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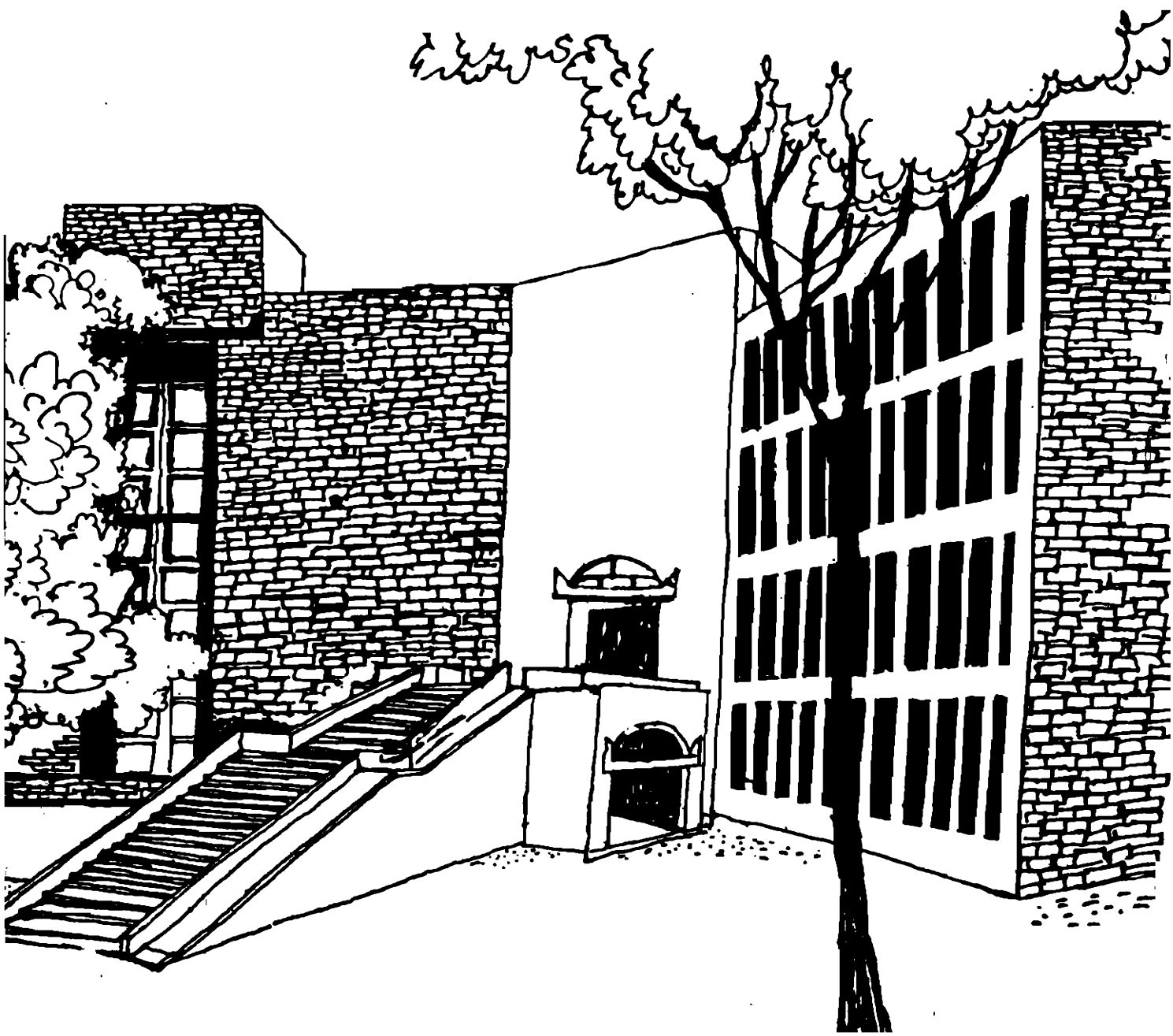

Strategies for Improving Indian Railways' Market Share of Port Based Coal Traffic: A Diagnostic Study

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Abstract

India is a vast country. After its independence in 1947, it steadily lost its position in international trade. With the beginning of economic liberalization in 1991, it has taken new initiatives in integrating itself with the world economy. Import restrictions have been removed for many commodities. One of the major impacts of liberalization has been on infrastructure: railways, roadways, ports and airports. Significant changes have also taken place in the composition of imported and exported commodities. Due to these changes, new challenges are being faced on the infrastructure front. One of the challenges is to rectify the mismatch of available infrastructure at ports where a modal change of commodities that are either imported or exported takes place. This paper examines such issues with a specific focus on improving infrastructure required for integration of railways and ports. This is achieved by focusing on coal which is a commodity that (i) brings significant revenues to Indian Railways, and (ii) is witnessing increasing imports. In this diagnostic study, we discuss the problems faced by Indian Railways and identify ways to increase its market share of coal movement between ports and the hinterland.

1. Introduction

> "Progress over the last decade has been good. Beginning in 1991, India's economic reforms have triggered an unprecedented growth of Gross Domestic Product (GDP) – by 6.0 to 6.5 percent a year over the last ten years. The Government of India's Ninth Five-Year Plan (1997-2002) set a growth target at an annual rate of 7.4 percent over the next 10 years. But India's transport system – especially surface transport – has serious deficiencies; its services are, by international standards, highly inefficient. With the sector being so central to the effective operation of the economy, poor transport has become a major drag on economic growth."
>
> [World Bank, 2002]

When we look at the Indian transport scenario, we notice that there has been a rapid growth in import and export of various commodities through the ports. However, the market share of the 'commonly perceived' efficient mode of transport for bulk commodities – the railways – has consistently declined over the years in favour of 'costly' roads. Now, Indian Railways (IR) is fighting to win back its market share from roads and other modes of transport.

In this paper, our focus is on one commodity of export-import traffic being routed through ports in India and linkages with IR for movement to and from the hinterland. The chosen commodity is coal. The reasons for choosing coal are: (i) its activity at the ports is increasing, (ii) the pattern of linkages is changing, and (iii) it is a business segment that IR know well since it has been the most significant commodity in the domestic sector.

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While past reported academic work in this specific context is limited, there are contributions that look at ports and hinterland connectivity in a broader context.

One of the earliest and almost similar context based work is reported by Doll and Waters [1979]. They describe a model for evaluating alternate routes for exporting bulk commodities from an inland location to overseas markets. The model was developed and applied to the prospective movement of coal from interior British Columbia. The model estimates total economic cost of movement including rail, port, and shipping costs. Freebairn [1989] reports that railway freight rates have a critical influence on the Australian coal industry. A 10% reduction in the otherwise monopolist driven rates could have a significant effect on national efficiency gains.

