the magnitude of railway construction expected in the future, some measures were proposed to decrease the demand on the deodar hill forests of the Punjab. These included the use of timber other than deodar for sleepers such as cheel61 and fir timber (PWD (Railway) Progs March 1861; PWD (Governor-General))

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61A species of pine.
Experiments were conducted to prolong the lifespan of the pines and firs by impregnating them with copper sulphate. These experiments were, however, not very successful (Troup 1912: 75).

Experiments using circular cast-iron sleepers known as Greave's Patent Pots were done on parts of the Multan line (PWD Progs November 1861; PAR 1862-63: 52). However, cast-iron sleepers were too expensive to offset their advantage of being more durable than their wooden counterparts (PWD Progs Dec 1861 Prog No. 22). Thus efforts to decrease the pressure on the deodar hill forests of the Punjab through the use of substitutes for deodar failed. Therefore, the exhaustion of the deodar forests continued as the railways expanded. Since the railway expansion was uneven temporally and spatially,\(^\text{62}\) as discussed above, the deforestation of the hill forests in the Punjab was also uneven. I will now examine the uneven impact of railway construction in the Punjab on the hill forests chronologically. This will be done by taking the case of each railway constructed within the British Punjab between 1859 and 1884 and by examining its impact on the hill forests that supplied it with timber.

**Punjab Railways Sleeper Procurement (1859-1865)**

The Punjab Railways connected Amritsar and Multan covering a total distance of 252 miles, requiring a total of 453,600 sleepers, meaning that 41,236 deodar trees had to be felled between 1860 and 1864. For the construction of this line most of the trees\(^\text{63}\) were

\(^{62}\) See Table 2.2.

\(^{63}\) Henceforth, trees will mean first class deodar trees throughout the chapter unless specified.
felled in the hill forests of the Chenab and Ravee river valleys. It was estimated that in 1861-62, about 11,152 trees in the Chenab and 5,649 trees in the Ravee hill forests were felled. Of the trees felled in the hill forests of the Chenab a total of 587,475 cubic feet of timber was sold in 1861-62. Of this, 459,743 cubic feet was supplied to the Punjab Railways (Cleghorn 1864: 158). In 1862-63, 12,706 trees in the Chenab and 6,083 trees in the Ravee hill forests were felled (PWD (Forests) Progs May 1864; August 1865 Prog No. 36). Out of a total of 538,871 cubic feet of timber sold from the trees felled in the hill forests of the Chenab in 1862-63, about 494,230 cubic feet was sold to the Punjab Railways (Cleghorn 1864: 158).

The Punjab Railways bought about 78% of the total timber sold in 1861-62 and 92% of the total timber sold in 1862-63 in the Chenab river valley. Thus, not only did the Punjab Railways consume more than three-fourth of the total timber sold between 1861 and 1863 in the Chenab valley, but its total consumption also increased by 14% from 1861-62 to 1862-63. This high consumption of timber by the Punjab Railways certainly corresponded with a peak period of railway construction in the Punjab, i.e. 1863-64, when about 227 miles of railway lines were under construction per year.

Because of the high demand for timber between 1860 and 1862 by the Punjab Railways there was increased denudation of the hill forests in the Chenab and the Ravee (PWD Forests Progs 1866 Prog No. 2). This resulted in the limited availability of first class trees in the Ravee hill forests, which were reduced to just 7,550 by 1863 (Cleghorn 1864: 121). Therefore, the number of trees cut in 1863-64 in the Ravee hill forests
decreased to 4,657 and in 1864-65 to 2,000 trees. These decreases show the limits to how much timber could be extracted from the hill forests; the rapid railway expansion of 1860-62 was beginning to exhaust them.

**Delhi Railways Sleeper Procurement (1864-1870)**

The next railway constructed was the Delhi Railways which between Meerut and Amritsar covered a distance of 320 miles. Like the Punjab railways, the Delhi Railways needed about 2,000 sleepers or about 10,000 cubic feet of timber per mile. Thus, the total number of sleepers that had to be laid between 1863 and 1868 on the Delhi Railways line was 640,000 or about 3,200,000 cubic feet of timber.

Given that the 1863-64 peak period of railway construction involving mostly the Punjab Railways had nearly exhausted the hill forests of the Chenab and Ravee valleys, the sleeper needs of the Delhi Railways had to be met from elsewhere. The Consulting Engineer to the Punjab Government estimated that about 400,000 cubic feet from the Beas in 1863-64, 1,000,000 cubic feet from the Sutlej in 1863-65 and 1,400,000 cubic feet from the Jumna between 1863 and 1868 would be required for the construction of the Delhi Railways (PWD (G. G.) Progs June 1863 Prog No. 12). This would amount to about 10,000 trees on the Beas, 25,000 trees on the Sutlej and about 35,000 trees on the Jumna.

However, the Progress Report of the Punjab for 1865-66 noted that the Sutlej hill forests contained about 21,167 first class trees while the Beas hill forests contained 5,000 first class trees (Forest Progs 1867 Prog No. 6). Thus, the sleeper demand of the railways
could not be met from the existing deodar hill forests of the Sutlej and the Beas and whatever hill forests existed would be exhausted completely by the time the Delhi Railways were completed.

The lack of forests to meet the above demand of timber for sleepers to the Delhi Railways was highlighted by Dr. Brandis, the Conservator of Forests in Burma, on special duty. He observed:

If any of the Hill Forests are to be conserved, it is certain that Deodar cannot be supplied in sufficient quantity for the Railway lines north-west of Delhi within the next three or four years, when the sleepers will be required (PWD (Railway) G.G. Progs, September 1863 Prog No. 2)

Thus, a timber scarcity situation developed for supplying sleepers to the Delhi Railways. This was especially so for the Delhi Railways lines to be built in the future i.e. in 1867-68 when an average of 229 miles of railways would be constructed per year. The earlier phase of rapid railway construction (in 1863-64) combined with the conditions of aridity and difficulty of timber transportation from the hill forests to the plains of the Punjab had almost exhausted the accessible hill forests of the Chenab and the Ravee. The above timber demand for sleepers by the Delhi Railways put further pressure on the remaining hill forests of the Punjab.

Given the already exhausted state of the forests in the Punjab and the huge timber demand of the Delhi Railways for sleepers, the existing forest sources in the Punjab would soon be depleted, thus delaying or stopping the construction of railways in a manner similar to what had happened at the national level. Because the earlier measures
of decreasing the pressure on the deodar forests through the use of substitutes were unsuccessful, the state stepped in to implement forest conservation in the Punjab. By doing so it wanted to ensure that the timber supply to the railways could be increased/maintained just as it had done at the all-India level. Therefore, in 1864, the Punjab Forest Department was established with J. L. Stewart as the Conservator of Forests in the Punjab (PWD (Forests) Progs March 1864 Prog No. 20). The chief purpose of forest conservation in the Punjab in the mid-1860s was to ensure a permanent supply of timber for railway sleepers as the following excerpt notes. “The supply of sleepers for the railway is one of the most important subjects connected with the timber of the Forest Department” (PWD (Forests) Progs 1866 Prog No. 2).

Just as at the all-India level, the state adopted forest conservation in the Punjab. This involved natural reproduction of the existing hill forests. Of the two methods of natural reproduction discussed in the previous section, for the deodar trees only the seed reproduction system was suitable (Ribbentrop 1873: 171). Since the gestation period of deodar to mature and yield timber was quite long, the emphasis of forest conservation in the hill forests was on the proper cutting of deodar trees. The scientific forestry method of selection and rotation felling was used for the cutting of the forests in order to increase the supply of timber relative to the sleeper demand of the railways.

However, the system of selection felling was not followed consistently in all the deodar forests in the Punjab as this extract taken from the Working Plan of the Kulu Forests notes.
In conducting the fellings of deodar no regular system has been adhered to. Some few forests were practically clean-felled [clear cut], and had to be planted up at a great cost, or the planting up failed entirely owing to the ... dense undergrowth.... In other forests again very heavy fellings have been made so as to leave an extremely light and broken canopy;... it has failed entirely to produce natural reproduction owing to the undergrowth which sprang up when the forest opened out. Finally, certain forests have been selection-worked, with very satisfactory results.... (1898: 20)

Although the forest department was supposed to use selection felling to allow the forests to regenerate, even as late as 1898 no systematic felling method was adopted in the Punjab making the loss of forest cover irreversible. This non-systematic, heavy and clean felling or clear-cutting of trees was due to the timber demand of the railways, as the following excerpt from a letter from the Home Department, Government of India to the Government of the Punjab shows:

It would appear from these statements that the deodar forests in the Punjab have to some extent been worked beyond their capabilities. This may have been justifiable while extensive railway works were in progress; but now that the great trunk lines are approaching completion, the annual cuttings should be restricted to what the forests can yield permanently.... (Home, Rev & Agri Progs, November 1881; italics mine).

Moreover, once the forest department was formed it had to generate adequate revenue through sale of timber and other forest products to justify its existence, in keeping with the colonial policy that the colony’s administrative machinery had to be self-supporting (Guha 1983: 1886). Hence, the felling of trees without any systematic and consistent efforts to regenerate the forests continued.

To supply sleepers to the railways broadly two methods of timber harvesting and sale were used by the Forest Department. The first method involved the Forest
Department directly in felling the trees from the hill forests and transporting them to the depots at the foot of the hills. The timber was mostly transported in the form of logs and sometimes in the form of sleepers cut to the proper dimensions in the forests itself. The Forest Department then auctioned the timber either directly to the agent of the railway companies or to private contractors, who had earlier submitted indents for them. In the latter case, the private contractors would transport the timber and supply them to the railway companies. In the second method, the Forest Department would select and mark the trees or forested areas to be felled by the private contractors who entered into a contract with the Forest Department to purchase the timber. The contractors then harvested, transported and sold the timber to the railway companies (Tucker 1993: 183-184).

Despite the implementation of forest conservation in the Punjab, the sleeper supply to the Delhi Railways could not be increased/maintained. Therefore, to solve the sleeper supply problem of the Delhi Railways in the wake of the timber scarcity crisis, it was decided that about half of the Delhi Railways line (i.e. 160 miles) should be laid with iron pot sleepers even though they were expensive. Once again, just as in the case of the railways of the Madras Presidency, when the method of natural reproduction of forests could not increase the supply of timber relative to the railway demand, the second method of decreasing the demand on the local forests through the use of substitutes such as cast-iron for sleepers was used by the state in the Punjab.

Of the remaining 30,000 tons of timber that the Delhi Railways needed for sleepers, it was estimated that about 23,000 tons could be met in four years from the hill
forests of the Chenab, Ravee, Beas and the Sutlej (PWD (Revenue-Forests) Progs October 1865 Prog No. 12). This would suffice for 115 miles of the Delhi Railways. The remaining supply (i.e. for 45 miles) had to come from the hill forests of the NWP such as the Jumna and the Ganges valleys or from other local sources or by using iron pot sleepers.

The above estimate of 23,000 tons of timber to be derived from the hill forests of the Punjab works out to be 15,333 first class trees that had to be supplied between 1864 and 1868 to the Delhi Railways. Dr. Stewart estimated that the Chenab valley contained about 12,000 first class trees (Forest Progs 1867 Prog. No. 44). About 50 % of these trees on the Chenab were inaccessible and for which special slides had to be constructed. The Ravee forests contained only about 5,500 first class trees (Forest Progs 1867 Prog. No. 44). Although the hill forests of the Sutlej were considered to be 'practically inexhaustible', the more accessible hill forests of the Sutlej could last only for another sixteen years with an annual yield of 3,000 trees or 4,500 tons per year. Only about 10,000 first class trees were available in the hill forests of the Beas valley (PWD

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64 This figure is for the actual building of the line and does not include the timber needed to replace the existing sleepers which were perishable.

65 In the context of the deodar tree, any tree that had reached a girth of 6 feet or more was classified as a first class tree by the Forest department. Only these first class trees were suitable as sleepers due to their durability.

66 Appendix to PWD Progs June 1865 Prog No. 26

67 Containing first class trees
Thus, the total number of first class trees available for the Delhi Railways in 1864 was 33,500 in the hill forests of the Chenab, Ravee, Sutlej and Beas.

Taking an average of 20% as the loss due to transportation in the river valleys of the Punjab, the total available trees for the Delhi railways works out to be about 26,800. Although the total number of available trees was sufficient to meet the needs of the Delhi railways construction up to 1868, the hill forests would be exhausted leaving hardly 11,500 trees for the construction of the railways in the future.

To prevent another timber scarcity situation from arising in the context of the Delhi Railways and to acquire timber for the increasing demand of railway sleepers in the Punjab, the colonial state expanded the supply of timber by leasing in forests belonging to native states outside of the British Punjab. Bussahir and Chamba were two native states who leased their forests to the colonial state. Bussahir was located in the Cis-Sutlej region while Chamba was near the origin of the Ravee river. The ruler of Bussahir leased out his forests to the colonial state for a period of 50 years (PWD Progs September 1864). Similarly the ruler of Chamba leased out his forests for a period of 20 years with a

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68 The loss in transportation of timber in the river valleys of the Punjab varied from 5% on the Chenab to about 35% on the Sutlej (Cleghorn 1864: 117-118).

69 Given the fact that the deodar tree in these forests, on an average took 35 years to grow from a second class tree to a first class one (Appendix to PWD Progs June 1865 Prog No. 26).
minimum payment of Rs. 20,000 per annum as rent. In return the colonial state would have complete control over those forests and could cut wood from them (PWD Progs December 1864).

IVR Sleeper Procurement (1869-1884)

We have seen that in 1869 the state began to construct railways directly rather than through the private railway companies. In the Punjab, the state-built railways were the IVR, the PNR and the Rajputana Railways. The construction of the IVR's main line that connected Multan with Kotri in Sind and covering a distance of 500 miles was started in 1869. Each mile of the IVR, as discussed before, needed about 1900 sleepers. Hence, for the IVR line from Kotri to Multan about 1,100,000 sleepers were needed (Agri, Rev & Comm (Forests) Progs, March 1872 Prog No. 29). This would require a total of about 100,000 deodar trees. The average annual requirement of deodar trees for the IVR line alone, excluding the maintenance needs, between 1871 and 1876 worked out to be about 20,000. In addition, for maintenance purposes an annual amount of 150,000 sleepers was needed (Agri, Rev & Comm (Forests) Progs, March 1872 Prog No. 29). This amounted to about 12,500 deodar trees.

The timber supply for the above quantity of sleepers for the IVR had to come from the nearby hill forests of the Sutlej, Beas, Indus and from the Sind Babool Forests. The timber yield of Indus river and its offshoots was estimated at 200,000 cubic feet per

70 This was equivalent to 5,000 trees per annum (Forest Progs 1867 Prog. No. 44).

71 The remaining 153 miles of the IVR lay completely outside the provincial limits of the Punjab.
annum which would be maintained for a few years to come. This amounted to an annual yield of 5,000 deodar trees\textsuperscript{72}. The estimate on the Sutlej was on an average 40,000 cubic feet while the Beas could yield 20,000 cubic feet. This would amount to 1000 trees and 500 trees respectively (Agri, Rev & Comm (Forests) Progs, August 1872 Appendix B).

On the Chenab, Ravee and Jhelum the estimated yield was 357,000 cubic feet or 8900 trees\textsuperscript{73} (Agri, Rev & Comm (Forests) Progs, August 1872 Appendix B). From the above data we can see that the hill forests could yield only about 15,500 trees annually to supply sleepers to the IVR while the IVR’s annual demand was about 20,000 trees. Also, the sleepers had to be supplied by 1876-1877 to complete the lines. Thus, the existing supply of accessible deodar trees in the hill forests of the Punjab was insufficient to meet the needs of the IVR.

The insufficiency of timber supply relative to the sleeper demand of the IVR can also be seen in the following example. By November 1872 about 100,000 sleepers had been provided for the IVR. Another 50,000 sleepers were diverted from the PNR supplies of the Ravee, Chenab, and Jhelum river valleys (Agri, Rev & Comm (Forests) Progs, August 1872 Appendix B). Thus, only 150,000 sleepers could be supplied with difficulty out of the required 1,100,000 sleepers.

Despite the insufficiency of timber for sleepers in the hill forests of the Punjab, timber needs of the railways in the Punjab and in the NWP were given top priority for

\textsuperscript{72} However, most of this timber was quite inaccessible.

\textsuperscript{73} This yield was expected to last until 1875-76 after which there would be a decrease in the yield.
timber supply by the Forest Department as this note from Dr. Brandis, the Forest Conservator suggests:

It is true that, at the present moment, when it has been decided that in the North-Western Provinces and in the Punjab, railway requirements are to take precedence of all other requirements, we are further off from encouraging an open trade in timber than ever, as far as the supply from Government forests is concerned (Agri, Rev & Comm (Forests) Progs, March 1872 Prog No. 74).

This priority given to the timber needs of the railways shows how important railway building and expansion was for the colonial state.

Therefore, as more and more accessible hill forests were cut to meet the timber needs of the railways, the price of the sleepers increased (Agri, Rev & Comm (Forests) Progs February 1872 Prog No.13). At the same time, the opening of the Suez Canal in 1869 decreased the cost of freight to India's west coast, making the imported sleepers from England cheaper (Wolpert 1982: 243). Given the above decrease in freight prices and the increase in price of indigenous sleepers, when the portion of the IVR line up to Kotri was completed, it became a lot easier\textsuperscript{74} and cheaper to import sleepers from England than to obtain it from the Punjab’s hill forests (Agri, Rev & Comm (Forests) Progs August 1877 Prog No. 42).

