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Abstract

The share of coastal shipping in the modal mix of domestic freight transportation in India is currently very low despite it being more cost-effective, fuel-efficient and environment-friendly compared to other modes of transportation. This paper estimates the benefits of coastal shipping, which are simply the costs avoided by transporting goods via sea as opposed to transporting them by road or rail. The economic, environmental and social benefits of coastal shipping are valued in the range of Rs. 16 – 64 billion per annum in 2012-13 prices. In physical terms, greenhouse gas emissions reductions amount to between 1 – 22 lakh tonnes of carbon per annum. The lower- and upper-bound values in the range represent cost savings (or emissions reductions) with respect to rail and road transport respectively. The results indicate that the country would stand to gain from a modal shift in freight transportation from road and rail transport to coastal shipping.

Keywords: *Coastal shipping; Freight transport; Cost savings; Transport policy*
JEL Codes: *L91; Q57; R40*

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INTRODUCTION

Waterways play an important role in the transportation of goods and people across the world and are thus crucial to the development of a country's industry, trade and economy. While 90 percent of world trade is carried by the international shipping industry[1], domestic freight is usually transported by different modes, including road, rail, water, air and pipelines. As such, domestic shipping (i.e. coastal shipping and inland waterways) is but one alternative in a country's modal mix of domestic freight transport, although the advantages of domestic shipping compared to other modes of transportation are manifold. It is well acknowledged that coastal shipping provides significant benefits over road and rail transport, including:

a. lower costs – the cost of transporting bulk goods by coastal shipping is about 20 percent of that of road transport and about 30 percent of that of rail transport[2];
b. lower consumption of fuel per tonne of cargo – fuel consumption by coastal shipping is 4.83 grams per tonne-kilometre, which is 15 percent of consumption by road and 54 percent of that by rail (KPMG, 2014);
c. lower carbon dioxide emissions – carbon dioxide emissions from rail transport is roughly twice as that from coastal shipping and about six times that from road transport (NTDPC, 2014)[3]; and
d. lower traffic congestion and lower rate of fatalities – the modal shift to coastal shipping helps reduce traffic on already congested roads. Moreover, road and rail movement result in significant loss

[1] From the International Chamber of Shipping. See http://ics.purestonedev.co.uk/shipping-facts/key-facts

[2] Based on the per kilometre transportation cost of road being Rs. 1.50, rail being Rs. 1.00 and waterways being Rs. 0.30. See http://www.thehindu.com/news/cities/mumbai/business/govt-plans-major-boost-to-water-transport/article8105069.ece

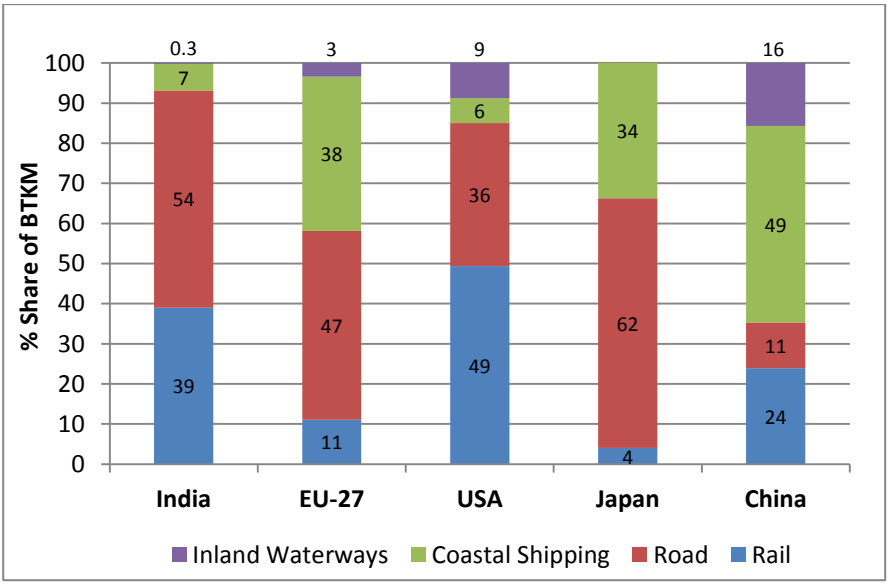
[3] Based on carbon dioxide emissions for ships (container – 10,000 TEU) being 10 g/tkm, rail (diesel train) being 21 g/tkm and truck (tractor/trailer) being 59 g/tkm (see NTDPC, 2014).

of lives in India. It was estimated that one life was lost in a road accident every 3.7 minutes in India in 2011[4].