Babb [1998] reports that Europe's largest container ports are turning to railroads to improve freight mobility. The author concludes that better transport connections to the hinterland could become an important differentiating factor for the container ports. Malchow and Kanafani [2004] identify that the location of the port with respect to the hinterland is the most important characteristic for selection of ports for maritime container shipments. Our view is that these issues will be even more significant in the context of bulk movement.

Frankel [1999] emphasizes the need to reduce the deviations in time and cost of 19 different links that are identified by the author in trans-ocean supply chains. Approaching the same issue from the context of ports, Juhel [2001] brings out the need to implement reforms in ports, keeping in view the risks, benefits, and beneficiaries to achieve seamless transport chains. The key beneficiaries identified are governments, transport and terminal operators, shippers and exporters/importers and consumers.

A study by Cerit [2000] examines various sources of competitive advantage in transport for international marketing. Using Porter's five-forces framework, the author identifies maritime transport as the most significant source of competitive advantage. Hinterland connectivity is mentioned as inter-modal transport, and it comes out as an important factor in creating and sustaining the advantage.

2. Port Traffic in India

India has had a long tradition of sea-based trade dating back to 5000 B.C. India was on major trade routes for South-East Asian locations, much before the trade began for spices and silk with the Western world.

As of mid-2004, India has 13 major ports administered by the central government. These are: Kandla, Mumbai, JNPT, Marmagoa, New Mangalore, Cochin, Tuticorin, Chennai, Ennore, Visakhapatnam, Paradip, Haldia, and Kolkata (Calcutta). It also has 140 minor ports administered by eleven state maritime administrations [IPA, 2003]. Out of these, the Gujarat Maritime Board (GMB) controls 40 ports [GMB, 2003]. A map showing the major ports' locations and the maritime states is given in Figure 1.

The traffic handled at ports can be divided as 'coming into' ports and 'moving out' of ports, from and to the marine side, respectively. There is also a category called 'transshipment', which is essentially a ship-to-ship transfer of cargo at a port. The 'coming into', 'moving out', and 'transshipment' can further be sub-divided as 'export-import' and 'coastal' traffic.

As shown in Table 1, in 2002-03, the total port traffic was 419 million tons (mt), of which 313 mt (75% of the total port traffic) were handled at major ports and 106 mt were handled at minor ports. Of this 106 mt, GMB accounted for 84 mt (20% of the total port traffic). Out of the 140 minor ports, 16 handled more than a million tons of cargo each.

These 16 minor ports accounted for 20% of the total port traffic. Out of these 16 minor ports, 12 are under GMB.

Figure 1: Major Ports of India

Table 1: Port Traffic in India (2002-03)

(mt)

		Major Ports	Minor Ports		Total
			GMB	Others	
Coming Into	Export-Import	126	45	1	172
	Coastal	42	8	8	58
Moving Out	Export-Import	93	19	4	116
	Coastal	38	12	8	58
Trans-shipment	Export-Import	11	-	-	11
	Coastal	4	-	-	4
Total		313	84	21	419

Source: [IPA, 2003], [GMB, 2003]

Out of the 419 mt, 230 mt 'came into' ports, 174 mt 'moved out' of ports, and 15 mt were transshipped. The total export-import traffic was 299 mt, while the total coastal traffic was 120 mt.

For comparison, we look at similar data of 1996-97 in Table 2. The most striking aspect is the more than four fold increase in GMB ports' traffic. The data has a discrepancy in that the coastal 'coming into' and 'moving out' do not match.

Table 2: Port Traffic in India (1996-97)

(mt)

		Major Ports	Minor Ports		Total
			GMB	Others	
Coming Into	Export-Import	99	9	2	110
	Coastal	31	3	3	37
Moving Out	Export-Import	58	6	1	65
	Coastal	30	2	1	33
Trans-shipment	Export-Import	8	-	-	8
	Coastal	3	-	-	3
Total		229	20	7	256

Source: [TRW, 2000], [IPA,1998]

2.1 Export-Import Traffic

As shown in Table 3, the foreign trade of India has nearly doubled in the last decade, from USD 68,572 million in 1995-96 to USD 113,815 million in 2002-03. The growth in 2002-03 over 2001-02 has been more significant. This trend is expected to continue.

Table 3: Indian Exports and Imports

(million USD)

Year	Exports	Imports	Total
1995-96	31,842	36,730	68,572
1996-97	33,498	39,165	72,663
1997-98	35,049	41,535	76,583
1998-99	33,211	42,379	75,590
1999-00	36,760	49,799	86,558
2000-01	44,147	50,056	94,204
2001-02	43,976	51,588	95,564
2002-03	52,370	61,445	113,815

Source: [CMIE, 2004].

Table 4 gives a list of major revenue earning exported commodities with year wise export values. In 2002-03, out of the total exports of USD 52,370 million, gems and jewellery lead with USD 8,877 million, followed by engineering goods (USD 8,384 million) and textiles (USD 5753 million). In 2002-03, only USD 51 million worth of coal was exported.

Table 5 gives a list of major imported items with year wise import values. In 2002-03, out of the total imports of USD 61,445 million, POL lead with USD 17,685 million, followed by pearls, precious and semi-precious stones (USD 6,070 million) and electronic goods (USD 5,358 million). Coal (including coke and briquettes) is at the ninth rank in the list of imported items at USD 1,225 million.

Table 4: Revenue from Major Export Commodities

(million USD)

S. No.	Commodity	1998-99	1999-00	2000-01	2001-02	2002-03
1	Gems & jewellery	5,928	7,511	7,396	7,331	8,877
2	Engineering goods	4,378	5,113	6,761	6,960	8,384
3	Textiles (excluding readymade garments)	4,500	5,063	5,725	5,218	5,753
4	Readymade garments	4,364	4,771	5,578	5,024	5,387
5	Chemicals & related products	3,057	3,572	4,260	4,319	4,994
6	Agriculture produce	2,338	2,487	2,735	2,818	2,802
7	Petroleum & crude products	89	30	1,896	2,126	2,428
9	Leather & leather manufactures	1,660	1,592	1,948	1,917	1,792
9	Marine products	1,038	1,184	1,396	1,241	1,385
10	Plastic & linoleum products	472	605	917	991	1,144
11	Iron ore	384	272	358	428	862
	Sub-total	28,208	32,200	38,970	38,373	43,808
12.	Others	5,003	4,560	5,177	5,603	8,562
	Total	33,211	36,760	44,147	43,976	52,370

Source: [CMIE, 2004].