Thereafter, from 1876 onwards about 72% of the sleepers needed for the remaining portion of the Indus line were imported from England (Agri, Rev & Comm (Forests) Progs August 1877 Prog No. 42). In this case, the state found the method of decreasing the demand on the local forests in the Punjab more cost-effective than the

\textsuperscript{74} Since Kotri was connected with the port of Karachi through inland steamers.
method of increasing timber supply through natural reproduction of the forests. It therefore procured its sleepers from outside the Punjab such as from England and decreased the timber demand on the forests of the Punjab. Hence, although railway construction mileage had reached a peak of about 510 miles in 1876-77 involving mostly the IVR\textsuperscript{75}, there was no increased denudation of the hill forests in the Punjab due to the railway expansion.

**PNR Sleeper Procurement (1869-1884)**

The construction of the main line of the PNR that connected Lahore with Peshawar in the northwestern frontier of the Punjab covering 280 miles also began in 1869. There were three branches of the main line that included the Khushalgarh Branch from Golra to Khushalgarh covering a distance of 72 miles, the Salt branch from Lala Musa to Khewra covering a distance of 69 miles and the Sialkot branch covering a distance of 26 miles between Wazirabad and Sialkot. In addition to these about 95 miles of temporary line in meter gauge was opened between Lahore and Jhelum\textsuperscript{76}. Thus, only about 446 miles of the PNR lay within the Punjab’s provincial limits (PAR, 1884-85: 118).

The PNR, as discussed before, required about 1900 sleepers per mile on an average. For the entire line within the Punjab, about 847,400 sleepers were needed. Initially these sleepers were obtained from the nearby hill forests of the Ravee, Jhelum,

\textsuperscript{75} 500 miles of the IVR and about 10 miles of the PNR were constructed during this period.

\textsuperscript{76} This temporary line opened and functioned between 1875 and 1878 after which the broad gauge line connecting Lahore with Jhelum was used.
Chenab and Cabul rivers even if it meant increased cutting of the forests. As Dr. Brandis wrote:

> It is of the utmost importance that as large a portion of the sleepers required for the Northern State Railway [PNR] as possible be furnished by the Punjab Forest Department.... To increase the supply of Deodar for next year, you have already at my suggestion issued instructions for extraordinary felling in addition to the usual quantity.... (Forest Progs September 1869 Prog No. 48).

This led to an additional cutting of 3,000 deodar trees from the hill forests by the Forest Department. Even then the sleeper supply from the hill forests of the Punjab, between 1869 and 1871, could amount to only about 200,000 sleepers covering a distance of about 109 miles (Forest Progs September 1869 Prog No. 49; Agri, Rev & Comm (Forests) Progs March 1872 Prog No. 29). This was sufficient to cover only the first part of the PNR line between Lahore and Jhelum.

The exhausted state of the Punjab’s hill forests by 1871 can be seen from the total remaining number of first class deodar trees left in the hill forests of each of the river valleys that supplied sleepers to the PNR, including inaccessible ones. There were 12,371 trees in the Jhelum, 10,215 trees on the Chenab and 11,752 trees on the Ravee (Agri, Rev & Comm (Forests) Progs January-June 1872). Even if all the above trees had been used, only about 360,000 sleepers could be obtained. This would be sufficient for a maximum of about 190 miles of the PNR. Thus, the timber supply for sleepers from the hill forests of the Punjab was running out.
The exhausted state of the deodar forests in the Punjab by the mid-1870s is also clear from the following excerpt taken from the Review of Forest Administration for 1879:

*The quantity of mature [deodar] timber in the forests, leased and British, under the control of the Forest Department of the Punjab and the NorthWestern provinces is very limited, and has been so much diminished by heavy felling to supply sleepers for the Rajputana and Punjab lines that cuttings must, for many years to come, be reduced considerably, and no considerable supply of sleepers can be expected from that source* (1879: 4; italics added).

The increased exhaustion of the forests due to high sleeper demands increased the price of sleepers sold by the Forest Department. In fact, one of the major concerns of the state in the early 1870s due to its construction of the PNR and IVR\(^7\)7 directly was the high prices of the sleepers obtained from the Forest Department compared to that from other sources (Agri, Rev & Comm (Forests) Progs March 1872 No. 29; Agri, Rev & Comm (Forests) Progs August 1872 Appendix B; Agri, Rev & Comm (Forests) Progs Jan 1873 Prog No. 18). Thus, the method of increasing timber supply to the railways by the natural reproduction of the existing hill forests in the Punjab was not cost-effective.

Therefore, to maintain the sleeper supply to the railways the state had to adopt the method of decreasing timber demand on the hill forests of the Punjab. One way in which this could be done was through the procurement of wooden sleepers from outside the British Punjab. Unlike in the case of the IVR, the PNR did not find it cost-effective to

\(^7\) This concern about high prices by the state was more so because the main purpose of state built railways, after 1869, was to cut down the cost of railway building which had become expensive under the private companies (Kerr 1997: 20).
import sleepers from England as its lines were far away from the Karachi port. Hence, from 1876 onwards the PNR found it cheaper to obtain sleeper supplies from sources outside the British Punjab but within India (Agri, Rev & Comm (Forests) Progs August 1877 Prog No.42). These cheaper sources of timber included the forests of the nearby non-British states or native states within India as the following excerpt from the Review of Forest Administration for 1879 shows:

Small quantities may be obtained from Native States between the Beas and Tons rivers, the forests of which are not leased by Government; but the largest supply must be expected from Kashmir. *The deodar forests in that State should be drawn upon largely for the extension of the Northern Punjab State railway, and they may furnish renewals for the Sind, Punjab, and Delhi and part of the Indus Valley Railway* (1879: 4; italics added).

The report also noted that the future sleeper requirements in the Punjab, especially from 1878 to 1884, would be 270,000 broad gauge sleepers for an annual building of 50 miles and for renewals. This would involve mostly the construction of the PNR lines. Therefore, to meet the sleeper needs, as the Punjab Forest Administration Report (henceforth FAR) for 1879-1880 noted, timber consisting of deodar, other pines, sleepers, bamboos and so forth was imported from non-British states such as Kashmir, Kapurthala, Mandi etc. This imported timber consisted of more than twice the amount of deodar, four times the quantity of other pines and 17 times the number of sleepers that were brought from the British Punjab forests to the depots (Home, Rev & Agri (Forests) Progs Jan-Aug 1880). Similarly in the FAR for 1880-81, 1881-82 and 1882-83 it was noted that the
timber imported from foreign territories,\textsuperscript{78} such as sleepers, were not only many times that obtained from the state forests but the amount of this imported timber, especially that of deodar, was significantly higher than the amount imported in the previous year (Home, Rev & Agri (Forests) Progs Nov-Dec 1881; Sept-Dec 1882; Oct-Dec 1883).

Since the exhaustion of the deodar forests in the British Punjab meant that the timber for railway sleepers was increasingly obtained from outside the Punjab, pressure increased on other forests outside it. Thus, despite the high mileage\textsuperscript{79} of railway construction in the Punjab between 1879 and 1882 involving mainly the PNR, there was no increase in denudation of the Punjab’s hill forests.

**Rajputana Railway Sleeper Procurement (1871-1884)**

The first section of the Rajputana Railways in the Punjab was constructed from 1871 between Rewaree\textsuperscript{80} and Delhi covering a distance of 58 miles. Because of the exhausted state of the forests due to the earlier demand of the Punjab Railways and the increasing existing demand of the Delhi railways, the sleeper supply for the Rajputana Railways was obtained from the hill forests of the NWP, especially from the Jumna and the Bhagaruthi valleys (Forest Progs August 1869 Prog No. 63). Here too, the method of increasing the timber supply relative to the railway demand through the natural reproduction of the existing local forests was not successful.

\textsuperscript{78} Outside the British Punjab, i.e. from the forests of the native states.

\textsuperscript{79} An average of about 305 mileas were constructed during this period.

\textsuperscript{80} Located south west of Delhi.
Therefore, just as in the case of the PNR, the method of decreasing the demand on the local hill forests was adopted by obtaining sleepers from the forests outside the British Punjab. Similarly, for the next section of the Rajputana Railways in the Punjab, the timber for sleepers was obtained from the hill forests of the NWP. Thus, the construction of the Rajputana Railway lines in the Punjab did not further exhaust the hill forests of the British Punjab, but all of this railway construction widened the scope of forest exhaustion considerably to surrounding areas.

3.4 Conclusion

In the above discussion we have seen that in the second half of the nineteenth century railway construction and expansion by the colonial state in India led to an enormous demand for wooden sleepers. This demand for wooden sleepers in turn denuded the forests in India from which they were obtained. More specifically, we have seen how the railway demand for sleepers led to the denudation of the Punjab’s hill forests.

Though there is no necessary connection between the building of the railways and deforestation, certain conditions in the context of railway building in India necessitated the use of wooden sleepers from the local forests in the areas where the railways were being built. These conditions included the use of wooden sleepers, procurement of

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81 Constructed from 1881 to 1885 between Rewaree and Fazilka via Hissar and Sirsa located in the southwestern part of the Punjab.
sleepers from India and the idea of India’s forests being inexhaustible. These conditions in the context of rapid railway expansion accelerated the exhaustion of the forests in the second half of the nineteenth century in colonial India.

Given the necessity of using wooden sleepers from the local forests, the pace of railway construction temporally and spatially determined the place and time of the denudation of the forests. For example, in the 1860-61 railway construction peak period, the construction of the Madras Railways and East India Railway lines led to an enormous demand for wooden sleepers from the accessible local forests in the Madras Presidency, Kumaon and Garhwal of the NWP and Oudh which soon exhausted. This led to a timber scarcity situation for railway sleepers in these regions.

Because the construction of railways had become totally dependent on sufficient wooden sleeper supply, any decrease or lack of supply would delay or stop the railway construction. Given the developmental importance that the state attached to the establishment and expansion of railways in order to increase timber supply relative to the railway demand it had to intervene in the forest arena. The colonial state, just like the modern states of industrial societies facing environmental problems, adopted the measure that had the lowest short-term costs (Smith 1992: 40).

One cost-effective way in which the state could maintain the railway timber supply was through the adoption of forest conservation to reproduce the existing forests naturally. This was done by using the scientific forestry method. This method was adopted by the state initially in the NWP and Oudh and later at the all-India level in 1864. However, natural reproduction was too slow a method to satisfy the immediate timber
demand of the railways. Therefore, in the Madras Presidency imported cast-iron and wooden sleepers were used by the 1860s, and proved to be more cost-effective in maintaining timber supply to the railways.

In provinces such as the Punjab, before the implementation of forest conservation in 1864, locally obtained wooden sleepers were used as they were cheaper than the non-local or imported ones. The local forests, however, soon reached a depletion level that precipitated a sleeper shortage situation for the railways. Hence, to maintain a permanent and cheap supply of timber for the railways, forest conservation using the scientific forestry method to reproduce the existing deodar hill forests naturally was adopted by the state.

Given the slowness of the natural reproduction method, to meet the immediate sleeper demand of the railways between 1864 and 1875 other measures such as leasing in forests from native states were adopted in addition to local felling of forests. This felling put further pressure on the already exhausted forests of the Punjab. Therefore, by the mid-1870s, sleepers began to be obtained by the Punjab Forest Department from the inner hill forests of the Punjab that increased their cost. Therefore, to cut the cost of railway building wooden sleepers began to be obtained from outside the British Punjab, especially after 1876. These sources included the native states for the PNR and England for the IVR, thus decreasing pressure on the local forests. To what extent these non-local forests were affected by the timber demand of the railways might be an important topic for research in the future.
In this chapter we have seen how the colonial state’s drive to extract resources from India efficiently led to the building of the railways which adversely affected the forests. The state failed to see the ecological costs of its resource-extracting mechanism. When it did realize the deforestation impact of the railways, it did not stop railway expansion; rather it looked for a technological fix to solve the timber crisis. This fix was in the form of forest conservation adopted to assure a continuous supply of timber for the railways rather than to restore ecological balance.

In the Western Himalayan region as a whole, the adoption of scientific forestry under forest conservation by the state, changed not only the forest ecology of the region but had a social impact as well. Silvicultural techniques were used in the hill forests to convert the mixed oak-coniferous forests into pure coniferous ones which were valued by the state. The oak trees were valuable to the local people as they met their fuel and fodder needs. Thus, the adoption of this method of forest conservation not only reduced the local people’s access to the forests but also reduced the availability of trees that were important for their survival.

The railways’ demand on the forests was not just limited to sleepers: impact of their demand for firewood on the forests is discussed in the next chapter.
4.1 Introduction

In the previous chapter, we saw that the construction of railways in India set up a demand for wooden sleepers that adversely affected the forests in colonial India. This was seen especially in the Punjab between 1859 and 1884. However, the railways' timber demand was not just limited to the railway construction phase. As the railways began their operation, another demand for timber developed in the form of firewood. To what extent this firewood demand of the railways affected the forests in India, especially in the province of the Punjab, forms the focus of the present chapter.

The rest of the chapter is divided into three sections. The first section examines the impact of the firewood demand of the railways on the forests in colonial India between 1853 and 1884. In this section, I first analyze the different conditions that facilitated the increased dependence of the railways on firewood. I then examine the varying nature of the deforestation due to the railway firewood demand at the all-India level over time, including the colonial state's role in maintaining the fuel supply to the railways. The next section examines the impact of the firewood demand created by the railways on the forests in the Punjab between 1860 and 1884. In this section, the unevenness of the deforestation due to the firewood demand of the railways is examined.
in the Punjab over time. In the concluding section I draw out the similarities and differences in the impact of the firewood demand of the railways on the forests at the all-India level and in the Punjab.

4.2 The Railway Fuel Situation and Forests in Colonial India

Steam engines of the railways needed fuel, preferably coal, for their operation. However, until the late 1870s, coal of suitable quality and quantity for the railways had not yet been discovered in India. Because of the scarcity of suitable Indian coal, the use of a mixture of imported English coal and Indian coal as railway fuel was suggested. This can be seen in the following excerpt of a letter from the Board of Directors, East Indian Railway Company in London to the Court of Directors, English East India Company.

[T]he Board of Directors caused several specimens of Indian coal to be analyzed in this country and that the result showed that with an admixture of Newcastle coal some one or more of the descriptions [of coal] sampled would probably make a useful coke [a type of railway fuel].... [S]omething like 50 per cent of Newcastle coal would be required to make the Indian coal available [for use as railway fuel when mixed with Newcastle coal].... (Railway Letters from Court of Directors 1854: 7-8).

Thus, to make a suitable fuel for the railways in India, the railways had to import coal from England. Imported coal had to be shipped in huge quantities from England and would entail huge expenses by the railway companies.

[A]nd the enormous quantity [of coal] that would consequently have to be shipped from this country would from its heavy cost not only seriously interfere with the profitable working of the railway but from the large demand for shipping which its export would create would tend greatly to increase the cost of construction of the large works yet to be carried out.... (Railway Letters from Court of Directors 1854: 8)
However, it was not until the mid-1860s, when more than 3,000 miles of railway lines were open, that the state became concerned regarding the lack of coal in India and the high costs of importing it from England. Given the active involvement of the state in the establishment and expansion of railways in India, the concern of the state regarding fuel supply to the railways was not surprising. The high cost of imported coal was due to the high freight charges. The cost of imported coal in India was four times that of coal in England. The following excerpts taken from the Railway report of 1866 shows the state’s concern regarding the cost of importing coal:

The consumption of fuel has increased every year, and the quantity of coal sent from hence [England] must continue to increase.... At the present time a considerable rise has taken place in freights, and in some cases lately it has been necessary to pay 45s.[shillings] per ton. This charge is more than four times as much as the value in England of the coal despatched, and points out the importance of taking advantage of Native supplies wherever practicable.... With regard to the working expenses, there are two items which, at present, are particularly high on Indian lines, and these are the European establishments and the fuel, both of which, compared with railways in Europe, entail a heavy charge.... (PP 1866 [c.3696]: 4, 18).

Thus, the state began to explore the use of cheaper locally available coal on the railways.

Surveys of coal distribution in India were undertaken by the state to locate locally available coal of suitable quality and quantity for railways’ use. The results of these surveys were, however, not very encouraging and showed the limited distribution of coal in India, as noted in the Railway Report of 1867:

A recent report by Mr. Oldham, the Superintendent of the Geological Survey of India, on the coal resources of the country does not encourage the hope that coal will be found in many parts of India where it could be of very great value to the railways. ‘Viewed as a coal producing country,’ Professor Oldham says, ‘the
British territories in India cannot be considered as either largely or widely supplied with this essential source of motive power. In the upper, western and lower parts of India it may be presumed that the railways will not possess the advantage of native coal. The importance, therefore, of obtaining other sources of supply increases every year (PP 1867 [c.3856]: 23).

Coal suitable for the railways was found only in a few areas such as Bengal and Central India. Also, the use of this coal in the railways of northern and southern parts of India would be too expensive due to the high transportation costs (PP 1867 [c.3856]: 23).