Despite being a cost-effective, fuel-efficient and environment-friendly mode of transportation, domestic shipping has a significantly lower share in the modal mix of domestic freight transport in India compared to other developed and emerging countries. Coastal shipping accounts for only 7 percent of freight transport in India, whereas the share of coastal shipping in Japan and the EU is roughly five to six times higher, and the same is about seven times higher in China, a fellow developing country (see Figure 1). The share of coastal shipping in the USA is slightly lower than that of India, however the share of inland waterways is significantly higher in the USA (9 percent) compared to India (0.3 percent). The share of freight transport by inland waterways is even higher in China at 15 percent. Water-based transportation of domestic freight, comprising of both coastal shipping and inland waterways, is approximately nine times higher in China, six times higher in the EU, five times higher in Japan and twice as high in the USA compared to India.

[4] From 'Road accidents in India: Issues & dimensions', Ministry of Road Transport and Highways, Government of India. See http://www.unescap.org/sites/default/files/2.12.India_.pdf

Figure 1: Comparison of Modal Mix of Domestic Freight Transport across Different Countries (in Percentage Share of Billion Tonne Kilometres)



Notes: Share estimated excludes air and pipelines. The most recent official data for India is available for the year 2007-08, which is used here; hence, data for corresponding years for all other countries is used, i.e. 2007 for EU-27, USA and China, and 2008 for Japan.

Source: India: TTS-RITES; EU-27: European Commission (2009); USA, Japan and China: European Commission (2010).

The share of coastal shipping in domestic freight transportation in India remained at 3 percent between the time period 1978-79 to 1986-87, however the same more than doubled to 7 percent over the twenty-year period between 1986-87 to 2007-08 (TTS-RITES). Currently, India's fright transport relies heavily on roads, and road and rail transport account for over 93 percent of total domestic freight transport. India's reliance on roads is almost five times more than that of China (see Figure 1). This is despite the fact that India has a long peninsular coastline and that a large part of its freight traffic comprises of bulk goods that have to be transported over long distances, which as noted above can be more economically served by coastal shipping. Given that there are significant

gains to be had in terms of costs saved and damages avoided by transporting goods via sea rather than by other (land-based) modes of transportation, the aim of this paper is to estimate the benefits of coastal shipping in India in terms of the economic and environmental costs saved with respect to road and rail transport. Large cost savings would imply that the country would benefit from a modal shift in domestic freight transportation, i.e. from road and rail transport to coastal shipping. This would in turn lead to an increase in the share of coastal shipping in the country's modal mix of domestic freight transportation. Thus, this paper analyses the benefits of coastal shipping as a potentially suitable alternative mode of domestic freight transportation in India. The rest of the paper is organised as follows: section 2 discusses the methodology used to estimate the benefits of coastal shipping in India; section 3 discusses the data used in the analysis; and the final section discusses the results, and concludes.

METHODOLOGY

The benefits of coastal shipping are valued by using the avoided cost method, which estimates the costs of transportation that would have been incurred in the absence of the sea (and thus, in the absence of coastal shipping). In other words, the benefits of coastal shipping are the costs avoided by transporting goods via sea as opposed to transporting them by alternative modes of land–based transportation such as road or rail.