Table 5: Expenditure on Major Import Commodities

(million USD)

S. No.	Commodity	1998-99	1999-00	2000-01	2001-02	2002-03
1	Petroleum crude & products	6,397	12,627	15,676	14,048	17,685
2	Pearls, precious & semiprecious stones	3,759	5,443	4,816	4,638	6,070
3	Electronic goods	2,223	2,800	3,514	3,795	5,358
4	Chemicals and related products	4,492	4,944	3,862	4,469	4,686
5	Gold & silver	5,071	4,712	4,646	4,598	4,245
6	Non-electrical machinery	3,044	2,748	2,713	2,981	3,450
7	Food & related items	2,757	2,655	1,687	2,331	2,646
8	Transport equipment	798	1,138	701	1,153	1,799
9	Coal (including coke & briquettes)	979	1,009	1,105	1,147	1,225
10	Instruments & optical goods	820	846	880	1,045	1,071
	Sub-total	30,340	38,922	39,600	40,205	48,235
11	Others	12,039	10,877	10,456	11,383	13,210
	Total	42,379	49,799	50,056	51,588	61,445

Source: [CMIE, 2004].

In the recent past, the ports in India accounted for about 95% of total export-import traffic in terms of the tonnage, and about 77% in terms of the value of cargo handled [INSA, 2003]. In the year 2001-02, the total tonnage of export-import cargo handled by ports was 207 mt, while airports handled 0.56 mt, and land handled about 11 mt.

In 2002-03, out of the total export-import traffic of 299 mt, POL (crude and product) accounted for the highest tonnage in 2002-03 at 109 mt, of which 71 mt was handled at the major ports and 38 mt at the minor ports. The entire POL is import ('coming into') traffic. POL also accounted for entire transshipment of 11 mt. POL was followed by iron ore at 47 mt, containerized traffic at 44 mt, and coal at 22 mt [IPA, 2003].

2.2 Coastal Traffic

The total coastal cargo was 120 mt in 2002-03. Out of this, 84 mt was handled in the major ports (including 4 mt of transshipment) and 36 mt was handled at minor ports (GMB 20 mt and others 16 mt). The most significant commodity is coal at 33 mt, followed by POL, iron ore, and cement.

Chennai port witnessed the highest coastal cargo of 12 mt, followed by Sikka (8.7 mt), Magdalla (6.9 mt), Cochin (5 mt), and Haldia (4.7 mt) in 2002-03 [IPA, 2003], [GMB, 2003].

Coastal traffic has consistently increased in the last ten years. For example, at major ports, it has increased from 47 mt in 1993-94 to 84 mt in 2002-03.

In India, some of the coastal districts have huge mineral deposits, which offer potential for future coastal traffic. For example, iron ore is found abundantly in Goa, Ratnagiri (Maharastra), Calicut (Kerala), Ongole (Andhra Pradesh) and Cuttack (Orissa). Further, many of the maritime states have proactively directed their industrial location policy to take advantage of coastal transportation.

2.3 Important Commodities at the Major Ports

We analyze commodity-wise traffic at major ports, which constitute 75% of the total port traffic. As shown in Table 6, in 1995-96, POL was the largest commodity handled at 91 mt, followed by iron ore at 35 mt, and then coal at 31 mt. However, since 1996-97, coal has taken the second position. In 2002-03, POL was at 110 mt and coal was at 53 mt. (This is according to CMIE database for all major ports. As per IPA [2003], the respective figure is 47 mt at the major ports and about 8 mt at the minor ports.)

Table 6: Leading Commodities Handled by the Major Ports

(mt)

Year	POL	Fertilizers	Fertilizer Raw Material	Foodgrains	Iron Ore	Coal	Other Cargo	Trans-shipment	Total
1995-96	91	6	4	3	35	31	46	10	215
1996-97	98	3	4	3	33	35	51	12	227
1997-98	104	5	8	3	41	42	49	15	252
1998-99	107	5	8	4	34	43	51	15	252
1999-00	117	6	6	3	36	42	62	21	272
2000-01	108	3	9	2	40	53	65	18	281
2001-02	103	3	10	4	46	50	71	15	288
2002-03	110	3	10	9	51	53	63	15	313

Source: [CMIE, 2004].

As shown in Table 7, among the items 'coming into' at the major ports, in terms of tonnage, POL was the largest commodity followed by coal. Over the years, coal has been increasing. For example, in 1995-96, the total quantity of coal handled at the major ports was 21 mt. This rose to 37 mt in 2002-03.

Table 7: Leading Commodities 'Coming Into' the Major Ports

(mt)

Year	POL	Fertilizers	Fertilizer Raw Material	Foodgrains	Iron and Steel	Coal	All Other	Total
1995-96	64	6	4	0	3	21	23	120
1996-97	71	3	4	1	2	22	25	128
1997-98	74	5	8	2	2	27	23	142
1998-99	79	5	8	2	2	28	27	151
1999-00	84	6	6	2	3	29	33	163
2000-01	77	3	9	0	2	36	32	160
2001-02	76	3	10	0	2	34	34	161
2002-03	82	3	10	0	2	37	35	168

Source: [CMIE, 2004].

As shown in Table 8, among the items 'moving out' of the major ports, in terms of tonnage, iron ore was the largest commodity, followed by POL and coal. In 2002-03, the quantity of POL and coal moving out of the major ports is about the same.

Table 8: Leading Commodities 'Moving Out' of the Major Ports

(mt)

Year	POL	Coal	Iron Ore	Food-grains	Other Cargo	Iron and Steel	Total
1995-96	18	11	34	3	6	1	85
1996-97	17	12	32	3	6	2	87
1997-98	16	14	40	1	6	2	95
1998-99	15	14	34	2	7	1	86
1999-00	13	13	36	1	6	2	88
2000-01	15	17	40	2	6	2	102
2001-02	14	16	45	4	8	2	110
2002-03	17	16	51	8	9	3	130

Source: [CMIE, 2004].

2.4 Coal Movement

In 2002-03, coal (39 mt) moved through ports for consumption in (i) thermal plants (thermal coal), (ii) steel plants (coking coal), and (iii) cement plants and other industries. Coal (16 mt) also moved to ports from mines for coastal transportation. Thus, remaining 23 mt of coal was imported.

As far as the movement of coal to the hinterland is concerned, it is split between coastal shipping, railways, and roadways. Railways are the 'commonly perceived' efficient mode of transport for this purpose.

We summarize the movement of coal, as shown in Table 9 and Table 10 for 1996-97 and 2002-03. The total coal handled at ports has gone up from 39 mt in 1996-97 to 55 mt in 2002-03. The total imports of coal have gone up from 15 mt to 23 mt, with the bulk of the increase being dealt with by GMB ports. The coal carried by coastal route has gone up from 12 mt to 16 mt.

Table 9: Coal Movement in 2002-03

(mt)

		Major Ports	Minor Ports		Total
			GMB	Others	
Coming Into	Export-Import	15	8	-	23
	Coastal	16		-	16
Moving Out	Export-Import	-	-	-	-
	Coastal	16	-	-	16
Total		47	8	-	55

Source: [IPA, 2003]

Table 10: Coal Movement in 1996-97

(mt)

		Major Ports	Minor Ports		Total
			GMB	Others	
Coming Into	Export-Import	13	2	-	15
	Coastal	12	-	-	12
Moving Out	Export-Import	-	-	-	-
	Coastal	12	-	-	12
Total		37	2	-	39

Source: [TRW, 2000]

The imported of coal at major ports is almost entirely coking coal for the steel plants. The imported coal at GMB ports is almost entirely thermal coal for the Gujarat based thermal power stations. This import has been on the rise with the relaxation of import norms for thermal coal. The coastal movement is almost entirely thermal coal from the coal mines to the Tamilnadu based thermal power stations.