The limited availability of coal and the high transportation costs involved in transporting it from the coal-fields to non-coal producing areas was an important condition that facilitated the use of other sources of fuel such as firewood on the railways in India. This was especially true for railways such as the Madras Railway, which operated in non-coal producing areas and had, by the mid-1860s, expanded to more than 500 miles. The cost of imported firewood from Australia on the Madras Railway was less than half that of coal and coke obtained from other regions within India (PP 1866 [c.3696]: 18). Thus, it was more economical for the Madras Railways to use locally procured firewood instead of imported coal. Hence, the Madras Railway began using firewood and coal from Australia.

In the Madras Presidency, firewood was obtained from scrub jungles, whose trees were not large. Most of the firewood was obtained from the jungles of the North Arcot, Salem and Malabar districts. Although the species used as firewood varied from district
to district, the palmyrah (*Borassus flabelliformis*), the babul (*Acacia arabica*) and punga (*Pongamia glabra*) were some of the species commonly used as firewood (Cleghorn 1860: 152-153).

By using firewood instead of coal the working expenses of the railways could be lowered, especially in non-coal producing regions such as the Oudh and the NWP. The following extract of a letter dated 18 October 1869, written by the Locomotive Superintendent to the Agent, Oudh and Rohilkund Railway, not only shows why firewood became a popular alternative to coal as a railway fuel, but also that there was no concern about exhausting firewood supplies — rather the opposite.

The question of fuel for this railway is undoubtedly one of very great importance, and one which requires the early attention of all concerned in the undertaking. *Wood is by far the cheapest fuel obtainable in India....* I think however, that *wood, should be used as much as possible while it lasts, and that every possible step should be taken to ensure not only the largest supply possible, but also as low a price as practicable....* (PWD-Forests 1869 Part B Prog No. 1-3; italics added).

Indeed, the goal expressed here was to exhaust supplies in pursuit of profits

In addition to the high cost of coal, the rapid railway expansion of the 1860s raised the demand for firewood for the railways. The East India Railway expanded to more than 1000 miles of open lines by 1865. The immediate consequence was a scarcity of firewood in the NWP, as noted in an East India Railway report for 1864.

The timely supply of wood-fuel for the opened line between Allahabad and Delhi is becoming a serious question, especially in the upper frontier of this section, where the country is poorly wooded. Practically, it is found that the country along the lower half of the line is obliged to supply wood for the whole length, and the denudation of the trees between Allahabad and Shekoabad is going apace. ... (PWD (Railway) Progs, July 1865 Prog No. 70).
Other areas, such as the Upper Provinces, which were away from the coal fields and also from the ports, also experienced the denudation of forests for railway fuel. A resolution of the Home Department pointed out:

The attention of the Government has been directed to the partial denudation of trees that has of late years been taking place in some parts of the Upper Provinces and particularly in the tract known as the Doab, to meet the large demand of the East India Railway for wood-fuel. The consumption of wood has been, and is, going on at a rapid pace while little if anything is being done to supply its place. It appears to me very doubtful whether coal will be available or if available, will bear the cost of distant carriage (Home (Pub) Progs Prog No.60 17 April 1865).

By the mid-1860s cutting of wood for railway fuel had exacerbated the destruction caused by sleeper demand, resulting in the denudation of forests especially in the Upper Provinces and the NWP as more and more railway lines were opened. Thus, a short-term solution, using firewood to stoke the engines rather than coal, which was a solution to an earlier fuel problem, it itself, became a problem as railway expansion increased.

One consequence of the resultant fuel scarcity experienced by the railways was the rise in firewood prices, as noted in an 1865 report of the East Indian Railway:

The cost of wood-fuel for locomotives during the half-year (June-Dec 1864) was Rs. 2,06,631-10-9 [206,631 rupees-10 pies-9 annas], which is at the rate of Rs. 0-7-9 per train mile. In the previous half-year [January-June 1864], the expenditure under this head amounted to Rs. 1,46,298-8-1, or Re. 0-6-4-1 per train mile. In the corresponding half-year of 1863 [June-Dec 1863], the expenditure under this head amounted to Rs. 1,41,474-10-0, or to Rs. 0-6-2-6 per train mile (PWD (Railway) Progs, July 1865 Prog No. 70).

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82 Due to high costs of imported coal and the lack of availability of suitable Indian coal.
Also, lack of fuel might retard the opening and functioning of railway lines. To prevent this eventuality the colonial state began directing its efforts at increasing firewood supplies by establishing timber plantations near the railway lines through the Forest Department, especially in areas where coal of suitable quality could not be obtained cheaply and where the demand for firewood had resulted in deforestation (PP 1867 [c.3856]: 23). These regions included the Upper and lower Doab of the North-Western Provinces and the Punjab (PWD (Forests) Progs 1869 Part B Prog No. 1-3). In addition to establishing fuel plantations, experiments on alternative fuels such as patent fuel were conducted (PWD Progs November 1869 Prog No. 21). Thus, the increased demand for firewood by the railways not only denuded the forests but also affected the operation of railways.

Given the fuel scarcity, the lack of suitability of patent fuel for use on the railways, and the long (10-15 years) gestation period before fuel plantations yielded firewood, the colonial state was forced to import coal for the railways, especially in the non-coal rich regions of India. As the railways expanded further in the 1870s,\(^3\) there was additional pressure on the colonial state to procure coal so that the newly opened lines could be worked. Given the importance of railways for the proper functioning of the state, it steadily increased coal importation from England through the 1870s. The total amount of fuel, i.e. coal, coke and patent fuel, imported from Britain into India increased from 45,530 tons in 1869-70 to 239,650 tons in 1877, despite its cost and the fact that the

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\(^3\) For example, in 1870, 516 miles of railway lines were opened and in 1874, 529 miles were opened. In 1878, 899 miles of railway lines were opened.
railways were beginning to utilize some Indian coal (Railway Reports for 1870 and 1877 in PP 1871[c.418], 1878[c.2179]). From 1878 onwards there was a decrease in the amount of imported coal because the production of Indian coal increased as more mines became functional and got connected by railway lines. After 1877, the East Indian Railway and the East Bengal Railway along with the Oudh & Rohilkund Railway began to use mostly Indian coal for their operations. Overall, the beginning of the 1880s saw increasing use of Indian coal on the railways in India as the Railway Report of 1882-83 noted, "It will be seen that 70 per cent of the coal burnt in 1882 was obtained from Indian mines, whereas in 1881 the proportion of Indian coal amounted to 67 1/2 per cent of the whole." (Railway Report 1882-83 in PP 1883 [c.3692]).

Thus, the increasing firewood demand of the railways led to the exhaustion of forests in many parts of India between 1853 and 1884. This exhaustion of the forests was more pronounced during the peak periods of railway line openings. Also, the denudation of forests was magnified in areas that were away from the coal fields. One area where the forests were most affected was the Punjab between 1860 and 1884, as detailed in the next section.

4.3 The Railway Fuel Situation and Forests in the Punjab

The urgency and the necessity of maintaining proper supply of fuel for railways was felt in the Punjab early on. A despatch of the Secretary of State for India to the

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84 The Madras Railways was an exception as it found the use of imported English patent fuel cheaper than Indian coal when the firewood supply in the Madras Presidency diminished (Railway Report for 1880-81 in PP 1880 [c.2683]).
Government of India clearly shows to what extent the demand for railway fuel had reached in the Punjab.

The necessity of maintaining an ample supply of timber and wood-fuel in the Punjab to meet the increasing demand, was urged upon your Government by my predecessor, in his despatch of the 28th February 1866.... I am of the opinion that it is necessary to proceed at once to the formation of fuel plantations adjacent to the lines of Railway westward of Delhi, and I would, therefore suggest to your excellency the prompt adoption of some such scheme ... to be undertaken by your Government so as to secure a greater supply of wood both for the public and the railway (PWD (Forests) Progs March 1867).

Most of the concerns of the colonial state in the 1860s regarding fuel supply to the railways were directed at the Punjab, in fact. Why was there such a timber crisis in the Punjab that it necessitated the formation of fuel plantations? To answer this question one will have to examine certain conditions, such as the mileage of railway lines opened, the availability and distribution of coal and firewood sources in and outside the Punjab. These conditions may have facilitated the dependence of the Punjab’s railways on firewood between 1860 and 1884. A recapitulation of the pattern and magnitude of railway line openings in the Punjab between 1860 and 1884 sets the stage for an appreciation of the variations in fuel demand in the area. The average mileage of railway lines opened between 1862 and 1884 was 83.68 miles per year. The below average opening years were between 1870 and 1879 (the exception was the opening of 499 miles of IVR in 1878). The years in which there was above average opening of railways in the Punjab were: 1865 when the Punjab railways opened 209 miles and 1868 and 1869, when the Delhi Railways opened about 120 miles in each of those years. In 1878, the IVR
opened 499 miles. During the 1880s, the PNR opened 124 miles in 1880 and 135 miles in 1881 while the IVR opened 151 miles in 1881. Given these peak years of railway openings in the Punjab and the railways’ dependence on firewood, how far did the railways’ expansion affect fuel availability in the Punjab?

Before answering this question, it will be first necessary to examine the sources of railway fuel existing in the Punjab at the time of railways’ opening. Fuel availability for the railways was especially problematic in the Punjab, as pointed out in a letter by an agent of the Punjab and Delhi Railways:

The position of the Punjab and Delhi Railways with regard to fuel is exceptional to that of any other line in India; all others enjoy the advantages of a supply either of wood or of coal. The Punjab, throughout its length and breadth is, with the exception of actual deserts, the most arid Province in India (PWD Progs 1866 Prog No. 26).

How did railway management meet this challenge? The use of imported coal on the Punjab’s railways was out of question due to excessive cost. Within the Punjab there was some coal available on the Salt Range but its transportation cost to Lahore for use on the Punjab Railways was high, as noted in an 1865 report of the Punjab Railway,

A quantity of coal has been received from the Salt Range, and has been used in working the regular trains, the most favorable results have been obtained with two-thirds of coal, and one-third of wood. The great cost of carriage to Lahore with the existing means of transport will, however, preclude its extensive use (PWD (Railway) Progs May 1865).

However, in addition to the high transportation cost, there was insufficient quantity of coal in the Salt Range, as seen in a Govt. of India resolution of the PWD. “Dr. Oldham's
Report is conclusive as to the insufficiency of the supply of Salt Range coal, even if its use were economically advantageous" (PWD Progs 1866 Prog No. 29). Salt Range coal was also not of the quality required for steam engines, which was noted in an 1867 memorandum from the Agent, Punjab Railway, to the Consulting Engineer to Govt. of Punjab, Railway Department.

The undersigned has given the subject of Salt range coal consumption on the line of railway under his charge, his most careful consideration, and does not feel himself justified, under existing circumstances, in making further purchases of this fuel at Lahore, or even at Mooltan[Multan], for the use of the Locomotive department. Independent of its excessive cost, it is not nearly as useful in generating steam as the Raneegunge coal; it is liable to spontaneous combustion in store on account apparently of the quantity of sulphur it contains; the damage incurred in land conveyance to Lahore is considerable, increasing its already very high cost. For these reasons, the undersigned begs, ..., that no further steps be taken for supplying the company with an item entailing very serious loss on its finances (Forest Progs June 1867 Prog No. 2).

Given the high cost of imported coal and the lack of suitable quality and quantity of coal in the Punjab, non-local sources of coal supply were next explored. Because the coal fields of Bengal and Central India were quite far away from the Punjab, the coal from these coal-fields could be transported to the Punjab only on trains of other railway companies. The state, meanwhile, had fixed a maximum rate for the carriage of goods for all the railway companies in India (PP 1867 [c.3856]). Because the railway companies engaged in coal transportation in Northern India such as the East India Railway Company

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For example, the three closest coal fields to Delhi were the Raneegunge fields in Bengal, the Singrowlee fields at Rewah, and the Mopani fields in the valley of the Nerbudda. They were at distances of 950, 550 and 700 miles respectively (PWD(Forest) Progs Sept 1866).
wanted to make profits in their operations, they maintained high carriage rates for coal transportation that added to the cost of coal delivered in the Punjab (PWD Progs 1866 Prog No. 27).

The attraction of using wood-fuel was obvious. Pointing out the importance of wood-fuel for the railways in the Punjab, the Secretary of State for India wrote to the Govt. of India, "Independently of the demand for sleepers and other purposes of construction, it is evident that wood is the only fuel that can be relied upon for a long time to come, the nearest coal being too distant to cover the cost of carriage" (PWD Proceedings, 1866 Prog No. 19). Even though the amount of firewood needed by the railways was three times its requirement of coal, firewood was still a cheaper fuel than coal, a realization that came earlier in the Punjab than nationally.

I will now examine the different sources of firewood for the railways in the Punjab. Although firewood was a cheaper alternative to coal in the Punjab, it was not always available close to the railway lines or easily accessible. The main sources of firewood in the Punjab were the canal plantations, the outer Himalayan forests and the forests of the plains known as rukhs, or sometimes referred to as rakhs. The canal plantations were an important source of firewood for the railways in the Punjab, but their timber had yet to mature and could not meet the immediate fuel needs of the railways in the 1860s. They were a useful source of firewood for railways in the future.

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86 Several efforts were made by the railways and the state to lower the carriage rates of coal on the East Indian Railways in the early 1870s when increased dependence of the railways on firewood along with increased railway openings began to exhaust the woodlands of the Punjab and the NWP. This is discussed later in the chapter.
The canal banks have been gradually planted with trees since 1854... but the plantations have been much extended within the last few years both in the Punjab and in the North-Western Provinces, their condition is promising, and the yield is increasing every year, and now forms an important contribution to the requirements of the railway. In 1864, it was found that Babool (Kikar) had been sown and planted upon both banks of the Baree Doab Canal for a distance of 144 miles, occupying an area of 2,760 acres.... [T]he Deputy Consulting Engineer calculates that the line from Umritsur[Amritsar] to Jullundur (50 miles) will be supplied from this source (PWD Progs 1866 Prog No. 19).

The forests of the outer Himalayan forests formed the second source of locally available firewood for the railways. However, there were transportation problems in bringing down the firewood from these hill forests. Dr. Cleghorn, as the Officiating Conservator of Forests, expressed this concern.

The Lieutenant Governor at one time thought that a very large and cheap supply of fuel might be obtained from the forests of the lower hills, but ... this cannot be the case. It might be supposed that the forests of Kangra, ..., where wood exists in large quantity, are well situated with respect to water carriage. This is true ... but rafts of fuel and charcoal cannot be easily taken down and reconstructed as in the case of logs, therefore the contractors now convey fuel chiefly upon carts and camels. Rafting is impracticable upon the Ravi and Sutlej within the hills, and the cost of labour and transport forbid the expectation of a large or regular supply of fuel borne upon those rivers (PWD Progs 1866 Prog No. 3).

Thus, due to the high transportation and labor costs, it was expensive to obtain firewood from the hill forests of the Punjab.
The third and most important source of firewood for the railways were the rukhs about which Dr. Edward Balfour\textsuperscript{7} wrote:

The great value of the wood-bearing rukhs consists in their being the source from which all the fuel for railway consumption is to be taken. The trees most commonly met with in "rakhs" are the jhand, Prosopis spicigera. This is the best fuel wood, being heavy and compact, and burns slowly... (Balfour 1858: 200)

The other species of trees found in the rukhs were phulahi or Acacia modesta, dhak or Butea frondosa, and the farwa or Tamarisk orientalis (Balfour 1858: 200).

The earliest mention of rukhs in the Punjab was in 1863\textsuperscript{8} in the context of fuel supply to the Delhi-Multan line. The Punjab government was then asked to estimate the amount of fuel supply required per train in this line so that the state could estimate the area of fuel reserves, to be reserved for the railways use. (PWD (G. G.) Progs June 1863 Prog No. 3). As railway construction in the Punjab progressed it was soon realized that the existing rukhs were not sufficient to meet the demands of the railways. Hence, given the importance of the rukhs as a firewood source for the railways, the management of the rukh or 'rakh' lands was placed under the Punjab Forest Department in 1865. The Officiating Secretary to the Govt. of India, PWD, Lieutenant Colonel J. P. Beadle wrote to the Secretary, Government of Punjab, PWD, "Respecting the management of the Rakh [rukh] lands, I am desired to say that it would appear expedient, in the first instance, to make them over to the Forest Department" (PWD (Forest) Progs 1864).

\textsuperscript{7} A surgeon in the Indian Medical Service and a botanical scientist

\textsuperscript{8} when only about 43.5 miles of the line was open.
In addition to bringing the rukhs under state control, J. L. Stewart, the Officiating Conservator of forests was asked to undertake a survey of the rukhs so that the fuel supply for the Punjab Railways could be calculated. Dr. Stewart found that in the rukhs the fuel trees that yielded good fuel such as jhand (*Prosopis spicigera*) were scarce towards the south of the Punjab. He calculated that the fuel trees in the rukhs required 10 to 20 years to attain maturity.

Dr. Stewart estimated that the total yield of 287,000 acres of rukhs was 3,278,000 maunds. He then calculated that the annual requirement for 252 miles of railways was 1,100,000 maunds for both workshops and engines and steamers. Of this 613,000 maunds of firewood were actually consumed by the engines annually (PWD (Revenue Forests) Progs January 1865 Prog No. 23). This formed 55.5% of the total firewood required by the railways. This calculation was based on the length of the railway lines that the engines traveled in each of the four districts and also included the fuel required in railway workshops and steamers. By comparing the total amount of fuel required by the railways and the total amount of fuel actually produced by the rukhs, one can see that the rukhs, contained only about three years' fuel supply for railways and steamers. Just as the colonial state saw the deodar forests as sources of railway sleepers, the rukhs were also seen as sources of firewood for the railways rather than as for meeting the needs of the local population. In fact, the only colonial official who expressed concern about the local population, that too in passing, was Dr. Cleghorn, who said “without careful management

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89 Amritsar, Googaira, Lahore and Multan districts which were surveyed by Dr. Stewart for their firewood supply.
difficulty will ere long arise in procuring adequate supply for public purposes, and perhaps inconvenience may ensue to the neighboring population" (Stebbing 1922: 484).