The benefits of coastal shipping as an alternative means of transportation are estimated in the following manner –

$$V_{Si} = \sum_{zjk} \left(\left(D_{iz} \times C_{ijk} \times T_{Szj} \right) - \left(D_{Sz} \times C_{Sjk} \times T_{Szj} \right) \right) \quad (1)$$

where,

V_{Si} are the benefits of coastal shipping, *S*, in terms of the costs saved with respect to *i*, the alternate mode of transportation;

i is the mode of transport other than shipping. Only the two major modes of freight transportation namely road and rail transport are considered as alternatives in this exercise;

z represents a pair of maritime zones across which goods are transported, from one zone to another. There are twelve maritime zones and forty eight pairs of maritime zones over which goods have been transported in 2012-13 (more on this in the next section);

j is the type of commodity being transported across maritime zones (e.g. Petroleum Oil and Lubricants (POL), cement etc.). Transportation costs tend to vary by the type of commodity being transported both within and across the different modes of transportation, which is taken into account here. Moreover, different commodities are transported via specific routes only depending on the demand and supply of the same;

k is the category of cost being estimated. Economic and environmental costs are considered in this exercise;

D is the distance in km between a representative port in one maritime zone and another. Note that transportation routes and thus distances will vary by the different modes of transportation for the same *z*;

C is the cost in Rupees per tonne-km by commodity. Costs vary not only by the type of commodity being transported but also by the distance travelled in some cases (road transport) as well as other specifics of the route (type of terrain- *ghat*/plain, type of road- national highway/other, type of track- single line/double line etc.) and the mode of transportation itself (whether diesel or electric traction etc.; more on this in the subsequent section); and

T is the tonnes of goods of various kinds that are transported by coastal shipping between the different maritime zones.

Looking at the right hand side of equation (1), the first part estimates what it would cost to transport goods actually transported by coastal shipping by another mode of transportation, and the second part estimates what it costs when they are transported by coastal shipping.

Thus, the difference between the two are the costs saved by transporting goods via coastal shipping compared to another mode of transportation, i.e. the benefit derived. Since costs saved over two alternate modes of transportation, namely road and rail, are estimated, two values for V_{si} are obtained which gives a range of values for the benefits of coastal shipping.

DATA

The Planning Commission's Total Transport System Study (TTS-RITES) has worked out the economic and environmental costs (in terms of Rupees per Tonne-Km) incurred by different modes of transport including coastal shipping, road transport (highways) and rail transport. The economic costs of transportation comprise of fixed capital costs (including ground facilities, ports, highways, tracks, terminals, workshops etc.), moving capital costs (including rolling stock, vehicles, vessels, trains, equipment at terminals and workshops etc.) and operating and maintenance costs (including fuel expenses, repair and maintenance, running costs, salaries, insurance etc.). Economic costs are nothing but the financial costs that have been adjusted for transfer payments, taxes and subsidies using a shadow pricing factor. Economic costs for coastal shipping are only available for commodities commonly transported by this means of transportation. These include iron ore, POL (product and crude), coal, cement and others (including containers). Thus, although economic costs for railways, primarily, and road transport are available for commodities other than those listed above, averages over respective commodity groups have been taken to represent the commodity-wise economic costs as per the coastal shipping classification of commodities. For railways, TTS-RITES also estimated economic costs on the basis of the type of terrain (whether traversing a plain section or a *ghat* section), type of train traction (whether diesel or electric) and the type of railway line (whether single or double). For the purpose of this study average values over all these categories have been used for each commodity group due to lack of information on the specifics of each journey. For

road transport, other than the usual commodity-wise cost estimates, TTS-RITES also estimated costs on the basis of terrain (whether plain, rolling or hilly), road type (national highway, state highway or major district road) and the number of lanes (single, double, four, intermediate and four lane expressway). In addition economic costs were also estimated on the basis of the distance travelled (i.e. distance slab-wise cost). Since almost all road journeys across maritime zones involve travel on national highways, commodity-specific economic costs for national highways (averaged across the other two categories- terrain and number of lanes) that corresponded to the distance range in question (i.e. range into which the actual road-distances between representative ports falls into) were used for the analysis. All unit costs as reported in TTS-RITES correspond to 2007-08 prices and were converted to 2012-13 prices using a GDP deflator (annual percentage, base year is 2004-05), data for which was obtained from the World Bank's World Development Indicators Database (available online). The commodity-wise economic costs of the three modes of transportation considered in this analysis are presented in Table 1. It is evident that the unit economic costs of road transport are the highest and those of coastal shipping, the smallest, across all commodity groups.