As seen in Table 11, coal is one of the major commodities handled at ports, based on import and coastal movement. It's loading and unloading is important from the point view of 'turn around time' of ships, storage requirements, and evacuation to the hinterland.

3. Indian Railways

IR is the largest railway system under single management in the world. Daily, it departs (on an average) 8,520 passenger trains and 550 loaded freight trains. At any time, there are about 2,700 freight trains on the IR (both on the move and at originating/terminating yards), of which about 1,700 trains are loaded and about 1,000 trains are empty [FOIS, 2004]. At any given point in time, 750 trains are on the move over 63,028 kilometers of network [CMIE, 2004].

Table 11: Share of Coal at Major Ports

(%)

Year	'Coming into'	'Moving out'	Total Traffic
1995-96	17.28	12.35	14.55
1996-97	17.54	14.15	15.34
1997-98	19.33	15.04	16.62
1998-99	18.71	16.56	16.99
1999-00	17.88	15.14	15.63
2000-01	22.45	16.91	18.98
2001-02	21.32	14.27	17.45

Source: [iMaritime, 2003].

3.1 Passenger versus Freight

The two major sources of revenue for IR are passenger and freight. Earnings from freight traffic have always surpassed that from passenger movement. At present, the ratio is about 2.1:1 in favor of freight traffic. Table 12 presents the traffic performance of IR, giving the originating traffic, the transport effort (net tonne kilometers (NTKM) and passenger kilometers (PKM)), and revenues.

Table 12: Comparison of Freight and Passenger Traffic on Indian Railways

Year	Freight Traffic			Passenger Traffic			Ratio of Revenues
	Qty mt	NTKM billion	Revenues[3] Rs billion	Nos million	PKM billion	Revenues[1] Rs billion	
1995-96	391	270	153	4,061	342	61	2.5
1996-97	409	278	167	4,216	358	66	2.5
1997-98	429	284	199	4,418	381	76	2.6
1998-99	421	281	200	4,469	405	85	2.3
1999-00	456	305	221	4,641	431	96	2.3
2000-01	474	312	233	4,840	458	105	2.2
2001-02	493	333	248	5,169	494	112	2.2
2002-03	519	357	265	5,022	485	127	2.1

Source: [CMIE, 2004]

As per the budgeted estimate (BE) for the year 2002-03, IR carried more than 5,022 million passengers and 519 mt of traffic. In the same year, it earned Rs 265 billion from freight operations and Rs 127 billion from passenger operations. Figure 2 shows the growth of passenger and freight earnings on IR.

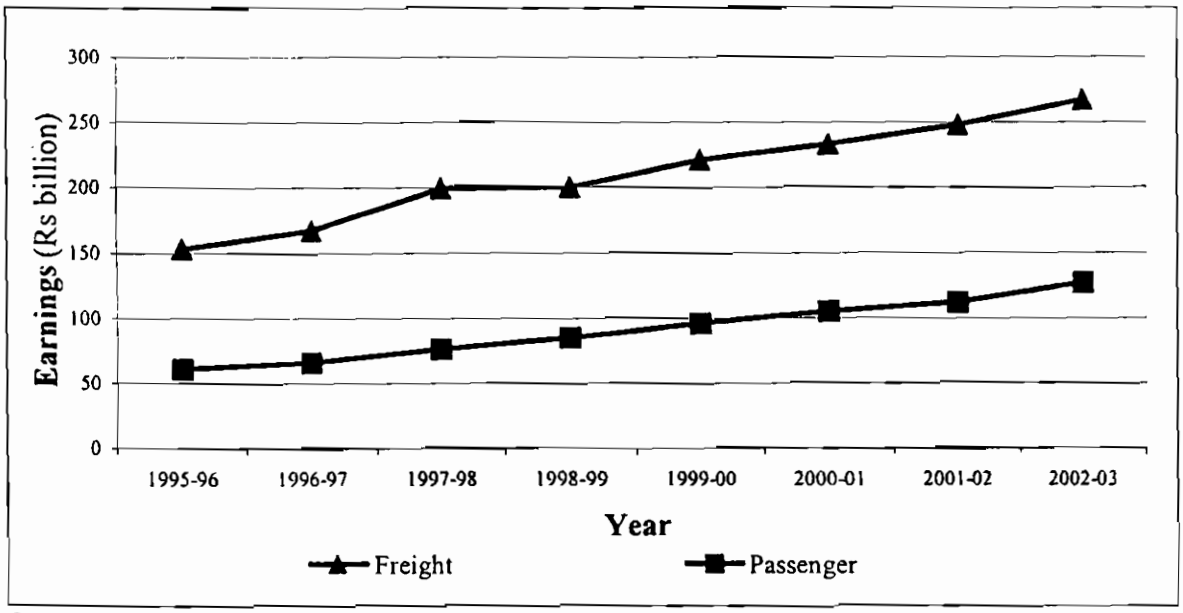
3.2 Profile of Freight Traffic

As seen in Figure 3 and Figure 4, the top seven commodities carried by IR account for nearly 90% of the traffic both in tonnage and revenue. Coal is the largest commodity whose share has remained more or less constant at about 46% in tonnage and a similar share of freight revenue. Coal is followed by cement, which is about 9% of the tonnage and

[3] Rs. 45.00 ≈ 1.00 USD, at current prices.