Given the above constraints in the Punjab, how was firewood supplied to the railways? There was no uniform system of firewood supply from the woodlands to the railways in the Punjab, but high variations from district to district, in part because the ownership of the rukhs varied not only between districts but also within them. For example, in the Lahore district, some of the rukhs were directly owned and managed by the state, but others in the Lahore district were leased out for a certain period to private fuel contractors or to the railway companies (PWD (Revenue-Forests) Progs January 1865 Prog No. 23). The fuel-yielding woodlands could also be leased from private owners such as the princely states (PWD Progs January 1868). When the rukhs were leased, the amount of wood in them was estimated and the contractors or the railway companies paid a fixed rate for the rukhs. In the case of rukhs directly managed by the state, the firewood was either cut by the forest department and sold at fuel depots to the contractors or to the railway companies, or cut by the railway companies, who had to pay a royalty on it (PWD (Revenue-Forests) Progs January 1865 Prog No. 23; Agri, Rev & Comm Progs May 1874 Prog No. 11).

What was the impact of railway expansion on firewood sources, especially in peak periods of railway expansion? The insufficiency of firewood from the rukhs became apparent only when the Punjab Railways opened 209 miles of railway lines for traffic in 1865 taking the total opened mileage in the Punjab to 252 miles. Dr. Cleghorn in his "Memorandum on the supply of firewood to the Punjab railways" noted that "The railway
has hitherto drawn its fuel from the rukhs estimated to contain three to seven or at most ten years' supply, when all will be exhausted in regard to immediate use" (PWD Progs 1866 Prog No. 3). Expansion of the railways would exhaust the firewood in the rukhs in 7-10 years. Hence, fuel supply to the Punjab and Delhi Railways was "one of the gravest questions of the day, connected with railway management and forest administration" (PWD Progs 1866 Prog No. 3).

The other existing sources of firewood also did not show any substantial increase to meet the fuel demands of the railways in the Punjab, as shown in Dr. Cleghorn's memorandum.

What is the increment of wooded area during the last two years ...? Including Canal Plantations the increased area under wood including all the plots of planting appears to be about 1,500 acres.... The produce, if irrigated, may be set down (eight years hence) at 120,000 maunds per annum 1,285 tons or about one-tenth of the amount required annually....(PWD Progs 1866 Prog No. 3).

The fuel requirements of the railways were so high that they could not be met from the limited plantations that the railway companies were allowed to start initially (PWD Progs 1866 Prog. No. 26).

By the mid-1860s the existing fuel sources in the Punjab such as the rukhs were denuded, resulting in a fuel scarcity that threatened to stop the railways from operating, as seen in the following note by the Agent of the Punjab and Delhi Railways:

[T]he fuel supply for many years past has been derived from jungles and forests, that is tracts of uncultivated land in which stunted trees and shrubs have managed to vegetate.... The jungle was then cut down never to sprout again, and the supplies of fuel, of necessity, restricted and enhanced in value to an extraordinary
degree before the introduction of railways. What before this event was a scarcity, is now rapidly resolving itself into a [timber] famine.... (PWD Progs 1866 Prog No. 26).

The scarcity of firewood in the Punjab was reflected in the price rise, taxing households to serve the railway industry. In a note on the Revenue Account of the Punjab Railway for the half-year ending 30th June 1864, the Consulting Engineer to the Government of Punjab wrote

The cost of wood-fuel is, as in previous records, taken at Rs. 21 per 100 maunds. The supply is drawn from the rukhs, or fuel preserves, near Lahore.... The wood-fuel consumed has been 70.7 lbs per mile run, costing 2 annas 10.64 pie per mile as against 67.71 lbs, and 2 annas 9.65 pie of the previous half-years....But the cost of fuel per train mile has been 3 annas and 3.1 pie as against 2 annas and 11.1 pie (PWD (Railway) Progs June 1865).

The cost of dry firewood varied from 13 Rupees and 8 annas to 50 rupees per 100 maunds, depending on the region it came from in the Punjab (PWD Progs 1866 Prog No.3). The rise in firewood prices was also indicative of the increased dependence of the railways on firewood and some concern was shown regarding the impact on local households of rising costs.

The price current of the Punjab shows an increase in the cost of wood varying from 100 to 200 per cent in about 8 years, and as the natural supply is scarcely sufficient for the local wants of the people, the railway requirements ought to be considered as an entirely new demand to be supplied from a new source (PWD Progs, 1866 Prog No. 3).

However, the fuel scarcity in the Punjab did not become a fuel crisis due to the timely intervention of the state. Measures taken by the colonial state to prevent a fuel
crisis were primarily motivated by concern about the working of the railways, however, rather than about the hardships for Indian households. Faced with a potential crisis, the state at last showed environmental concern (Smith 1992: 38).

One of the earliest measures that the colonial state adopted was to maintain the rukhs as reserves. As Dr. Cleghorn noted “The great and increasing importance of these fuel reserves, the need of husbanding their resources and of turning them to the best account, is admitted by all. The Punjab Government have ordered that rukhs are not to be sold or alienated without special report and permission....” (PWD Progs 1866 Prog No. 3). The state’s concern with the reservation of certain minimum area of rukhs to supply fuel to the railways can be seen from this report by J. L. Stewart:

The total uncultivated area of the 15 rukhs proposed for strict reserve by the Committee, is about 46,000 acres.... Considering that fully one quarter of these 15 rukhs have been cleared within the last five years in order to furnish part of the supply of fuel for the railway, I conceive that this is a minimum area for reserves.... They ought, however, to be kept as a reserve, and only be given over to the railway for this purpose when other available sources of supply are exhausted.... (Forest Progs, May 1867 Prog No. 38)

Hence a new division called the Fuel Reserve Division was started under the Forest Department “for the purpose of protecting and working systematically the existing rakhs [rukhs] or wood-lands in the plains”(PAR 1868-69: 91).

In the face of the above firewood scarcity that threatened to stop the railways from functioning, the state decided to develop new sources of fuel supply through the establishment of plantations, a measure that was more cost-effective in the case of fuel plantations than for sleeper supply because of the much shorter gestation period until
trees yielded fuel compared to that of the timber-yielding trees such as deodar. In a despatch dated 11th October, 1865 the necessity for fuel plantations was pointed out:

The formation of plantations on the newly-formed alluvial lands of the rivers was particularly looked to as a means of speedily and effectively securing an abundant supply of timber.... The absolute necessity for yearly and sustained action was enforced by the observed effects of the Railway on the forests near Lahore of which a large area had already been cleared to meet the requirements of a railway, but 32 miles in length and running two trains only daily.... As respects fuel, the importance of the issue will be best understood by a consideration of the following particulars:— It is calculated, on the supposition that four trains run each way daily, that the consumption of wood fuel per annum per mile would be 3,650 maunds. The trees suitable for fuel come to maturity in from 10 to 17 years,... all who have considered the subject agree in thinking that each mile of railway will require at least 20 acres of plantation for its supply (PWD (Revenue-Forests) Progs 1866).

Plantations were the best source of firewood because they were cheaper. They had to be extensive to meet the huge fuel demands of the railways, not only of the present but also of the future (PWD Progs 1866 Prog. No. 3).

Next the question arose as to who would establish and maintain the fuel plantations for the railway, the state or the railway companies. Given the large up-front cost for establishing fuel plantations and delay until returns were gained on the investment, no private railway company was willing to invest on a necessary scale.90 Some small plantations were started, for example, by the Madras Railway Company and also by the Delhi Railway Company in the Ludhiana district in 1865 (PWD Progs 1866 Prog. No. 3). But these plantations run by private railway companies, especially in the Madras Presidency, came in for a lot of criticism from the local administrators as they

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90 So large a sum for such a long time, especially on extensive fuel plantations.
were unable to meet the growing fuel demands of the railways. Hence, the state was forced to establish and maintain plantations for railway fuel supply, as this resolution of the Govt. of India, PWD stated:

[I]t has been settled, in correspondence with the Secy. of State, that it is undesirable that Railway Companies should undertake such operations as forming plantations for fuel.... Thus the Forest Department is the agency, if any, by which the plantations must be formed and managed in the Punjab.... Further, there is no present prospect of private enterprise coming forward for the establishment of plantations, this being an undertaking in which no profits could be secured for a long period (PWD Progs 1866 Prog No.29) (PWD (Forest) Progs March 1867).

The colonial state had the advantages of a long-term view of the relation between the railways and the forests and did not want the firewood supply to be completely exhausted in the future as more railways opened, as well as funding through taxation of Indians. This was unlike the private railway companies, who were interested only in short-term gains and were looking at future profits from railway operation. Even though the establishment of fuel plantations was not remunerative and involved quite a lot of expenditure,91 the colonial state saw the long-term benefits of providing a continuous supply of firewood for the railways. The colonial state, just as it had promoted and provided the conditions suitable for railway establishment and expansion to take place, now provided for the working of the railways by establishing fuel plantations.

With the opening of about 120 miles of railway lines each in 1868 and in 1869 by the Delhi Railways, the total opened mileage in the Punjab was about 540 miles by the

91 For example, the agent of the Punjab Railway estimated that plantations of 20,000 acres would require an expenditure of Rs. 1,350,000 within the first ten years (Forest Progs May 1867 Prog No. 54).
end of 1869, having doubled since 1865. This expanded mileage put a lot of pressure on the colonial state to obtain fuel to keep the railways working. With the fuel plantations yet to mature and the reserved rukhs of 1865-66 exhausted, the state brought more rukhs under reserve. According to the 1869-70 PAR:

The following area of selected rukhs has been actually transferred.

<table>
<thead>
<tr>
<th>Location</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amritsar</td>
<td>2202</td>
</tr>
<tr>
<td>Lahore</td>
<td>41824</td>
</tr>
<tr>
<td>Montgomery</td>
<td>59300</td>
</tr>
<tr>
<td>Multan</td>
<td>162714</td>
</tr>
<tr>
<td>Mozaffurgurh</td>
<td>125668</td>
</tr>
</tbody>
</table>

(PAR 1869-70: 84)

By 1870 a total of about 391,708 acres of rukhs were reserved, which would provide a total yield of about 4,473,305 maunds according to Dr. Stewart’s calculations, to meet a demand of approximately 2,300,000 maunds.\(^\text{92}\) Clearly, the firewood supply from the rukhs would last only a couple of years and non-local firewood sources had to be relied on including the forests on the banks of the Jumna and its tributaries and the forests of Meerut division or the Gurhwal forests. For example, the Commissioner of the Meerut division wrote “[T]he pressing emergency of the question [of fuel supply] was also somewhat relieved by the fact that the Fuel Contractor drew his supply for the season from the Gurhwal forests east of the Ganges, where wood for fuel is abundant, and the

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\(^\text{92}\) This is a conservative figure because the total number of trains on these opened lines is assumed to be constant at four trains.
rate of forest dues lower than that of this division...” (Forest Progs June 1868) However, outside sources of firewood were also subject to exhaustion in the form of deforestation which spread the destructive effects of railway expansion in the Punjab.

The opening of about 120 miles of railway lines each in 1868 and 1869 brought into focus the amount of firewood that would be required, both in the present and in the future and the deficiency of the fuel plantations to supply them. By 1870 the total area of the fuel plantations had increased to 12,315 acres (PAR 1869-70: 86). It was calculated that at least 20,000 acres would be required to supply the Delhi line from Delhi to Multan (PWD (Forests) Progs June 1870 Part B, No. 12). The existing plantations in the Punjab were clearly not sufficient to supply the Delhi line, as the Punjab Forest administration report for 1870-71 states. “As regards our existing plantations, we have hardly effected anything for a supply of the line. For though I may refer to the plantations of Jullundhur, Philor and Loodiana, roughly aggregating 480 acres, as fairly complete, they are little more than wayside groves capable of meeting a small local demand” (Agri, Rev & Comm (Forest) Progs January- June 1872 Appendix B).

The colonial state was concerned not only about the present railway fuel supply needs but also about the future lines that were being constructed such as the PNR. The existing rukhs in the Punjab did not have sufficient firewood to supply the PNR even before the PNR actually opened its lines in 1875 (Forest Progs July 1869). By the early 1870s the firewood from the rukhs was barely enough for preliminary works and for the railway workshops (PWD (Revenue-Forests) Progs Sept 1870 Prog No. 35). Thus, the rukhs could not be expected to supply firewood to the railways for long. Hence, the state
extended the plantations (PWD (Revenue Forests) October 1870 Prog No. 91; PAR 1873-
74: 61). However, the cost of the extension of plantations was high and the yield distant
(PAR 1874-75: 64).

Hence, the use of other sources of fuel began to be explored. Suggestions about
using alternative sources of firewood in the Punjab were put forward such as:

There are forests in the North-West provinces which might yield considerable
supplies, such as the dhoon and other forests at the foot of the hills. There are also
the Kalesar forests in the Punjab, [and] the lower forests on our different rivers....
(Agri, Rev & Comm (Forests) Progs Jan-June 1872 Appendix A).

However, these suggestions could not be carried out due to the widespread deforestation
that was taking place, especially, in the NWP for railway fuel supply. One example of
deforestation was reported in the Pioneer newspaper, drawing the attention of the Under
Secretary, Government of India. According to the Under Secretary,

[T]he undersigned is directed to invite the attention of the Public works
Department to the paragraph noted in the margin, which appeared in the Pioneer
newspaper of the 17th ultimo.... ‘It is a great shame to see large, old, splendid
topes of trees daily being felled down for fuel to burn bricks, &c., for the Oudh
and Rohilkund Railway. Government should take the matter in hand to prevent
the destruction of topes of trees by passing a Bill for the purpose.’ (Agri, Rev &
Comm (Forests) Progs June 1872 Prog No. 7).

The increasing use of firewood even in wood-scarce regions such as Delhi, due to
the high carriage rates of coal, denuded the forests of the nearby NWP and Oudh (Agri,
Rev & Comm (Forests) Progs June 1872 Prog No. 7). Therefore, efforts were made by
the colonial state to lower the carriage rates of coal from Bengal and other coal rich regions to the Punjab. However, the railway companies could choose any rate within the limits of the state’s maximum rate, and did not lower the freight rates for coal.

Thus, the state’s maximum rate policy for railway carriage became a hindrance to the operation of the railway as the carriage rates of coal were high, as shown in this 1872 memorandum from the Officiating Deputy Secretary to the Govt. of India, PWD.

The Department of Agriculture, Revenue and Commerce are probably aware that, owing to the sanction of maximum rates, within which the railway companies are free to lower or raise the rates, as they think fit, the Government are at present unable to interfere imperatively.... At the present time renewed negotiations are in progress for the concession of a low rate for the carriage of Bengal coal to be burned in the locomotives of the Panjab and Delhi, and Oudh and Rohilkund Railways.... (Agri, Rev & Comm (Forests) Progs June 1872 Prog No. 8).

It may be noted here that in the establishment and expansion of railways, there was a lot of emphasis on the development of foreign trade (Gadgil 1971: 133). Hence, as discussed in chapter 2, lower carriage rates were implemented for Indian exports such as wheat to carry from the wheat producing area of the Punjab to the ports (Prasad 1960: 47). The colonial project did not favor fostering internal trade such as in coal.

Although by October 1872 coal was used for the first time in engines on the Delhi Railway from from Ghazeeabad to Phillour, this usage was not economical; firewood was still cheaper and the engines could not be adapted for the exclusive use of coal (PAR 1872-73: 107). The exclusive use of coal, would have to wait until the beginning of the 1880s. It was still necessary to import coal from England, making it too expensive.
Therefore, the Punjab continued to depend on firewood for its railway operations, which caused a shortage of firewood by the early 1870s. To meet the demand the area under reserved rukhs was increased, along with their cutting by the Forest Department. For example, in 1873-74 nearly a million cubic feet of firewood were sold by the Fuel Reserve division to the Railway Department (Agri, Rev & Comm (Forests) Progs, May 1874 Prog No.11). At this time the total opened railway mileage was 468 miles within Punjab’s provincial limits. By 1878 the total opened railway mileage had increased to 610 miles (PAR 1879-80: 123), and the fuel supplied by the Central Fuel Reserve Division increased to 2,284,500 cubic feet of firewood in 1877-78 (PAR 1877-78: 109). Similarly, the total area of the rukhs by March 1876 increased to 1,871,896 acres when compared to 391,708 acres in 1870 (Agri, Rev & Comm (Forests) Progs, Sept 1877 Prog No. 13).

This increased cutting of the rukhs quickly exhausted them, raising concern about the future capability of the Punjab rukhs to supply fuel to the PNR as noted by the Forest Administration Report for 1878-79:

The whole of the Lahore rakhhs have now been cut out, and I doubt if a rakh can be found anywhere to cut, poor as they are, and yielded about 40,000 cubic feet. The difficulty of supplying the requirements of the Northern State line at present is very great. The Bhera and Phallian rakhhs are too far off. The Salt Range area sufficiently near is very limited; from rakhhs Nili and Manki 855,837 cubic feet, chiefly Phulai, were supplied during the year. In Rawalpindi some of the Kahuta forests have supplied 122,500 cubic feet of green hard wood fuel to the Railway (FAR 1878-79: 20).

This denudation of the rukhs occurred despite the fact that from 1876 until 1880, the PNR operated only 103 miles of its railway lines. The denudation of the rukhs was so severe
that the state encouraged the IVR to buy firewood, which it did, at a cheaper rate from private contractors, who were most likely to get their fuel supply from outside the state-owned forests and reduce the destruction of the state forests (Agri, Rev & Comm (Forests) Progs June 1878 Prog No. 12).

By the late 1870s and the early 1880s in the Punjab the increased cutting of the rukhs and their expansion in area was exacerbated by the opening of high mileage of railways. These opened lines included 499 miles of the IVR in 1878, 124.5 miles and 135 miles respectively in 1880 and 1881 of the PNR. By March 1881 the total opened railway mileage in the Punjab’s provincial limits was 1048.5 miles. This high mileage of opened railway line would require 18,307,142 cubic feet or 4,576,785 maunds of firewood. By March 1881 the total acreage of rukhs in the Punjab was 1,900,490 which could produce about 21,684,590 maunds or 86,738,360 cubic feet of firewood for the railways (Home, Rev & Agri (Forest) Progs Nov-Dec 1881 Prog No. 4). Thus the firewood yield of the rukhs was much below the demand for fuel created by railway expansion in 1881. The total acreage of plantations by 1881 was about 20,362 that could produce a maximum yield of 1,628,960 maunds or 6,515,840 cubic feet of firewood. The total firewood yield of the plantations and of the rukhs was 93,254,200 cubic feet or 23,313,550 maunds. This firewood yield could last for about five years if the opened railway mileage were the same. Since the rukhs and the plantations required about 10 to 15 years time to mature, they would be completely denuded at the end of five years of railway fuel supply.
Since, by the end of the 1870s the rukhs of the Punjab were already getting exhaust ed, the crisis only deepened in the 1880s. The search for new supplies involved surveys for fuel tracts in the lower hill forests of the Punjab, for example, on the banks of the Jhelum, detailed below in an extract from the FAR for 1878-79.

Mr. Sparling was deputed to examine the slopes overhanging the Jhelum river, from Owen and below to be examined, and there is plenty of fuel there, if only we could get hold of the forest as reserve, and also if we could transport the material. Experiments are, however, being set on foot for this purpose (FAR 1878-79: 21).

The pressure on the colonial state to provide firewood to the railways became so intense that orders were issued to cut wood from the woodlands regardless of conservancy. The drastic measures adopted by the state to increase the fuel supply to the railways can be seen in the following selection taken from a memorandum written by C. Bernard, Secretary to the Govt. of India to the Secretary, Govt. of Punjab.

The requirements of the new railways, however, introduce an additional element of great importance into the question; and, in the opinion of the Governor General in Council, it will now be necessary to take a comprehensive view of the measures that must be adopted to ensure a permanent supply of fuel from the woodlands in the vicinity of these lines.... In order to hasten on the construction of the line and its working at the outset, it may be necessary to sacrifice future interests, and to cut fuel without regard to the requirements of conservancy.... I am further directed to suggest that a competent forest officer be placed specially in charge of the operations that may be undertaken to supply the railways with fuel, and to ensure, as far as may be practicable, the protection of the areas which it may be necessary to cut over in order to satisfy the requirements of the railway.... (Home, Rev & Agri (Forests) Progs September 1879 Prog. No. 31, italics added).

The fuel demand of the railways in the late 1870s, especially that of the PNR which was due to open about 589 miles of its lines to traffic in 1880-81, was so high that
firewood was procured even from the village forests leading to their complete denudation. This can be seen in the following extract excerpted from a letter written by Baden-Powell (later of Boy Scout fame) and Secretary to the Governor-General to the Secretary, Govt. of Punjab:

Mr. Baden-Powell feels anxiety about the Northern State Railway fuel-supply, and he states that at present wood is being brought up for the railway all round, while the fields and the villages are denuded (Home, Rev & Agri (Forests) Progs November 1879 Prog No. 5).

This over-cutting of forests, especially the ones near the villages must have not only upset the forest ecology of the region but would have also caused firewood deficiency to the local people. The colonial state was, however, more concerned about adequate firewood supplies to the railways.

The deficiency of firewood finally forced the conversion to coal especially on the PNR in the Punjab.

It has been calculated that ... the cost of coal per train mile was 6.9 annas as against 5.12 annas cost of wood, and that the small difference in favor of wood is counterbalanced by savings in establishments, lessened loss by risk of fires, lessened detention of trains at wood depots and other circumstances. The result of this and of the increasing difficulty in procuring wood has been that, while in the half-year ending 30th June 1878, 1,519 tons of coal were used as against 1,314 tons of wood, the consumption in the corresponding half-year of 1879 was 3,427 tons of coal as against 1,698 tons of wood. Yet coal is now costing the Government Rs. 34 a ton on the Punjab Northern State Railway (Home, Rev & Agri (Forests) Progs November 1879 Prog No. 5).

Coal had been used on certain railway lines such as the Ghazeeabad-Phillour line and the Delhi-Lahore line in the mid-1870s but its use increased as its advantages over the use of
firewood were soon realized (PAR 1874-75: 77). By the end of the 1870s, the notion of using coal as railway fuel began to gain ground.

It may also be taken for granted that wood cannot be economically burnt on any sections very much longer. First, between Delhi and Lahore, and then on the Punjab Northern Railway, wood fuel has had to be abandoned owing to its increasing scarcity (Railway Administration Report for 1880-81: 303).

Coal samples began to be extracted from the Salt Range in the Punjab and subjected to experiments in order to determine their suitability for railways (Home, Rev & Agri (Forests) Progs July 1881 Prog No. 6). The Punjab Forest Department levied a royalty of Rs. 2 per ton on the Salt Range coal. This came in for a lot of criticism from the miners as both the excavation and use of the coal was still in the experimental stage (Home, Rev & Agri (Forests) Progs July 1881 Prog No. 6). In response to this criticism, the colonial state directed the Lieutenant Governor of the Punjab to lower the royalty charged on the Salt Range coal (Home, Rev & Agri (Forests) Progs July 1881 Prog No. 9), which not only made coal use cheaper on the railways and met the fuel needs of the railway lines that had opened in the early 1880s but also averted a major fuel scarcity that would have negatively affected the operation of railways in the Punjab. Accordingly, supply of coal to the PNR increased and the demand for firewood by the PNR began to decrease.

The considerable decrease in wood-fuel sold, of 9 lakhs [900,000] of cubic feet, is due to reduced sales to the Punjab Northern State railway. Its place has been taken partly by Bengal coal and partly by the Salt Range coal, of which nearly 30,000 cubic feet were sold during the year. The Lieutenant-Governor has already communicated to the Government of India his views as to the arrangement to be made for coal-mining in the Salt-Range and the royalty to be charged (Home, Rev & Agri (Forests) Progs 17 September 1881).
The PNR began to use a combination of Salt Range coal and Bengal coal. Although it continued to use firewood on certain sections of its lines, its overall consumption of firewood decreased,\(^93\) despite the fact that by this time many of the plantations in the Punjab had started producing good yields of firewood (Home, Rev & Agri (Forests) Progs November 1879 Prog No. 5). The decreasing use of firewood was seen in all the railways of the Punjab by the late 1870s. The IVR began using a combination of wood and English coal. The SP& D R started using a combination of Bengal coal, English coal and wood. The Rajputana State Railway used a combination of Bengal coal and English coal (Railway Administration Reports for 1880-81 and 1882-83).

The total firewood sold by the Forest Department from the Punjab plantations in 1878-1879 was 640,017 cubic feet while the amount felled was 1,186,276 cubic feet. (FAR 1878-79: 20). Thus, the Punjab Forest Department was able to sell only about 50% of the total firewood felled in its plantations. Similarly in 1879-80 the total firewood cut and sold from the plantations in the Punjab decreased to 397,960 cubic feet. (Home, Rev & Agri (Forests) Progs, Jan-August 1880). There was a clear decrease of about 50% in the amount of firewood sold from the plantations to the railways. Coal as railway fuel became so popular that the extension of plantations in the late 1870s was seen in terms of the cost of the firewood they would produce vis a vis the cost of coal delivered to the railways (Home, Rev & Agri (Forests) Progs, November 1879 Prog no. 5). Finally, the cost of extending or even establishing plantations for railway fuel was seen to be

\(^93\) Railway Report for 1880-81 in PP 1880 [c. 2683] and Railway Report for 1882-83 in PP 1883 [c. 3692]
expensive because of the problems associated with the use of firewood in railway engines. Hence, the formation of new fuel plantations was discouraged and stopped by 1880 (Home, Rev & Agri (Forests) Progs 17 Sept 1881). As firewood demand decreased, so did concern with conservation.

Privileging ecological conservation of forests at the expense of railway construction and fuelling would have delayed the economic transformation of India into a satellite economy of Britain. Therefore, in order that the economic transformation of India would not be retarded, the state adopted forest conservation in 1865. The fact that forest conservation was adopted only when there was shortage of timber for the railways can be seen in the following excerpt of a despatch to Home Government from Government of India.

But so long as the supply of timber in the country was generally sufficient for the public works in hand, the question of Forest management did not present itself to the Government as one calling for earnest consideration. Latterly, however, while the supply of timber has been steadily diminishing from want of proper conservation, the demand both for State and private purposes has been rapidly increasing, and the enormous requirements of the different railways for sleepers has especially brought the matter into very prominent notice, and has now made the subject of Forest conservancy an important administrative question (PWD Progs November 1862).

Thus, only when the state faced the timber scarcity situation in the 1860s with respect to the timber supply to the railways it began to take forest conservation seriously and finally adopted it in 1864 at the all-India level. In fact until the 1830s when the colonial state’s
dominant mode of surplus extraction from India was through land revenue, it encouraged the felling of forests for cultivation both by the natives and by European planters (Amery 1876: 216).

In meeting the timber needs of the railways by implementing forest conservation the colonial state in India acted as all natural resource bureaucracies do when forming policy. This resonates with Peluso's argument that state natural resource bureaucracies face various contradictions in forming policy. In managing the natural resources these bureaucracies may be expected simultaneously make a profit, preserve the resource for future generations, prevent environmental degradation. Depending on the immediacy of each of these functions at any given point in time, one or more of these contradictory functions can confound the others (Peluso 1992: 55).

In the case of India by the 1860s, the huge demand for sleepers by the railways and the limited availability of timber led to a timber scarcity situation in the 1860s. This scarcity threatened the construction and working of the railways and other public works. Therefore, the maintenance of a permanent timber supply for the railways and other public works became the immediate function of the state in adopting forest conservation. This function of the state's forest conservation was at the cost of other functions such as maintaining ecological stability.

4.4 Conclusion

The main focus of this chapter has been to analyze the impact of the increasing demand for firewood by the railways on the forests in the second half of the nineteenth
century in colonial India. More specifically, to what extent the local forests were affected by the increasing firewood demand of the railways in the Punjab is examined in this chapter.

The railways became dependent on firewood to a large extent in the second half of the nineteenth century because of lack of proper quality and quantity of native coal, the high cost of importing coal from England and difficulty of access to the existing coal sources due to the priority placed by the colonial state on fostering export transport infrastructure. The expansion of the railways put a lot of pressure on the existing firewood sources in India that led to their denudation in the mid-1860s, especially in areas far from the coal rich regions or from the ports. The Punjab was one of the earliest provinces in which the fuel supply to the railways was perceived as a problem due to these conditions exacerbated by rapid railway expansion of the mid-1860s. Extreme pressure on the rukhs and their exhaustion led to a fuel crisis in 1865 that would have become a firewood famine had not the state intervened. The colonial state with its active involvement in the establishment and expansion of railways in India had every reason to prevent the operation of railways from being halted as a result of firewood scarcity. Thus, it established the Forest Department in 1865 in the Punjab under which the rukhs were placed as forest reserves and instigated fuel plantation formation to meet future needs, unlike in the case of maintaining sleeper supply from the hill forests of the Punjab since a shorter gestation period was required. Finally, to meet the immediate fuel needs of the Delhi Railways that were expanding in the mid-1860s, the state encouraged the use of firewood sources from outside the Punjab to avert fuel famine.
The further expansion of railways in the Punjab in the 1870s led to increased cutting of the rukhs, while the fuel plantations had not yet matured enough to yield firewood. Increased cutting of the rukhs led to another fuel crisis by the end of the 1870s. The opened mileage of the railways peaked by 1880-81, exacerbating the fuel scarcity. Despite the environmental costs of railway expansion, the colonial state did not stop the expansion of railways as the exploitation of resources in the Punjab through railway access was regarded as necessary. Hence, the state again intervened by encouraging the use of coal in place of firewood on the railways by the beginning of the 1880s by lowering the royalty on local coal.

By the beginning of the 1880s, even though the fuel plantations of the Punjab were yielding considerable amounts of fuel and coal was still more expensive, the use of firewood on the Punjab’s railways decreased. Local, imported and Bengal coal were used on the railways in the Punjab. This decreased dependence on firewood by the railways helped to prevent further denudation of the plains’ woodlands and the outer Himalayan forests in the Punjab. The decreased dependence of the railways on firewood with the increased availability of indigenous coal by the 1880s was characteristic of the railways in general at the all-India level. Hence, by the 1880s there was no increase in deforestation due to firewood demand by the railways at the all-India level, even though it was a peak period of railway expansion and operation.

In the Punjab, unlike in the NWP and in Oudh, the sources of firewood and sleepers were different. Sleepers were obtained from the hill forests of deodar, while firewood was obtained from the plains forests or rukhs. Hence, when the railways
expanded their operation in the Punjab, deforestation took place in both the hill forests and the plains forests. Given the aridity of the Punjab, the dual demand of sleepers and firewood by the railways made the deforestation problem severe.

We have seen here that, as regards firewood supply in particular, the colonial state prioritized railway needs over indigenous needs, and extraction over conservation. Conservation, indeed, was only undertaken to meet railway needs and even abandoned in the throes of a fuel crisis, as well as after that crisis forced conversion to coal. In its conservation policy, the colonial state created fuel reserves which restricted the forest communities\textsuperscript{94} access to firewood and, of course, denied any control over the fuel woodlands to the local communities. We can thus say that exploitation of firewood sources included both their development and exhaustion, and did not involve concern for indigenous needs.

In the preceding chapters and the present one, the main focus of analysis has been on the important role played by the structure of colonial relations in shaping the establishment and expansion of railways and how this expansion in turn denuded the forests at the all-India level and in the Punjab. Another locus of analysis in the previous and the present chapter has been the state intervention through various measures to lower the denudation levels so that the required sleepers and fuel were available for the railways. While focusing on the colonial state’s role in mediating the impact of railway expansion on the forests, the important role played by specific colonial actors in

\textsuperscript{94} The impact of forest conservation on the forest communities has been studied by Gadgil and Guha 1989.
highlighting the deforestation in colonial India and their contribution to forest policy cannot be denied. This is examined in the next chapter by taking the case of Dr. Hugh Cleghorn, one of colonial India’s earliest forest conservators.
CHAPTER 5

HUGH CLEGHORN AND FOREST CONSERVANCY IN INDIA

5.1 Introduction

A public resolution by the Government of India of 10th January, 1865 noted:

The Governor General in Council avails himself of this opportunity to express his sense of the great service rendered to the State by Dr. Cleghorn in the cause of forest conservancy.... His long services, from the first organisation of Forest management in Madras, have, without question greatly conduced to the public good in this branch of the administration. In the Punjab also,... Dr. Cleghorn's labours have prepared the way for the establishment of an efficient system of conservancy and working of the forests of that Province (PP 1871 [c.466]: 95).

The above excerpt summarises the important role played by Dr. Hugh Cleghorn in initiating forest conservancy in the Madras Presidency and in the Punjab.

In previous chapters we have seen how the colonial social and economic structure or how the economic relation between the metropolis i.e. Britain and the colony i.e. India, shaped railway establishment and expansion, which adversely affected the forests in the second half of the nineteenth century in India. The colonial state not only promoted railway expansion but also responded to the denudation crisis due to railway expansion. One such response of the state was the implementation of forest conservation through the establishment of a forest department and forest reserves.
However, the colonial social and economic structure was not the only factor that influenced the forest conservancy policies. There were specific colonial historical actors, who by virtue of their expertise were able to play an important role in shaping colonial forest conservation policies and whose contribution cannot be ignored. These actors included surgeons such as Alexander Gibson, Edward Balfour and Hugh Cleghorn, all members of the Indian Medical Service. The role played by Hugh Cleghorn in initiating and shaping forest conservancy in India, even before forest conservation was adopted in Britain, was key. He was one of the colonial actors who could be dubbed pioneers in developing new institutions that later proved of benefit both in ex-colonies and in the metropole, and whose goals went beyond immediate profits. It is therefore worthwhile to examine his character and actions in detail.

This chapter is divided into three sections. The first section deals with the social and intellectual background of Cleghorn. The next section examines Cleghorn's contribution to the implementation of forest conservation in India, his ideas on the importance of forests and on forest conservancy and the extent to which Cleghorn was able to use his ideas to influence the state to implement forest conservation. It specifically examines Cleghorn's intellectual role as opposed to institutional role in influencing the colonial state's forest conservation policies related to timber supply for the railways.