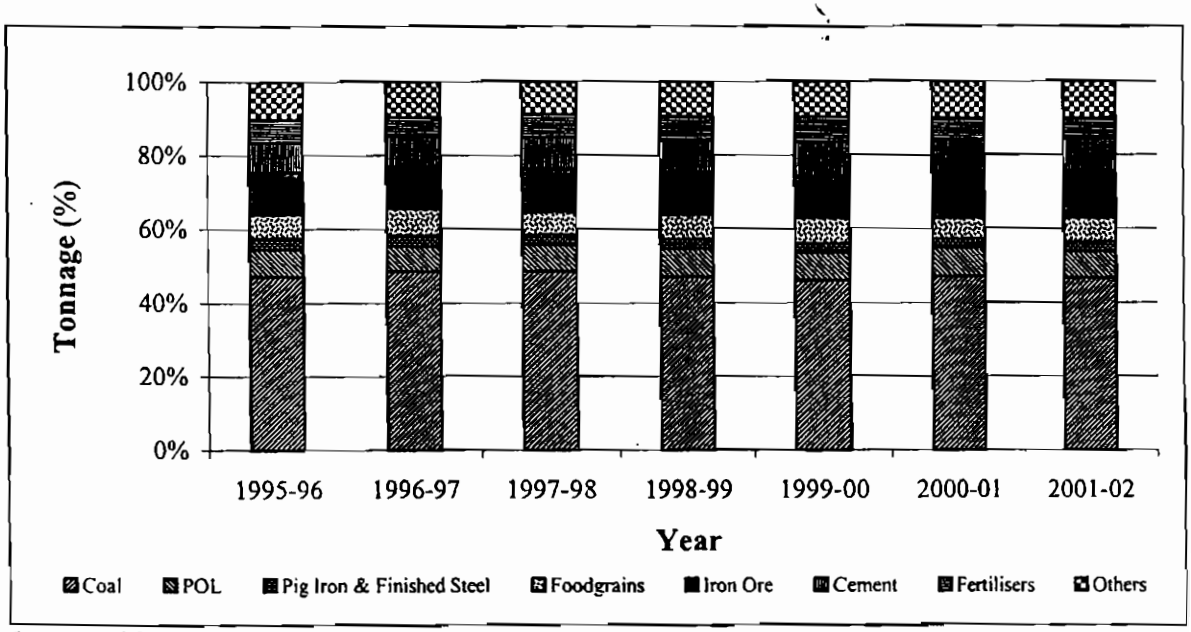
7% of freight revenue. POL accounts for 7% of tonnage, while in terms of earnings it brings 11% of freight revenue for IR.

Figure 2: Growth in Earnings of IR: Passenger and Freight Traffic



Source: [CMIE, 2004]

Figure 3: Share of Major Commodities in Tonnage Carried by IR



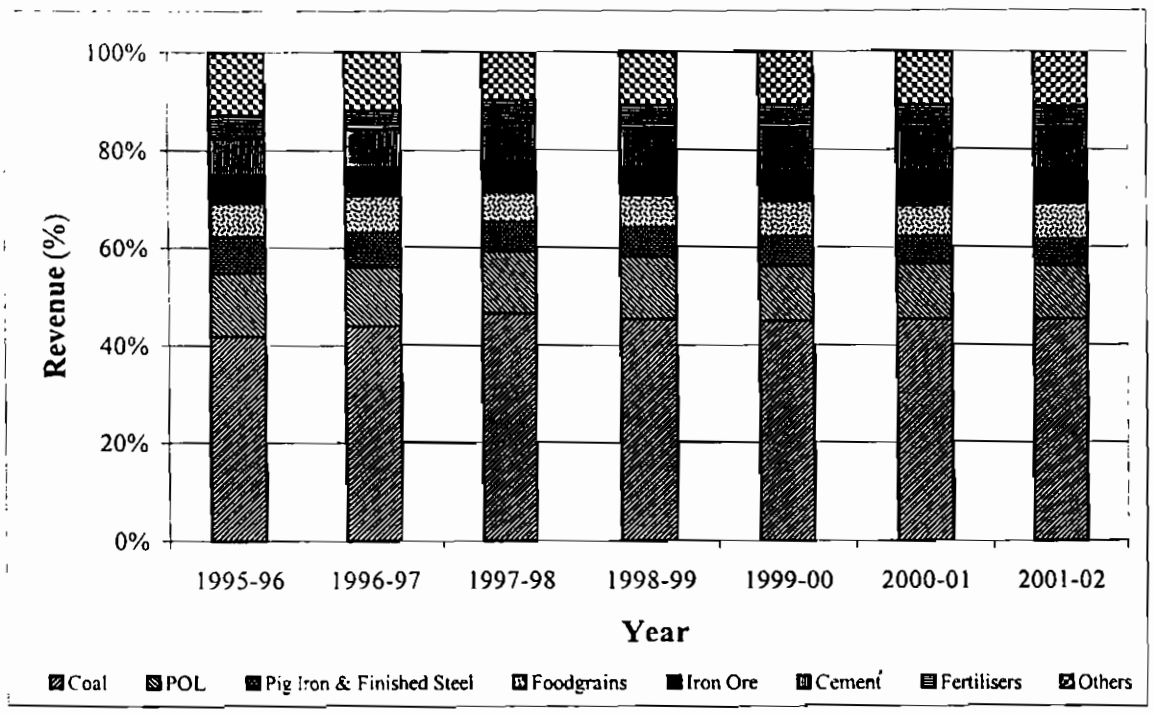
Source: [CMIE, 2004]

3.3 Coal Movement

As shown in Table 13, IR handled about 230 mt of coal during 2001-02. The shares of coal in terms of tonnage, NTKM, and earnings are more or less the same indicating that coal is an 'average' commodity, both in terms of distance moved and freight per tonne.

The share of coal has been steady over the recent past, indicating that the growth in coal traffic and overall traffic have kept pace with each other.

Figure 4: Share of Major Commodities in Freight Revenue of IR



Source: [CMIE, 2004]

Table 13: Coal on IR

Year	Tonnes Originating		NTKM		Revenues	
	million	%	billion	%	Rs billion	%
1995-96	184	47.21	112	41.40	64.06	42.78
1996-97	198	48.45	119	42.90	73.22	44.77
1997-98	209	48.62	128	44.86	92.45	47.18
1998-99	198	46.94	122	43.26	90.51	46.00
1999-00	210	46.00	127	41.54	99.30	45.64
2000-01	224	47.24	133	42.72	105.52	45.79
2001-02	230	46.67	141	42.34	112.41	45.72

Source: [IR, different years].

In India, thermal power plants are the largest consumers of coal, accounting for about 70% of total coal consumption, followed by steel plants (about 10.3%) and cement plants (about 4.5%) [iMaritime, 2003]. As shown in Table 14, the revenue for IR from carriage of coal for thermal power plants has steadily increased from Rs 45.75 billion in 1995-96 to Rs 93.70 billion in 2003-04.

3.4 IR-Port Interface for Coal Movement

It can be observed from Table 15 that in 2002-03, six out of thirteen major ports namely, Haldia, Paradip, Visakhapatnam, Chennai, Ennore, and Marmagoa handled about

98.38% of total coal at major ports in India. No coal is handled at JNPT and Mumbai ports. It can also be observed that IR carried the major component of this coal to and from the hinterland locations. For example, in 2002-03, 95% of coal at Paradip and Visakhapatnam and 92.5% of that of Haldia was handled by IR. In the remaining three ports, this percentage varied from 60% to 75%. The remaining coal at Ennore is consumed at the coastal thermal power plant and is carried on conveyor belts. At Chennai and Marmagoa, the remaining coal moves by road for industrial and retail use.