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95 Grove 1995: 12
5.2 Social and Intellectual Background

Hugh Cleghorn’s Scottish background was as influential in his life as was his Indian involvement. He was born in 1820 in Madras, India where his father was the Administrator-General in the Supreme Court. In 1824, along with his parents, he returned to his family estate in Stravithie near St. Andrews, in Scotland. A characteristic feature of Scottish forestry from the seventeenth century onwards was the improvement of the landed estates by planting trees and using forestry techniques imported from the Continent, especially from France (Anderson 1967, I: 279). His childhood at Stravithie familiarized him with the rural way of life and put him in touch with nature (Progs of the Royal Society of Edinburgh September 1895: i) which seems to have laid the foundation for his love of plants and trees that occupied so much of his time later in life (Progs of the Royal Society of Edinburgh September 1895: i).

After completing his school and undergraduate education from Edinburgh and St. Andrews, Cleghorn went on to study medicine at Edinburgh in 1837 for five years. During this period of study he developed an interest in botany, which became his favorite subject. After graduation in 1841 he was appointed to the Indian Medical Service and posted to Mysore, India. While fulfilling his duties as a doctor in Mysore Cleghorn, on the advice of the eminent botanist Joseph Hooker, began studying plants (Scottish Arboricultural Society 1890, xii: 202). This expansion of interest and expertise in botany was typical of the Scottish medical surgeons employed in the Indian Medical Service.

*Botany was one of the subjects that one had to study while studying medicine.*
since they were trained in the French-influenced Enlightenment tradition of Scottish universities where disease, climate and plants/trees were clearly connected (Grove 1995: 11). Many of the Scottish surgeons had been taught by Professors John Hope in Edinburgh and William Hooker in Glasgow, who advocated rigorous field observation, holistic approaches to nature and tree-planting programmes (Grove 1997: 67). The expansion of medical surgeons’ expertise in non-medical areas could also be seen in their increasing employment as superintendents of botanical gardens in India where their knowledge was put in service by the colonial state to gain knowledge about not only the tropical diseases, but also about the natural and agricultural resources of India.

Cleghorn soon acquired knowledge of the flora in Mysore. Officials and fellow scientists often consulted him regarding the medicinal and economic plants of India (Scottish Arboricultural Society 1890, xii: 202). In 1848 due to poor health Cleghorn returned to England, where he continued to extend his botanical knowledge. His interest in economic botany extended to his study of the forests. In 1850 he along with other scientists was asked to report on the influence of tropical forests on the climate and the resources in those countries by the British Association for the Advancement of Science. The report, written by Cleghorn and submitted in 1852, discussed the economic and physical effects of tropical deforestation, especially in India. It used various examples of

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97 This was unlike the English medical schools.

98 Grove 1997: 66
deforestation in Europe and in India to show that lack of an effective forest conservation system could lead to ecological disasters (Cleghorn 1852: 79). Cleghorn clearly believed that forests played an important role in the ecology and climate of tropical countries.

While appreciating the ecological importance of forests, Cleghorn also recognized their economic importance. The 1852 report contained a list and description of trees that were economically important. Writing about the economic value of the Indian forests, he noted:

> It is not only in affording indigenous woods ... serving all the purposes to which timber is applied, that the Indian forests claim our attentive consideration. In them [the Indian forests], nature presents to us other sources of wealth, many of which are imperfectly known, but may under judicious management, yield a considerable increase to the present revenue (Cleghorn 1845: 1).

Cleghorn saw the forests as a resource that, if managed properly, would not only provide raw materials to be used for various purposes but would also be a source of revenue. This interest in the economic productivity of forests probably stemmed from the fact that Scottish forestry of the first half of the nineteenth century was characterised by the dominance of productive forestry. Most trees in Scotland, a country initially deforested as a British colony by widespread introduction of sheep-raising by absentee landowners, were planted with the view of meeting the industrial needs of the country at profitable prices (Anderson 1967, II: 559). The importance Cleghorn attached to the economic value of forests can be also seen in the following excerpt of a letter he wrote to J.H. Balfour, the Director of the Royal Botanical Gardens, Edinburgh, before starting his return trip to Madras from England, towards the end of 1851:
With our present information as to the Economic and Pharmaceutic resources of the Malabar Coast, where they are I am convinced, many products as yet insufficiently known and appreciated but which as the light of European Science penetrates these unfrequented forests will be applied to many useful purposes in the arts and manufactures; if my services are required on the Western coast [of India], and if my health is strengthened to endure the unfeeling influences of that climate, I shall exert the energies allowed to me to develope [sic] the unknown value of these forests (J. H. Balfour Correspondence III)

This excerpt shows to what extent Cleghorn was interested in the economic importance of forests and in the development of natural resources.

In 1852 he returned to India as the chair of botany and Materia Medica in the Madras Medical College, an appointment that reflected his expertise and interest in medical and economic botany. He often emphasized the medical and economic importance of plants in his lectures. In a report on his botany teaching at the Madras Medical College for the year 1852-53 he wrote:

After explaining the structure of plants, ... I entered upon those most useful branches of the Science, which may be called Geographical and Economical Botany. I carefully avoided speculative theories in vegetable physiology and specially directed the attention of the class to the medical importance and economical value of many indigenous plants found in southern India. (Cleghorn papers 4 Box 9)

From the above excerpt we can see to what extent medical and economic botany was important for Cleghorn over other branches of botany.

99 A branch of botany dealing with plants important from an economic and medical point of view.
While in Madras, Cleghorn became a member of several societies such as the Madras Literary Society\textsuperscript{100} and the Madras Agri-Horticultural Society of which he became the Secretary in 1853. In joining these scientific societies Cleghorn was certainly influenced by the Scottish Enlightenment tradition,\textsuperscript{101} since both were engaged in promoting the development of natural and agricultural resources in the Madras Presidency by publishing exploration reports\textsuperscript{102} and by organizing exhibitions.

The Madras Agri-Horticultural Society also established an Agri-Horticultural Garden with the aim of “the introduction and propagation of new and useful plants of all kinds, but more especially those possessed of commercial value, which are likely in the event of successful introduction to extend and improve the commercial resources of the country....” (A published note in J. H. Balfour Correspondence III: 5-6). This effort was part of the world-wide British imperial project of plant introduction and experimentation, conducted primarily to increase colonial exports and often without regard to local needs or conditions (Claire Robertson personal communication 27 October 2001). Cleghorn, who was interested in developing the natural and agricultural resources of India, began preparing a descriptive catalogue of the plants in the Madras Agri-Horticultural Garden in 1853 (J. H. Balfour Correspondence III). Cleghorn’s special interest in economic botany and in the economic value of forests led him to be a part of the sub-jury of the timber and

\begin{footnotesize}
\begin{enumerate}
\item Of which Dr. Edward Balfour was a member.
\item A characteristic feature of Scottish Enlightenment was its emphasis on the formation of societies by scholars where they could freely argue and discuss their research with other fellow scholars.
\item These reports were published in journals such as the Madras Journal of Literature & Science of the Madras Literary Society.
\end{enumerate}
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ornamental woods section in the Madras Exhibition of Agricultural Products, 1852-53 organized by the Madras Agri-Horticultural Society, whose main purpose was to encourage the cultivation of staple agricultural products of commercial value through the award of prizes and medals by the state to the competitors (Cleghorn Papers Box 9 No. 2).

In a report of the Committee for the Madras Exhibition of 1852-53 Cleghorn attached a list of woods authorized to be used as railway sleepers and a list of woods that were native to the Madras Presidency along with their economic uses (Madras Exhibition Report 1852-53: 53 in Cleghorn Papers Box 9, No. 3). Also, he noted that, given the huge amount of wood being exported from the Madras Presidency and the large amount of timber imported into Britain, it became important to ascertain “which is the best kind of timber for each particular purpose, and 2d[second], whence the supply can be obtained with the greatest certainty and economy” (Madras Exhibition Report 1852-53: 53 in Cleghorn Papers, Box 9, No. 3).

Cleghorn’s recognition of the economic value of forests can be also seen in the following excerpt from the proceedings of a meeting of the Committee for the Madras Exhibition of 1855 of which he was a member.

The following raw materials have occurred to the Members of your Committee as susceptible of improvement or development, and by way of encouragement, they would recommend the adjudication of pecuniary rewards... at the close of the exhibition. As vegetable products constitute 9/12 ths of the whole commerce in raw materials which employs the vast mercantile marine of Great Britain, at least 20 prizes in that department seem advisable, 10 also are recommended for animal substances, and 15 for mineral productions (Second supplement to the Fort St. George Gazette September 15 1854: 1 in Cleghorn Papers Box 9, No. 2).
Thus, those raw materials that had commercial value or were potentially valuable were recommended by the Committee of the Madras Exhibition for prizes or awards.

One of the ways by which the state encouraged the development of the agricultural and natural resources of commercial value in mid-nineteenth century India, so that they could be exploited, was through the award of prizes to peasants at agricultural exhibitions. This was a part of Governor-General Dalhousie’s plan to extract India’s resources by developing them so that it would benefit the British metropolitan economy. Local administrators such as Lord Harris, the Governor of the Madras Presidency, took up Dalhousie’s policy of developing India’s resources at the provincial level. However, encouragement in the form of prizes was not sufficient, Lord Harris discovered, to raise the productivity level of agricultural and natural resources in the Madras Presidency, as can be seen in the Minutes of Consultation of 14th July 1854 written by Lord Harris’s Secretary and addressed to the committee of the Madras Horticultural Society.

The attention of the Right Honourable the Governor in Council has been recently engaged in the consideration of the efforts made in the past years for the promotion of objects affecting the improvement of the Agricultural and Manufacturing Industries of this Country.... [A]lthough a willing and generous desire has been manifested by government to encourage and support individual or combined exertions directed towards the development of the resources of the country, the success which had attended such efforts has not been satisfactory. (Extract from the Minutes of Consultation 14th July 1854: 1 in Cleghorn papers, Box 9 No. 2)

Lord Harris thus felt that there was still potential for further development of India’s agricultural and natural resources.
To develop the agricultural and natural resources further Lord Harris felt that experienced scientists, especially botanists, should be sent out “for acquiring an extensive and practical knowledge of the inexhaustible sources of mineral and vegetable productions of the vast territories under this Government.” By sending out scientists to explore the Indian flora, Lord Harris, like Dalhousie, was sure that “[T]he importance of thus bringing western science and appliances to bear upon the dormant natural resources of the country, and the ultimate benefits which may be expected to accrue from such researches, there can hardly be any doubt” (Extract from the Minutes of Consultation 14th July 1854: 3, Cleghorn Papers Box 9 No. 2). He was so committed to furthering the exploitation of resources in the Madras Presidency that more action was taken in this regard in 1854-55 than in the ten years before (J. H. Balfour Correspondence III).

Cleghorn too, like Lord Harris, felt that explorations of countries not only resulted in increased knowledge but also helped in the discovery of hidden resources of a country that could be potentially profitable (Cleghorn Papers Box 9 No. 7). For instance, the exploration reports were helpful in highlighting the forest products useful for the development of European capital in India (Cleghorn 1860: xi). For example, in 1856 when Cleghorn became the Conservator of Forests in the Madras Presidency, he began exploring the forests there and noted:

It will thus be seen that the result of our excursion was not without interest. Some curious botanical novelties were found; the timber resources of the district were ascertained; and a large tract of country suitable for coffee culture was traversed, which will doubtless be the scene of future colonization (Cleghorn 1861: 586).
These explorations made him realize not only the economic wealth of the forests but also made him conscious of the primary causes of deforestation such as railway expansion, coffee cultivation and kumari cultivation,\textsuperscript{103} which he described in his reports. Before coming to Madras Cleghorn had already explored the Mysore and Canara forests and had seen the destructive effect of kumari cultivation on the forests, which made him realize the importance of forest conservation in the face of growing deforestation in the Madras Presidency. Also, through his exploration reports in the Madras Presidency, he was able to provide information on the distribution and capability of different kinds of timbers available in the Madras Presidency to the railway engineers (Cleghorn 1860: x).

In 1861 Cleghorn was deputed to the Punjab to explore the hill forests there “to obtain reliable information regarding the timber resources of that Province and to institute a systematic plan of Conservancy and Management” (Cleghorn 1864: i). In his survey of the Punjab forests, Cleghorn had not only to describe the location of the forests where the most valuable timber could be found but also to list all the economically useful plants that he saw, as well as map and describe the course of all local rivers, canals and railways. This information on forest distribution and timber transport facilities enabled the state to calculate and demarcate certain forested areas, depending on their value and location, to be reserved so that a permanent supply of timber to meet the state’s needs could be maintained. Just as in the case of his forest explorations in the Madras Presidency, Cleghorn’s exploration of the Punjab’s hill forests also made him aware of the important

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\textsuperscript{103} A type of shifting or slash and burn cultivation practised in Mysore and Canara.
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causes of deforestation there. By 1864, forest conservation was adopted at the all-India level and Cleghorn was appointed the Joint Commissioner of Forests along with Dr. Brandis.104

5.3 Cleghorn’s Contribution to Forest Conservation in India

The implementation of forest conservation at the provincial level and at the all-India level did not come about easily. Surveys and explorations undertaken by Cleghorn during his work in India quickly made him realise that India’s forests were being depleted. Reflecting on the causes of deforestation in the British colonies after his retirement from the Indian Medical Service, he noted that:

During the first stage of colonisation in most countries, as for instance Australia, India, and America, and while settlers are thinly scattered, demands on the wood supply are usually so limited as not to cause undue destruction of indigenous forest, nor to occasion alarm for future requirements. But immigration goes on, agricultural industry is extended, railways are formed, all these causing encroachments on the forests to take place, and ultimately denudation follows.... (Cleghorn 1873: 3-4).

The denudation of the forests in the colonial context also made him conscious that such denudation had not taken place in Britain. He said:

That such [denudation due to expansion of the railways, agriculture etc.] has not been the result in our own country is doubtless due to our insular position, and to our rich resources of mineral fuel. Of the first, and the advantage we thereby possess of being able to draw supplies from all quarters of the globe, nothing short of a convulsion of nature can deprive us.... (Cleghorn 1873: 4)

104 He was a German forester brought to British Burma to implement forest conservation, who was later asked to form the Imperial Forest Department in 1864 as the Joint Commissioner of Forests with Cleghorn.
Thus, Cleghorn recognized that Britain did not face a denudation crisis because it had good supply of coal and because it could obtain timber from its empire.\textsuperscript{105} For example, by the beginning of the nineteenth century, Britain often depended on India for timber to build ships for the royal navy, which led to the denudation of the forests in the Western Ghats on the southwestern coast of India. The ecological impact of this denudation in the Malabar and Canara portions of the Western Ghats to supply timber for shipbuilding was highlighted by Cleghorn in his report on tropical deforestation in 1852 (Cleghorn 1852: 80-81).

The depletion of forests, especially in the southwestern parts of India, prompted Cleghorn to analyze the reasons for deforestation and attempt a solution to the problem. By the 1850s Cleghorn knew that the railway construction in Scotland had made heavy demands on the forests of Scotland\textsuperscript{106} for carriage and wagon building and also for sleepers, which may have made him more sensitive to the impact of railways on the forests in India.

Cleghorn was the first scientist in India to point out that increasing timber demand by the railways for sleepers and firewood, was the most important reason for deforestation in India. In all his Madras forest reports, especially between 1857 and 1860, he emphasized the fact that the timber demand by the railways was an important cause of

\textsuperscript{105} This was especially so because towards the end of the eighteenth century when exports of timber from America declined, Britain had to meet its heavy naval timber demand from its own oak forests which got exhausted (Anderson 1967, II: 1).

\textsuperscript{106} Anderson 1967, II: 2
deforestation in the Madras Presidency. For example, in his third report on forest operations in the Madras Presidency, he noted:

There are many causes at work which are gradually thinning the ranks of our indigenous forests. The first, and by far the most formidable of these, is railway requirements. It is scarcely credible the many thousands of large forest trees which have been felled in the neighbourhood of the various lines of railway within the last few years (Cleghorn 1860: 60).

Cleghorn noted that although there were several causes of deforestation, the timber requirements of the railways had the maximum negative impact on the forests. Underlining the enormous negative impact of the railways on the forests when compared to any other agency, Cleghorn wrote in his second report on the forest operations in the Madras Presidency (1858-59) that “The [timber] requirements of the Indian navy were not so large as in previous years, but the requisitions of the different railway companies were much greater” (Cleghorn 1860: 32).

Similarly in the case of the Punjab, where he was sent to report on the hill forests in 1861, he felt that the railways were an important cause of deforestation. He wrote “[T]he forests of the Western Himalayas have been subjected to greatly increased demands in connection with the progress of Railway enterprise, and of advancing civilization....” (Cleghorn 1864: ii) Cleghorn was one of the first persons to note that improper methods of felling and transporting timber had led to the exhaustion of the hill forests of the Punjab, which had been exacerbated by much timber wastage. For example, in the hill forests of the Sutlej valley in the Punjab he noted:
Unskilled persons are working for immediate profit, without regard for the young trees, or the future supply of timber.... The axemen habitually fell the trees at the height most convenient to themselves, viz., four to six feet from the ground.... Unless the forest lies conveniently, so that the logs fall into the water, the contractors select trees of second class dimensions, say nine to ten feet in girth.... Out of the several thousand logs which I saw, very few exceeded twelve feet in length, being cut expressly for conversion into railway sleepers (Cleghorn 1864: 30-31).

Immature trees did not meet the needs of the railways for sleepers as they were not seasoned or durable, while their felling also exhausted the timber supply for the future. The high stumps of trees cut four to six feet above the ground caused obstruction to the logs being sent down from above to the river (Cleghorn 1864: 30-31).

In addition to improper felling methods, Cleghorn also noticed that unsuitable sites were selected by the timber contractors for transporting the timber from the hills to the plains in the Punjab. He wrote:

Little care or judgement is displayed in selecting suitable sites for slipping the timber.... In one place, eighteen logs out of twenty were shivered to pieces.... Fine wood is often seen overhanging mural precipices, or in situations whence it cannot be removed without certain injury at the ordinary working season.... I should say, that from one-third to one-fourth of the logs felled in the basin of the Sutlej become available for the construction of the public works in the Punjab, within two or three years after they are dressed (Cleghorn 1864: 32, 36).

Thus, two-thirds to three-fourths of the logs launched from the hills were lost due to careless transportation. Given the ecological and economic importance that Cleghorn attached to the forests, their increasing depletion made him even more aware of the need for forest conservation in India.
I will now examine Cleghorn’s ideas on forest conservation and the duties of a forester and state conservancy versus private conservancy, as well as to what extent and how these conservation ideas were used by Cleghorn to bring about forest conservation in India. For Cleghorn, the purpose of forest conservation was to meet the needs of the future. In his address delivered at the 19th annual meeting of the Scottish Arboricultural Society in 1872 he said, “foreseeing provision for the future ... distinguishes the profession of a forester more perhaps than any other” (Transactions of the Scottish Arboricultural Society 1873, VII(I): 2).

Regarding who would be responsible for the implementation of forest conservation in India Cleghorn felt that control or regulation of forest cutting could only be provided by the state, which he had learnt from his previous experience in Burma (Cleghorn 1860: vii). In Burma, he saw that when teak forests were thrown open to private businesses they were denuded by the profit motive in a context of competition between enterprises. This deprived the state “of those supplies which were indispensable to the public service” (Cleghorn 1860: vii). Hence, in the context of forest conservancy in the Madras Presidency Cleghorn wrote:

The results of this wholesale and indiscriminate denudation gradually became apparent, and rendered it imperative that measures should be taken to organise a system of forest administration, which would enable the authorities to economise public property for the public good (Cleghorn 1860: v-vi).

Cleghorn believed that it was only through the establishment of forest conservancy by the state that the entire population would benefit rather than a few individuals.
Cleghorn's strong belief in state intervention in forest conservancy was also seen earlier in his report on tropical deforestation presented to the British Association for the Advancement of Science in 1852 (Grove 1995: 468). Cleghorn saw a clear dichotomy between forest conservancy by the state and that by private interests. As he noted in his address to the 19th annual meeting of the Scottish Arboricultural Society:

Few private individuals can afford to take that higher view of forest conservancy which wishes to make provision for generations yet unborn...They are generally engaged, not in the husbanding of state forests, where the good of generations yet to come guides your measures, but in forests belonging to private individuals, where the chief objects are, to meet the current demand for estate purposes, and to yield a good annual revenue (Cleghorn 1873: 2-3, 6).

For Cleghorn, state conservancy was concerned with providing timber for the future generations while private conservancy had mainly to do with meeting its own needs and generating a good revenue from its forests. He did not at that time question the colonial enterprise of putting state-provided infrastructure in the service of private sector profits, which was clearly a motive in Indian railway siting and construction. Rather, Cleghorn made a clear distinction between private and state conservancy in the 1850s, when he was sent to observe forest conservancy in Burma. In the preface to his book *Forests and Gardens of South India* Cleghorn wrote:

The somewhat chequered history of these provinces [in Burma], and the difficulties experienced in blending the interests of the State with those of private enterprise on the one hand, and in maintaining a supply of first-class timber without seriously or permanently interfering with the future prospects of the
forests on the other, exercised an important influence on the question of forest administration, both in Madras and Bombay (Cleghorn 1860: vii).

Thus, Cleghorn believed that the state and private interests in forest conservancy were incompatible.

His views changed, however, when he began forest-related work in the Madras Presidency. There the objectives of state and private interests in forest conservancy were more or less the same. For the state, the aim of forest conservation was to maintain timber supply for meeting the needs of the railways and other public works and to generate revenue, especially after the Mutiny. These objectives were similar to the objectives of private conservancy perceived by Cleghorn. The state’s objective of meeting the timber needs of the railways through forest conservancy was pointed out by Cleghorn in his address to the 19th annual meeting of the Scottish Arboricultural Society. “The introduction into India of railways, and the rapidly increased demand for timber for sleepers and fuel, at length forced the attention of the Government to the vital question of forest management.”(Cleghorn 1873: 5). Cleghorn was thus aware of the commercial motive when the state implemented forest conservation in India.

Although Cleghorn and his fellow scientists such as Gibson and Balfour had lobbied the state to implement forest conservation for ecological reasons since the late 1840s, the state began forest conservation at the all-India level only in 1864 (Grove 1995: 467-468). In his report of 1852 Cleghorn highlighted the ecological importance of forests in assuring the welfare of the local population.
To tropical countries, the preservation of the springs which feed the rivers, on which the fertility of the land and the prosperity of the people are so essentially dependent, is of the greatest importance. These springs rise in the mountain regions where forests prevail, and it is to such regions that a protective agency should be extended, for there can be but little doubt that the entire removal of wood leads to diminution of water (Cleghorn et al. 1852: 79).

As Grove argues ‘the public basis of Cleghorn’s environmentalism ... was based primarily on a fear of the climatic and physical effects of tropical deforestation as part of a wider global problem’ (1997: 82). The climatic and ecological basis of Cleghorn’s argument for forest conservancy is also clear in the following excerpts taken from his report on the Madras Exhibition, 1852-53 and from his book *Forests and Gardens of South India*.

Besides this, the influence of trees on climate is very considerable, tending as they do, to prevent the too rapid withdrawal of moisture from the soil, a point of great importance in a country, where the heat of the sun is intense, and the supply of water is dependent only upon periodical falls of rain (Madras Exhibition Report 1852-53: 53 in Cleghorn Papers Box 9, No. 3).

If conservation be needful in temperate climates, how imperative is it in the tropics, where the supplies of water, and consequently of food and other produce, are in a great measure dependent on the existence of forests.... (Cleghorn 1860: x)

I may observe, that in granting forest land, it seems to me that while the destruction of forest ... for bonafide cultivation [of coffee] may be considered legitimate, yet the preservation of the fringe along the crest of mountain ridges[of the Eastern Ghats in the Madras Presidency] is of special importance in a climatic point of view; and this should never be given over to the axe (Cleghorn 1860: 16).

For Cleghorn forests were important as they were a part of the ecological system whose depletion would adversely affect the rainfall and water supply especially in the tropical countries.
Although the basis of Cleghorn’s argument for forest conservancy was ecological, he was aware of the difficulty\footnote{A difficulty currently exploited by U. S. anti-environmentalists to resist ecologically driven policies.} of proving the influence of forests on the rainfall or on the ecological system of any region. In his 1852 report to the British Association he noted:

In reference to the physical effects of the removal of forests, we found considerable variety of opinions. There is, it must in fact be admitted, a deficiency of exact or experimental information on the subject. Observations of a precise character on climate in countries once covered by forests but now cleared, do not to our knowledge exist, and the evidence with which we have to deal is a kind of evidence which admits of considerable variety of interpretation (Cleghorn et al. 1852: 78)

Not only was there a deficiency of evidence showing the influence of forests on rainfall and climate but the existing evidence was also subject to many interpretations. After his retirement from the forest service in India, in his address delivered at the 20th annual meeting of the Scottish Arboricultural Society, Cleghorn said:

[F]rom the capricious distribution of the rainfall at all times, many years must be allowed to elapse (at least twenty or thirty years) before the influence of forests on the rainfall can be unmistakably indicated from the data collected by gauges...(Cleghorn 1874: 7)

Experiments to establish the influence of forests on the climate, particularly on the temperature and humidity of a country, only started around 1873 in Britain, long after Cleghorn’s retirement from the Indian Medical Service (Cleghorn 1874: 7). In any case, it is doubtful that the colonial state would have adopted ecological conservation, given their
goal of maximizing resource extraction. In Britain, unlike in other European countries such as France and Germany there was no forest conservation system (Saldanha 1996: 1265). The economic interest of the British colonial state by the 1810s lay in transforming India into a market for British manufactured goods and into a raw material supplier for British industries. Cleghorn therefore found himself in an anomalous position when he, as a colonial officer, criticized the negative impact on the forests of the state-sponsored projects such as the railways and also of private ones such as coffee/tea plantations. Moreover, he could not use his anti-exploitation argument directly to press for forest conservation (Grove 1995: 466), given the lack of evidence for the link between forests and climate and the state's goal of economically strategic forest conservancy.

Cleghorn realized that the only way that his suggestions of forest conservation and other conservancy measures would be implemented by the state was by showing that conservation would (a) help solve the timber scarcity that threatened the progress of the public works and (b) generate revenue. First of all, Cleghorn had to arouse awareness of the timber scarcity crisis so that the state would implement forest conservation.

"The enhanced value of timber had led to an indiscriminate felling of the finest trees, threatening speedily to exhaust the deodar forests, and to deprive the State of those supplies which are essential to the construction of Public Works (Cleghorn 1864: ii)."

108 Scotland being an exception in this respect (Anderson 1967, II: 314).

109 Cleghorn 1860: 3-4.
Cleghorn was the first scientist to warn the state of the timber scarcity that would result for the public works in the future if uncontrolled felling of trees was allowed in the hill forests of the Punjab. He concluded that as

[T]he demand [by the railways and other public works on the forests] is certain to continue, while the sources of supply are limited, and the physical difficulties of transport from the Himalayan forests being very great, systematic and skilled management are imperatively called for (Cleghorn 1864: ii).

Thus, given the demands made on the forests by the railways and the limited sources of timber supply in the Punjab, Cleghorn reported that forest conservation was necessary. Based on his report and suggestions the state implemented forest conservation in the Punjab in 1864 along with its implementation at the all-India level.

Similarly, in the mid-1850s in the Madras Presidency when the railways faced shortage of timber for sleepers due to deforestation, Cleghorn had been asked by the government of Madras to solve the problem (McIntosh 1895: iv). He wrote to Dr. J. H. Balfour

The Governor [Lord Harris] informed me in his private room that the greatly increased price of Timber for Railway, Ordnance, Commissariat and Ship building purposes had of late been so frequently brought before him that he considered a thorough exploration of the forests necessary. He asked me if I was willing to organize a system of conservation, and desired me to state my views generally.... (J. H. Balfour Correspondence III)

His subsequent report in 1856 suggested the establishment of forest conservancy in the Madras Presidency as a solution to the railways timber scarcity (Stebbing 1922 I: 301). By the end of that year, the Madras Forest Department was formed with Cleghorn as the
Conservator of Forests. Thus, Cleghorn used the argument that forest conservancy was necessary to maintain the timber supply to the railways and other public works so that forest conservancy was implemented in the Madras Presidency and in the Punjab.

Cleghorn’s realization of the state’s motive of exploiting resources to boost revenue in its adoption of forest conservancy also influenced his suggestions in the forest reports to the state. For example, in his first report on forest conservancy in the Madras Presidency for 1857-58, Cleghorn proposed that the Annamalai forests of the Madras Presidency should be reserved in perpetuity for the Indian navy in order to maintain the supply of teak for the ships (Cleghorn 1860: 7).

Even Cleghorn’s selection of trees to be conserved in the forests was based on their economic importance to the state in terms of their revenue yield or in meeting the needs of public works. For example, in the Madras Presidency, Cleghorn reserved teak, sandalwood and blackwood trees during the first year of the forest conservancy, 1856-57. In the very next year of forest operations, he extended his list of reserved trees. He noted (Cleghorn 1860: 43):

The list of trees which, under the native rule, comprised only teak, sandal, and blackwood, has been extended to other trees highly valuable for building purposes, which in most districts are [scientific names in brackets]--

Jack (*Artocarpus integrifolia*).
Ayni (*Artocarpus hirsuta*).
Venge (*Pterocarpus marsupium*).
Palavu (*Mimusops Indica*).

Marada (*Pentaptera coriacea*).
Cedar (*Cedrela Toona*).
Erul (*Inga xilocarpa*).
Of these ayni was being considered for shipbuilding purposes of the British navy while venge, erul and ayni were on the list of timbers being experimented as sleepers for railways (Cleghorn 1860: 60-61). Thus, even Cleghorn’s selection of trees to be reserved was based on the satisfaction of the building needs of the state and of the railways.

Moreover, Cleghorn tried to solve the timber supply problem, especially in the Madras Presidency, by working closely with the railway companies. He pointed out that because the railway companies were using immature timber for sleepers, which were less durable and had to be replaced every two to three years, the cutting of the forests was increased (Cleghorn 1860: 61-62). At Cleghorn’s suggestion the wooden sleepers were branded by the railway companies with zinc labels showing the kind of wood used, so that their life span on the lines could be calculated (Cleghorn 1860: 61-62). He regularly supervised the felling of trees for sleepers, seeing to it that they were felled in the proper season.

When Cleghorn surveyed the hill forests of the Punjab from 1861 to 1863 his report was mostly concerned with the availability and distribution of deodar forests. He noted, ”Besides deodar, which is the principal object of forest operations, the wood of other trees has been sought by different public departments” (Cleghorn 1864:148; italics added). Given the importance of deodar for largely meeting the sleeper need of the railways Cleghorn made detailed observations of the number, size, distribution and accessibility of deodar trees in the forests of the five river valleys of the Punjab and proposed their conservation. Highlighting the importance of Cleghorn’s report on the
Punjab forests and its impact on forest conservancy in the Punjab, his fellow forester Brandis noted:

His Report on the Forests of the Punjab and the Western Himalayas, which was published in 1864... has been of great value in facilitating the organisation of forest administration in that province and in those native states of the Western Himalayas where it was possible, by means of leases, to obtain control of the forests (Brandis 1890: 91)

It was not only in his proposals regarding the preservation of forests that Cleghorn saw to it that the state’s economic objective was satisfied, but also in his afforestation suggestions to the state. In a report on the forest conservancy in the Madras Presidency he wrote “To meet this prospective demand [of sleepers for railways], it seems most desirable that immediate steps should be taken to raise large numbers of hard-wood trees suitable for sleepers....”(Cleghorn 1860: 33). Summing up Cleghorn’s contribution to the establishment of plantations and to forest conservancy in the Madras Presidency in general, Brandis wrote

Under his direction numerous new plantations were established, while existing plantations were maintained and extended. Establishments for the protection and proper management of the forests were organised in all districts (Brandis 1890: 91).

Later, when the question of establishing fuel plantations in the Punjab arose, Cleghorn who was the Officiating Conservator of Forests of India argued:

It appears evident from the concurrent testimony of all the Officers consulted that extensive clearances are now overtaking the country adjoining the Punjab and Delhi Railways.... *Unless large plantations be formed, the [timber] agent anticipates serious difficulty in working the line from the increasing dearth of*
fuel.... The Railway has hitherto drawn its fuel from the Rukhs estimated to contain three to seven or at most ten years' supply, when all will be exhausted in regard to immediate use.... In seven years (1874), when the Railway will have been four years opened, the entire (568 miles) distance to Delhi, it may be certainly assumed that the traffic will require more than four trains daily. The consumption of wood will then probably be double, as estimated by the Deputy Consulting Engineer.... (PWD Progs 1866 Prog No. 3)

Thus, Cleghorn highlighted the fact that the railways' need for fuel both immediately and in the future, would be met by the establishment of fuel plantations in the Punjab. Based on Cleghorn's proposal and Dr. Stewart's report the state established fuel plantations in the Punjab (PWD Progs 1866 Prog No. 25).

In addition to the maintenance of timber supply for the railways and other public works, generation of revenue became one of the objectives of forest conservation by the state, especially after the Mutiny (Guha 1983: 1886). As C. F. Amery, a forester in the NWP Forest Department noted,

The Forest Department, as a first result of its labours, is expected to promptly meet the timber requirements of the Railways and Public Works Department, to bring timber within the reach of the people and to execute all operations of felling, conversion, transport with intelligence and economy, so as to produce a fair revenue from the estates administered by it....(Amery 1876: 220; italics added)

Hence, in arguing for forest conservancy Cleghorn had to highlight the financial viability of forest conservancy in his reports. For example, he highlighted the beneficial financial results in the Madras forest conservancy report for 1858-59 submitted to the state.

From the returns of my assistants in Canara, ..., rendered to the close of the official year, it may be seen that the operations have in these ranges been financially profitable. Large supplies of timber have been furnished to public departments at a time when such was indispensably necessary (1860: 36)
Furthermore, when there was a discussion on whether kumari cultivation should be allowed in the forested areas as it destroyed forests, Cleghorn sided with the railways and the state against local needs.

In North Canara (Supah and Yellapur), where there is much most valuable timber, and the conservancy of which is financially profitable, I would be more careful. I would disallow all Kumari without previous sanction.... Great supplies of timber have been made to public departments from these two taluks, and the railway pressure is now heavy upon them. We cannot afford to give up any of the fine forests for Kumari (Cleghorn 1860: 138).

Thus, even in deciding where the practice of kumari was to be allowed and where it was not be allowed, Cleghorn used the revenue and timber yielding potential of the forests as a guide. Orders prohibiting kumari cultivation were issued by the state.