Table 14: Railway Revenue from Different Types of Coal Movement

(Rs billion)

Year	Total Freight	Coal				
		Steel Plants	Washeries	Thermal Power	Other Public	Total
1995-96	152.90	5.17	0.24	45.74	12.91	64.06
1996-97	166.68	5.37	0.30	52.06	15.49	73.22
1997-98	198.66	6.01	0.33	68.86	17.25	92.45
1998-99	199.60	6.03	0.32	68.08	16.08	90.51
1999-00	220.61	6.44	0.25	76.85	15.76	99.30
2000-01	233.05	6.24	0.24	82.39	16.65	105.52
2001-02	248.45	7.10	0.17	88.47	16.68	112.41
2002-03	266.58	7.74	0.19	91.05	15.42	114.41
2003-04	278.15	8.16	0.19	93.70	16.36	118.41

Source: [CMIE, 2004].

IR's transport effort for coal in NTKM has grown at a rate slower than the growth rate of coal handled at the ports. For example, in 1996-97, IR generated 119 billion NTKM on account of total coal traffic that rose to 141 billion NTKM in 2001-02, indicating an increase of 1.18 times over 1996-97. The total coal handled at the major ports increased from 37 mt to 47 mt in the same time period, indicating an increase of 1.27 times over corresponding base.

The primary reasons for this relatively lower growth of NTKM as compared to the total quantity handled are: (i) The thermal power plants are gradually increasing use of imported coal as fuel due to high calorific value, and low ash and sulphur content as compared to the domestic coal. This reduces both quantity carried by IR and average lead. (ii) There is a definite move to set up more pit-head power plants to minimize transportation and handling costs. Additionally, coastal movement of coal from Haldia to Ennore for thermal power plants in Tamilnadu has adversely affected the quantity of coal carried by IR. (Box 1).

These two business decisions are affecting and leading to lower than expected growth of NTKM of coal carried by IR. The overall share of rail for major port based coal traffic is 84%, down from 88% two years ago, as seen in Table 15. (In terms of all port based commodities, LEA [2004] estimates that the share of IR is 30%).

While transport mode-wise market share of port based traffic necessary for evolving strategies for transportation, there are some conceptual issues involved in the measurement of modal split, as explained in Box 2.

Table 15: Rail Share of Coal Traffic at the Major Ports

(mt)

Year	Ports	Haldia	Paradip	Visakha-patnam	Ennore	Chennai	Tuticorin	Marmagoa	Kandla	Total	GMB
2000-01	Coal Import	4.33	1.69	5.79	-	14.99	-	1.58	0.62	29.01	6.74
	Rail Share	3.74	1.48	5.94	-	11.39	-	1.23	0.03	23.80	
	% by Rail	86.38	87.46	102.50	-	76.00	-	77.55	4.33	82.05	
	Coal Export	3.67	8.21	5.40	-	-	-	-	-	17.28	
	Rail Share	2.96	8.31	5.43	-	-	-	-	-	16.70	
	% by Rail	80.43	101.28	100.59	-	-	-	-	-	96.64	
	Total Coal	8.01	9.90	11.19	-	14.99	-	1.58	0.62	46.29	
	Total Rail Share	6.70	9.79	11.37	-	11.39	-	1.23	0.03	40.50	
	% Total by Rail	83.67	98.92	101.58	-	76.00	-	77.55	4.33	87.50	
2001-02	Coal Import	4.45	1.45	6.21	3.40	9.76	0.68	2.53	0.34	28.82	7.28
	Rail Share	3.85	1.41	6.20	0.65	8.20	0.51	2.02	0.00	22.84	
	% by Rail	86.37	97.38	99.92	19.11	84.00	75.37	79.58	0.00	79.24	
	Coal Export	2.93	8.95	3.92	-	-	-	-	-	15.80	
	Rail Share	3.22	8.97	3.95	-	-	-	-	-	16.13	
	% by Rail	109.84	100.31	100.56	-	-	-	-	-	102.14	
	Total Coal	7.38	10.40	10.13	3.40	9.76	0.68	2.53	0.34	44.62	
	Total Rail Share	7.06	10.39	10.15	0.65	8.20	0.51	2.02	0.00	38.97	
	% Total by Rail	95.68	99.90	100.17	19.11	84.00	75.37	79.58	0.00	87.35	
2002-03	**Coal Import**	**4.94**	**1.87**	**6.76**	**8.49**	**5.80**	**0.51**	**2.44**	**0.25**	**31.06**	**7.69**
	Rail Share	4.38	1.66	6.75	5.28	4.10	0.38	1.71	0.07	24.33	
	% by Rail	88.66	88.71	99.88	62.23	70.67	74.12	70.14	27.17	78.33	
	Coal Export	**3.38**	**9.74**	**3.20**	-	-				**16.32**	
	Rail Share	3.32	9.39	2.73	-	-				15.44	
	% by Rail	98.19	96.38	85.39	-	-				94.60	
	Total Coal	**8.32**	**11.61**	**9.96**	**8.49**	**5.80**	**0.51**	**2.44**	**0.25**	**47.37**	
	Total Rail Share	7.70	11.05	9.48	5.28	4.10	0.38	1.71	0.07	39.76	
	% Total by Rail	92.54	95.14	95.23	62.23	70.67	74.12	70.14	27.17	83.93	

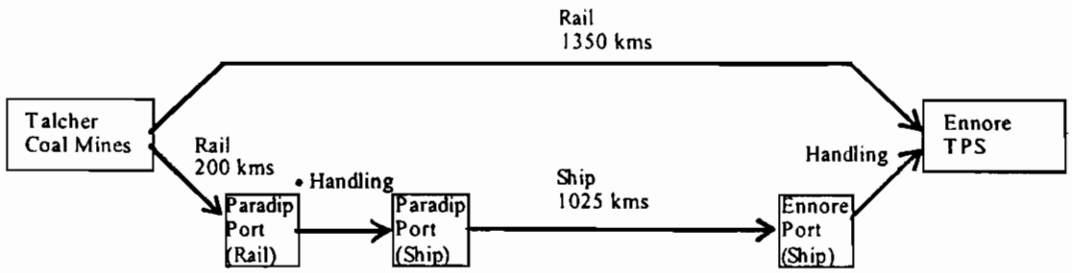
- Share is more than 100% due to mismatch between inward and outward movements. Mismatches may also exist when the share is less than 100%.

Source: 1. [IR offices dealing with respective ports].
2. The 'total' data for Haldia is from the IPA [2003].
3. GMB data is from GMB [2003].

BOX 1
Economics of Coastal Shipping

In case of carriage of coal over long distances, at one level, railways and coastal shipping complement each other. At another, they compete with each other. Figure 5 provides an example. As one option, coal can move from Talcher mines in Orissa to Ennore Thermal Power Station (TPS) end to end by rail. As another, coal from the mines is brought to Paradip port by railways. This coal is then loaded on ships and taken to Ennore port and unloaded. It is then carried on conveyor belts to the Ennore TPS.

Figure 5: Coal Movement (End-to-End by Rail versus Rail-cum-Coastal)



The economics for the movement from Talcher to Ennore TPS is shown in Table 16.