In this paper Dr Cleghorn replies to the reference made to him ... on the subject of Kumari cultivation in Canara, and the proper measures to be taking[sic] for checking it.... The Government now prohibit Sarkar Kumari, or Kumari cultivation in Government forests, without previous permission. This permission should be given sparingly, and never for spots in the timber forests (Cleghorn 1860: 142-144)

Similarly in the Punjab, Cleghorn was conscious of the state’s revenue generation objective when he advocated forest conservancy. In a note on the preservation of plains forests or rukhs written with Dr. Brandis he stated:

The conclusion at which we arrive, after a careful consideration of the data before us, is, that the hill forests are not likely to be more than self-supporting.... *We look therefore to the forests in the outer hills and plains of the Punjab for the yield of a regular surplus revenue*.... Independently of the grave question of fuel supply for Railways and steamers, a sufficient area of the best Rukhs should be reserved, and permanently placed under the Forest Department for the production of timber, fire-wood, charcoal, & c. *This will yield a steady surplus revenue, which may*
Thus, in pushing for the conservation of the rukhs or the plains forests, Cleghorn emphasized their revenue-yielding potential to the state.

Cleghorn was therefore successful in getting his proposals on forest conservation implemented by underlining the satisfaction of the state’s timber and revenue needs through conservancy rather than ecological reasons. He was, however, not successful in pushing his proposals through at all times. For example, when Cleghorn and his fellow scientists strongly advocated state-managed forest conservancy, the state pushed the idea further by completely alienating the state forests from the common people (PWD Progs November 1862) implementing this type of conservancy at the all-India level through the Indian Forest Act of 1865. Also, through consequent Forest Acts such as the 1879 Act, the state brought more and more forests under its control, while at the same time denying access and control to the local population (Guha 1989: 147-148).

Complete alienation of the forests from the common people by the state went against Cleghorn beliefs. For example, in his first report on forest operations in the Madras Presidency Cleghorn observed:

There [in Wainad and Heggadevincotta forests] being no cultivation, and a very scanty population, and the timber consequently not being required for local purposes, I would strongly urge that this should be considered a reserved forest (Cleghorn 1860: 8).

It is most important that, while strict supervision is enforced in the Government forests, conservancy should not be carried so far as to interfere with the supply of agricultural implements to the *bona fide* ryot [peasant], or to obstruct the
application of leaves and branches for alkaline material to fertilize his fields (Cleghorn 1860: 16).

Thus, Cleghorn was very conscious of the importance of forests in meeting the needs of the common people, even though he himself betrayed their needs on occasion, as we have seen. When pushed to clarify his anomalous position, he sided with the state and the railway companies.

Most of Cleghorn’s suggestions, in fact, cohered with the goals of the colonial state and were therefore implemented. In 1864-65, he along with Dr. Brandis became the Joint Commissioner of Forests and advised the state in the general organisation of forest administration at the all-India level (Brandis 1890: 92). His achievements were recognized when in a public resolution dated 10th January 1865, the Government of India designated Cleghorn as the “founder of Forest Conservancy in India” (PP 1871 LII: 95). He briefly held the post of the Inspector- General of forests in 1867 and finally retired from his service in India in 1869. His importance and influence in the field of forest conservancy in India can be seen from the following note by Brandis

When Cleghorn laid the foundation of an effective system of Forest Conservancy in Mysore and Madras, Forestry was very little known in India. A commencement had been made in several places, but Dr. Cleghorn was the first to carry out conservancy measures on an extensive scale (Brandis 1890: 93).

Cleghorn’s importance in forest conservancy can also be gauged from the fact that after retirement from his service in India, he was appointed as a confidential adviser to the Secretary of State in the India Office to select candidates for the Indian Forest Service (Brandis 1890: 93)
5.4 Conclusion

Grove (1995: 7) asks why the state accepted the conservationist views of scientists such as Cleghorn when it involved the curbing of the uncontrolled operation of capital. The state’s acceptance of forest conservancy was contradictory, according to Grove, because the unfettered operation of capital for profit was the basis of colonial expansion. There was nothing contradictory, I argue, in the colonial state’s action. In fact, it accepted the conservationist views of the scientists such as Cleghorn only when their arguments did not run counter to its long-term interests. As long as the scientists were able to argue that forest conservation would maintain the timber supply to support infrastructure intended to exploit India’s resources efficiently and thereby generate revenue, the state accepted their proposals.

The colonial state as a capitalist state did not act at the behest of individual capitalists but rather on behalf of what was beneficial to capital and to the metropolis, i.e. Britain, as a whole, in the long term.110 In the case of forest conservation in India, by accepting the conservancy proposals of the scientists, the colonial state put restrictions on the extraction of timber by the private capitalists and made sure that sufficient timber supply to the railways and other public works would be provided for so that long-term economic benefits for British capitalists and for Britain could be derived from India. The state was aware that, in the face of no restrictions on timber extraction, the capitalists

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110 See Miliband 1980; Alavi 1982
with short-term profits in mind would denude the forests. Hugh Cleghorn's actions on the
whole supported the state's goal, despite any reservations he might have had, and he was
rewarded commensurately.
CHAPTER 6

CONCLUSION

Colonial infrastructural projects such as the railways in India adversely affected the environment, particularly the forests, especially between 1853 and 1884 when most of the trunk and the branch railway lines were constructed and opened in India. The adverse impact of railway expansion and operation on the forests in both quantity and quality was unprecedented in the environmental history of colonial India. The construction of railways in India, which began in the 1840s, was part of the colonial project of maximizing the profitability of colonies through efficient resource extraction.

Given the structure of colonial relations between Britain and India, the value of the colony’s resources and the mode of exploiting them by Britain depended largely on Britain’s needs. By the beginning of the nineteenth century, British industries had become very productive and required larger markets for their products, for which Britain began to look in her colonies such as India. Hence, by the second half of the nineteenth century, trade became Britain’s dominant mode of exploiting India’s resources. In deciding what strategies to pursue to augment Britain’s trade with India, the economic and political conditions in the colony at that time played an important role. For example, after the 1857 Mutiny, a depleted imperial exchequer put pressure on the state to generate revenue. This

165
extraction of revenue/surplus had to be done without provoking rebellion. This could be done by boosting British trade with India rather than by increasing land tax or by territorial expansion.

The state’s continued extraction of surplus or profit through trade from India was dependent on the profitable exploitation of India’s resources through the construction of infrastructure. To facilitate increased trade between Britain and India, there was huge British investment in infrastructural projects such as transportation and irrigation works, including the railways in which the state was actively involved.

Britain’s exploitation of India’s resources through trade by the early 1850s was mostly focused on increasing India’s export surplus to meet the home charges which were transferred annually from India to Britain. India was transformed into an exporter of agricultural products such as cotton, jute, tea, coffee, wheat and oilseeds. The railways facilitated the export of the above agricultural commodities from India, which were low-wage, low-capital intensive goods, in exchange for high-wage, high-capital intensive goods such as textiles, from Britain. In other words, railways in colonial India enabled efficient exploitation of India’s resources through unequal exchange.

The fact that the construction of railways was shaped by Britain’s need to exploit India’s resources through trade was seen in the laying of the railway lines under the state’s direction. The state prioritized the laying of the trunk lines over that of the local feeder lines. The trunk lines were in turn laid in such a way that they encouraged trade between the agriculturally rich interior, such as the cotton tracts, and the big ports. Attention was not given to the development of internal trade through the construction of
feeder lines locally. The largely export-oriented nature of the railway lines can also be seen from the fact that, even when there was a famine in certain areas, large-scale export of foodgrains continued. Similarly, when it came to the extension/expansion of lines the state prioritized the construction of economic/commercial lines over that of the political lines; where possible it tried to combine the two functions.

The colonial state’s aim of efficient resource exploitation or, at least, in laying the infrastructure for efficient resource exploitation through the railways was also seen in the agriculturally fertile provinces such as the Punjab, whose productivity could be further exploited by railway establishment and expansion. Thus, the state prioritized economic goals by maximizing railway infrastructure where the most wealth was thought to be available for exploitation. The colonial state’s revenue-maximizing motive in railway establishment was reflected, as at the all-India level, in the laying of the lines in the Punjab. Most of the lines were constructed in such a way that they connected the rich agricultural interior of the Punjab with the port of Karachi in Sind. This facilitated, as we have seen, efficient and increased transport of agricultural commodities such as wheat and oilseeds from the Punjab for export to Britain.

As the railways expanded and operated on an increasing scale to facilitate efficient resource extraction through trade, their timber demand for sleepers and firewood increased causing deforestation of the local forests. Thus, the construction and operation of railways which were primarily designed to enable efficient resource extraction from India, itself depleted the natural resources of India. The economic exploitation of the colony by the metropole had ecological costs that cannot be ignored. More specifically,
the Punjab's hill forests were cut down to supply sleepers for the railways while the plains’ forests or rukhs were cut to meet the fuel needs of the railways. In contrast to the situation in other provinces in India, the deforestation impact of railway expansion was felt early on and was more severe due to the aridity of the Punjab. By the early 1860s, the depletion level of the hill forests was so high that it resulted in a sleeper shortage situation for the railways. To maintain a continuous and cheap supply of timber for the railways rather than to maintain ecological balance, the colonial state took up forest conservation in the Punjab and at the all-India level in 1864 through the establishment of a Forest Department.

The colonial state was not only interested in improving resource extraction by expanding railways but was also interested in maximizing its profits in the process. Hence, to alleviate the timber shortage for the railways the state chose the cost-effective measure of adopting forest conservation. Just like the states of contemporary industrial societies facing environmental problems, the colonial state adopted the measure that had the lowest short-term costs at that time (Smith 1992: 40). However, the colonial state had available to it greater power of coercion that allowed it to bring the forests under its control while denying access to the local people or users. The establishment of state forestry in India was one of the first instances of large-scale state reservation of forests in

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111 For details on why the colonial state in India brought the forests under its control by reserving large forested areas and by denying the local people access to these forests see Guha 1983 and also Gadgil and Guha 1989.
the world. It, in fact, influenced environmental thinking in the United States in the late
nineteenth and early twentieth century that led to massive forest reservations there
(Barton 2000: 187).

In the Punjab, forest conservation to meet the railways’ needs involved two main
methods. For the hill forests the natural reproduction method of coppicing and selective
felling was used. To maintain firewood supplies from the plains’ forests or rukhs, the
state used the method of establishing artificial plantations.

The colonial state’s measure of adopting forest conservation was a technological
fix that attacked only the effect of deforestation, i.e., timber shortage, rather than the
cause of deforestation, i.e., rapid and incessant expansion of the railways. Because this
approach was fueled by the motive of improving resource extraction the state did not
reduce the expansion and operation of the railways, which resulted in recurring timber
crises in 1876 for railway sleepers and in 1880-81 for fuel. For the colonial state, the
forests were merely resources to meet the raw material and fuel needs of the railways and
other projects so that efficient resource extraction could take place from India. The state,
thus, had a very instrumentalist conception of India’s forests, which in turn influenced the
kind of measures it adopted to reduce deforestation.

The ecological costs of railway establishment and expansion to India were a
consequence that was not accidental but intentional. Colonial administrators first assumed
“inexhaustibility” of forests needed for sleepers and firewood, then understood their
limits but kept on commissioning and clear-cutting anyway. Forest conservation began as
a late attempt to stave off closure of the railways, and then partly was abandoned with the
cessation of timber plantations. Similar cases of unprecedented deforestation followed by implementation of forest conservation by the colonial state to meet its own timber needs have been studied in nineteenth-century Java and Burma.

The above discussion demonstrates how colonial rule was able to alter the inhospitable Old World environment in India radically through, among other changes, technological ones. Technological changes such as railway establishment enabled the colonial regime to extract the colony’s resources efficiently but in the process the technology itself was resource-intensive and consumed huge quantities of natural resources such as forests. As more and more resources were consumed by the technologies, the resources were depleted altering the environment in the process. Thus, in contrast to Crosby’s (1986) argument that Europeans were able to modify the favorable New World environment through the flora and fauna they brought with them, the case of deforestation in India due to railway expansion shows how Europeans caused environmental changes in regions with a less hospitable environment.

To paraphrase Arnold and Guha, in this environmental history of India while the collective agency of the state cannot be ignored, the role of individual colonial actors too in highlighting the problem of deforestation to the state and in pushing for forest

\[112\] See Peluso 1992

\[113\] See Bryant 1996

\[114\] To the Europeans when compared to the New World environment.

\[115\] 1995: 13
conservation cannot be disregarded. As Grove\textsuperscript{116} rightly argues, for ecological changes to elicit state intervention, they had to be observed, measured and analyzed by scientists. One such scientist who played an important role in bringing about forest conservation was Dr. Hugh Cleghorn, who became one of colonial India’s earliest forest conservators. He was not only the first scientist in colonial India to realize the adverse impact of railways expansion on the forests, but was also responsible for the establishment of a forest department and forest conservation in Madras, Punjab and at the all-India level. The benefits of this seemingly disinterested action, however, were undermined by the dominance of the resource extraction motive in the state’s push for forest conservation. Only the threat to the railway timber supply forced the state to promote forest conservation as a cost-effective measure. Hence, even though Cleghorn was quite aware of and averse to the ecological damage caused by the state’s headlong railway development, he nonetheless employed economic arguments in his proposals on forest conservancy. Since Cleghorn’s suggestions on forest conservancy were compatible with the state’s long-term objective of developing India’s resources, they were accepted and implemented by the state. Unlike Grove, I argue that the conservationist arguments of scientists such as Cleghorn meshed nicely with the state’s overarching interest of ensuring that the long term timber supplies for the railways and other public works would be maintained. In that way Britain would continue to derive economic benefit from India.

\textsuperscript{116} 1995: 7
To summarize the arguments I have made in this dissertation, the colonial state, by the 1850s was to a large extent engaged in promoting infrastructural projects that would facilitate maximum resource extraction from India. The dominant mode of resource extraction from India by Britain was through trade in the second half of the nineteenth century. In other words, these projects would enable increase in export of British manufactured goods to India and export of raw materials and other agricultural produce from India to Europe. To this end the state promoted the construction of railways. The establishment and rapid expansion of railways from the mid-nineteenth century affected the environment adversely, especially the Indian forests. Thus, the resource-extraction improvement interventions of the state had ecological costs.

The railways' main demand on the forests was timber for sleepers and for firewood. This demand led to the exhaustion of the accessible local forests wherever the railways were built, especially in the early 1860s. In order to gain control over the negative consequences of railway expansion on the forests, the state adopted forest conservation and scientific forestry as an attempt to maintain sleeper and fuel supplies to keep the railways running; by bringing the forests under its control the railway timber supply was maintained and the colonial state contributed to the subordination of not only the colony's economy but also the colony's environment to Britain's interest. In this situation colonial actors such as Cleghorn played an important role in helping the state perceive a crisis situation and in suggesting measures to alleviate the timber scarcity problem.
When conservation solutions to the deforestation crisis were not effective, the colonial state obtained sleepers and firewood from other sources outside British India, or used alternatives. To what extent the non-local forests (within and outside of British India) were affected by the timber demand is an interesting research topic for the future, which would shed light on how resource exploitation and exhaustion affect the environment in another region.

Some scholars have suggested that the expansion of the railways led to increases in cultivated areas (Harnetty 1971: 415; McAlpin 1975: 46). However, this extension of cultivated areas could be at the cost of forested areas. Hence, another possible question for future research could be to assess the decrease in forested areas as a result of the expansion in cultivation due to railway expansion.

Although the main focus of this dissertation has been to assess the impact of colonial public works projects such as the railways on the forests and the state's/officials response to deforestation, the social impact of deforestation and state forest intervention cannot be belittled. In other words, to what extent were the forest communities affected by the deforestation and by the state's expansion of control over the forests? Did they resist overtly or covertly, and how did this resistance affect forest policy? As Sivaramakrishnan argues, state forestry as 'development' was contested and negotiated during colonial rule (2000: 83). Further research on this topic might also yield rewarding results only hinted at here, as might, for instance, an exploration of the social and economic consequences of the increased timber and firewood trade.
An historical perspective on deforestation and ecological crisis will, I hope, enable a better understanding of the environmental impact of development projects in the present which are often pursued by states who largely ignore their environmental consequences (Porter and Brown 1991: 36; Haeuber 1993b: 486). This study is also important from an environmental policy point of view as it sheds light on the making of state forest policy. The colonial forest conservation policy was an insufficient technological fix to combat the timber scarcity faced by the railways. Since technological fixes attack the effects of environmental problems and not the causes, they are short-term in their scope. Modern-day states in both developing and developed countries need to work towards a long-term solution to the environmental problems that threaten the world today and in the future.
APPENDIX A

CURRENCY AND EXCHANGE RATES (1853-1884)

India

4 pies 1 anna
16 annas 1 rupee

Britain

12 pence 1 shilling
20 shillings 1 pound sterling

Exchange Rate (rupee - sterling)

Until 1871 rupee 2 shillings or 24 pence
1872-73 rupee 22.75 pence
1880-81 rupee 19.96 pence

Government accounts used the old rate of 24 pence throughout the nineteenth century

Source: Personal communication with Prof. Tomlinson 13 November 2001
Maund as a unit of weight in colonial India varied from province to province.

27 maunds of wood 1 British ton 45 cubic feet

Source: Stebbing 1922 I: 284
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177
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