Table 16: Comparative Cost Structure for Coal Transport

	Source	Destination	Distance (km)	Mode	Costs (Rs/ton)
End-to-End by Rail	Talcher	Ennore TPS	1350	Rail	384
Rail-cum-Coastal	Talcher	Paradip Port (Rail)	200	Rail	65
	Paradip Port (Rail)	Paradip Port (Ship)		Handling	24
	Paradip Port (Ship)	Ennore Port (Ship)	1025	Ship	34
	Ennore Port (Ship)	Ennore TPS		Handling	93
	Talcher	Ennore TPS		Total	216

The end-to-end rail movement does not include costs for setting up or upgrading railway infrastructure on the segments which are not common with the rail cum coastal movement. On the Paradip-Ennore route, the economies of scale did not apply to ship size in the considered range of 30,000 to 70,000 tons per shipment. The development costs at Paradip port are shared by all coal shipments other than just for Ennore TPS. This is reflected in the handling costs at Paradip. The rail cum coastal movement would require additional inventory to the tune of one mt for an eight mtpa throughput. Valuing this at Rs 350/ton which is the landed cost of coal at Ennore, the inventory carrying cost at 12 % pa works out to Rs 42 million pa. For a throughput of eight mtpa, this works out to Rs 5.2/ton which is not significant in the context of the transportation cost.

Source: 1. [ADB, 1992]
2. [Frederic R. Harris Inc. 1997]
3. [Haskoning, 1989]

BOX 2

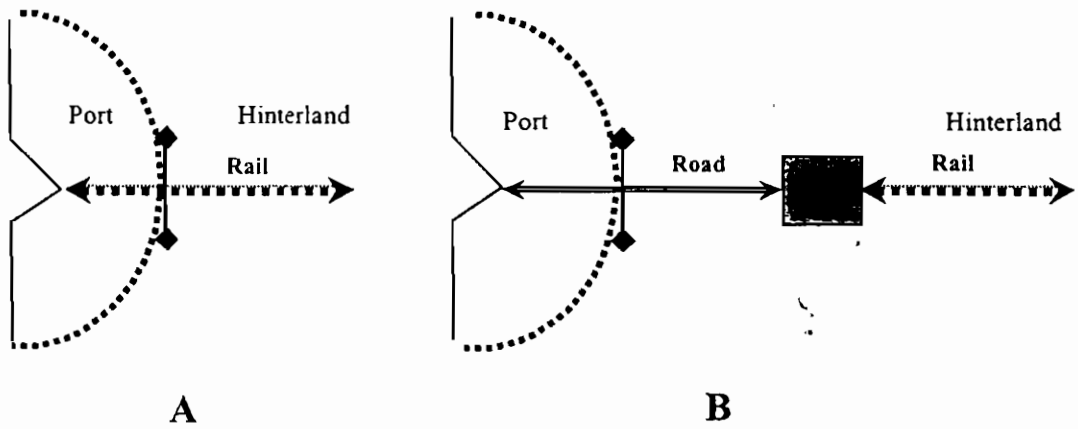
Conceptual Issues in Measurement of Rail-Road Modal Split

There are some basic issues in measurement of modal split of carriage of coal (or any commodity) based on port data because the ports report the mode that was used to evacuate the commodity through its gates.

As shown in Figure 6(A), if the same carrier (say rail) is used from/to the hinterland origin/destination through the port gates, then there is no ambiguity about the carrier used for evacuation of the commodity. However, as shown in Figure 6(B), the port reports that the commodity is carried by road, while in reality, road is used only for taking out the commodity through the port gates, while the 'real' long distance movement is by rail! This creates an ambiguity and needs to be recognized while reporting modal shares.

In the case of POL, at some places, evacuation takes place by pipeline to a few hundred kilometers and then rail carries it to the hinterland locations.

Figure 6: Movement Between a Port and Hinterland



4. A Study of Thermal Coal Requirement in Gujarat State

Gujarat is one among most prosperous and industrially developed states in India. Gujarat state has five coal based thermal power plants located at Ukai (850 MW), Sikka (240 MW), Wanakbori (1470 MW), and Gandhinagar (870 MW), under Gujarat Electricity Board (GEB), and Ahmedabad (550 MW), under Ahmedabad Electricity Company (AEC), a private limited company. In addition to these coal based power plants, Gujarat has a lignite based power plant at Kutch (215 MW), gas and LSHS based power plant at Dhuvaran (534 MW), and a gas based power plant at Utaran (135 MW). Gujarat also has hydro power plants at Ukai (305 MW) and Kadana (277.55 MW) [GSEB, 2004].

As shown in Table 17, until 1998-99 all these thermal power plants relied completely on Indian coal. In 1999-2000, AEC started with some imported coal, followed by all the plants in 2000-01, except Sikka. The usage of imported coal, which has better calorific value, and low ash and sulphur content, started increasing after liberalization of coal imports. However, due to technological constraints of the thermal power plants, effective substitution of domestic coal by imported coal is limited.

This change in fuel has led to changing pattern of traffic. For example, AEC, Ahmedabad received its coal from the eastern parts of India (especially, Madhya Pradesh). The railway siding was designed accordingly. Now, with the sourcing of coal from Australia via the port of Navlakhi, the operation of the coal siding has become

cumbersome. This is because the ports of Gujarat are located on the western side of the state and sidings were designed for coal movement from the eastern side.

Table 17: Domestic and Imported Coal at Thermal Power Plants in Gujarat

(mt)

Year	Ukai 850 MW		Wanakbori 1470 MW		Sikka 240 MW		GEB Gandhinagar 870 MW		AEC Ahmedabad 550 MW	
	Indian	Imported	Indian	Imported	Indian	Imported	Indian	Imported	Indian	Imported
1995-96	3.21	0.00	4.39	0.00	0.91	0.00	0.35	0.00	1.56	0.00
1996-97	3.14	0.00	4.76	0.00	1.08	0.00	0.26	0.00	1.67	0.00
1997-98	3.43	0.00	5.76	0.00	1.16	0.00	0.29	0.00	1.66	0.00
1998-99	3.13	0.00	6.03	0.00	2.52	0.00	0.34	0.00	1.62	0.00
1999-00	3.11	0.00	7.13	0.00	6.18	0.00	0.31	0.00	1.27	0.22
2000-01	3.70	0.13	6.66	0.34	6.63	0.00	0.26	0.04	1.00	0.46
2001-02	3.43	0.21	6.36	0.91	7.95	0.00	0.20	0.10	0.92	0.64
2002-03	3.58	0.45	7.17	0.81	7.44	0.00	0.24	0.10	0.81	0.82

Source: [IR offices dealing with respective thermal power plants].

Table 18 gives port-wise coal traffic into GMB ports. The entire coal is imported for use by the various thermal power plants. Imported coal for Ukai is primarily serviced via Magdalla, Wanakbori via Sikka and GAPL, GEB Gandhinagar via GAPL, and AEC Ahmedabad via Navlakhi.

Table 18: Coal Traffic at GMB Ports

(mt)

S. No.	Ports	2000-01	2001-02	2002-03
1	Navlakhi	1.57	1.64	1.07
2	Bedi	0.03	0.19	0.27
3	Sikka	0.90	0.07	0.13
4	Jafrabad	0.12	0.21	0.52
5	Okha	0.61	0.52	0.73
6	Bhavnagar	0.00	0.02	0.06
7	Porbandar	0.11	0.49	0.53
8	Magdalla	1.09	0.88	0.85
9	Muldwarka	0.46	0.43	0.56
10	Dahej	0.36	1.22	1.36
11	GPPL	0.84	0.61	0.63
12	GAPL	0.63	1.00	0.97
13	Veraval	0.03	0.00	0.00
	Total	6.74	7.28	7.69

Source: [GMB, 2003]

5. Prominent Issues in Coal Transport for IR

During the discussions with coal users and port authorities, it clearly emerged that the mode choice for carrying coal from and to the hinterland is typically based on: (i) lead to/from port, (ii) freight rates, (iii) volume per shipment, (iv) availability of wagons, and (v) services at the customer interface.

The lead is influenced by sourcing of coal. Import of thermal coal is expected to increase due to usage by more thermal power plants, at least up to the technological limits. This would increase leads as more hinterland power stations change their fuel mix. The same would be true for coking coal and public coal for cement plants and other industrial use. Longer the lead, greater the opportunity for rail movement.

The freight rates are influenced by the routing. Some of the ports, especially those in Gujarat cannot access their potential hinterland market by the shortest possible route, either due to lack of uniform gauge connectivity or due to bottlenecks in specific segments.

Depending on the use and user, coal is not always required in full trainloads. Unless there are appropriate stocking points and forwarders who can consolidate demand, such coal may naturally move by road.

Availability of wagons as per the customer's requirements is an important determinant of rail movement. Cement industry has increasingly moved in favour of road transportation due to the availability of high capacity trucks and the not so easy availability of covered rail wagons for their cement distribution. This has a consequential impact in their using the same trucks for bringing in coal to the cement plants.

The customer interface, and the settlement process of IR is not as friendly as it is in road transport. In roadways, the liability of the material lies entirely with the carrier of the goods. Whenever IR does assume liability of the goods, the claim settlement process is highly cumbersome. The customer is often more comfortable by accepting the loss rather than seek compensation from IR.

Other emerging modes of transport like coastal shipping and coal-oil slurry pipe lines pose threats to IR. The cost advantage of coastal shipping is presented in Box 2. Figure 7 shows a schematic of how long land leads from the coal mine area to the coal consuming points could be reduced to short leads to and from ports due to the potential use of coastal shipping. These shorter leads are also potential opportunities for IR, if the port interfacing is right.

Location of new industries in a manner that reduces land lead is also a threat to IR. Pit-head and coastal thermal power plants are specific examples. Merry-go-Round based rail transportation could be an opportunity here.

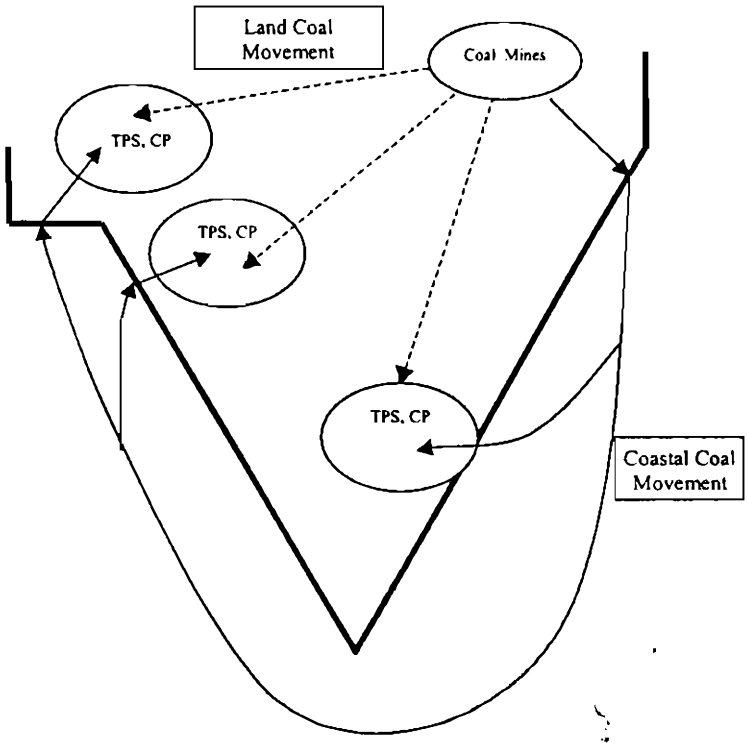
6. Conclusions and Strategic Imperatives for IR

This paper is a diagnostic study to identify the issues that IR needs to be aware of to improve their market share of port based coal traffic. The study has provided certain strategic imperatives for IR.

As shown in Table 15 and Table 13, in 2000-01, port based originating traffic of coal accounted for about 45 mt (39 mt in the major ports and 6 mt in the minor ports – almost entirely GMB) out of total coal movement by IR of 230 mt. In terms of market share of the major port based coal, an 87% share in 2001-02 declined to 84% in 2002-03. IR is a significant player in moving port based coal, but it needs to put efforts to sustain its place.

Patterns of coal movement are changing due to imports and coastal movement. IR needs to develop a deeper understanding of various market segments, and their preferred supply chains, driven both by use and sourcing of coal, to enable proactive action.

Figure 7: Impact of Coastal Shipping on Land Leads



TPS =Thermal Power Stations
CP = Cement Plants

The Government of India is working on an ambitious (Rs 1000 billion) project to improve maritime infrastructure, called 'Sagarmala'. As part of this initiative, Rs 550 billion is expected to be spent on ports, Rs 160 billion on inland waterways, and Rs 100 billion on coastal shipping [MOST, 2003]. IR needs to take advantage of this by proposing projects under 'Sagarmala' that would improve port-rail interface in areas like, handling, storage, information processing, and in rail infrastructure that would help evacuation like appropriate railway sidings at ports, adequate railway capacity along the evacuation route etc. For example conversion and doubling projects between Kandla and Delhi/Punjab would improve the performance of ports in this region.

The rail access from or between ports and major traffic origins/destinations in the hinterland needs to be streamlined, with appropriate capacity. Gauge conversion, doubling of tracks, improved signaling for higher speeds, and streamlining terminal/siding operations would be essential. The gauge conversion that provided access to Navlakhi port and the siding access to GAPL are recent examples of steps in the right direction.

Flexibility in wagon allotment and usage is critical to making wagons available as per customer requirements. Research and development efforts need to be under taken. A specific example would be to design a dual purpose wagon which could serve the purpose of both a covered and an open wagon, for use by different commodities in a complimentary manner.

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