Table 1: Commodity-Wise Economic Costs of Different Modes of Transportation in Rupees per Tonne-Km (2012-13 prices)

Commodity Group	***Coastal Shipping***						
Iron Ore	0.094						
POL Product	0.497						
POL Crude	0.271						
Coal	0.287						
Cement	0.363						
Others	0.313						
	Railways						
Iron Ore/ Coal	0.741						
POL Product/ Crude	0.814						
Cement	0.736						
Others	0.744						
	Road Transport						
	Upto 200 km	*201 - 400 km*	*401 - 600 km*	*601 - 800 km*	*801 - 1000 km*	*1001 - 1500 km*	*Above 1500 km*
Iron Ore/ Coal/ Cement	1.769	1.623	1.575	1.527	1.551	1.493	1.502
POL Product/ Crude	2.136	1.942	1.879	1.816	1.802	1.771	1.782
Others	1.943	1.800	1.717	1.664	1.663	1.625	1.635

Source: TTS-RITES. Converted to 2012-13 prices.

In addition, the TTS-RITES study also estimated the per unit environment costs that are incurred by the different modes of transportation. Environment costs in TTS-RITES were assessed on the basis of the abatement costs of air pollution from road transport in India (as estimated by Chatterjee et al, 2007). Abatement costs for different types of road vehicles, in the Chatterjee et al. study, comprised of the cost of upgrading vehicular technology to make it compatible with Euro III emission standards and the cost of improving fuel quality, i.e. the incremental cost of producing improved petrol and diesel compatible with

Euro norms (as reported in the Mashelkar Committee Report, 2002). TTS-RITES used an annualised incremental cost of upgrading road vehicular technology of Rs. 17,212.50 per vehicle and an average incremental cost of improving fuel of Rs. 1.80 per litre to estimate the abatement cost per tonne-km for road freight transport. The abatement cost for railways and coastal shipping was arrived at in proportion to fuel consumption under these sectors. A fuel consumption norm of 2.54 litres per thousand GTKM under rail and 0.00216 litres per TKM under coastal shipping were adopted.

The environment costs estimated by TTS-RITES represent the costs of air pollution abatement; they do not include Greenhouse gas (GHG) emission costs of the different modes of transportation. It is important to include the latter in the environmental cost calculations to evaluate the GHG emission reduction benefits under coastal shipping as against other modes of transportation. The per unit GHG emissions costs for the different modes of freight transportation were computed by multiplying the estimates of GHG emissions per useful distance travelled for each mode of freight transportation, measured in grams of carbon dioxide equivalent per tonne-kilometre obtained from IPCC-AR5 (Schlömer et al., 2014), with the Social Cost of Carbon (SCC)[5] for India, estimated by Nordhaus (2011) and measured in Rupees per tonne of carbon dioxide. Note that the GHG emissions per tonne-kilometre estimates of the different modes of freight transport from IPCC-AR5 are based on the currently commercially available transport technologies world over and therefore they represent average global values (i.e. they are not India-specific).

The per unit environmental costs, comprising of both the air pollution abatement costs as well as the GHG emission costs, for the different modes of transportation that were used in this study are

[5] SCC is the estimated monetised value of damages caused by an additional tonne of CO_2 emissions or its equivalent released into the atmosphere. Economists and climate scientists often consider SCC as an underestimated value of the damages caused as a result of climate change impacts.

presented in Table 2. Note that both the environmental costs for railways represent average values of diesel traction and electric traction. Given that the proportion of freight transported by diesel traction as opposed to electric traction is not known, this is a reasonable assumption.

Table 2: Environmental Costs of the Different Modes of Freight Transportation in Rs. per Tonne-Km (2012-13 prices)

Mode	Air Pollution Abatement Cost [a]	GHG Emissions Cost [c]
Road	0.197	0.101[d]
Railways	0.032[b]	0.008[e]
Coastal Shipping	0.029	0.002[f]

Notes:
[a] Source: TTS-RITES converted to 2012-13 prices.
[b] Average of diesel traction (Rs. 0.05/t-km) and electric traction (Rs. 0.015/t-km).
[c] Source: Own calculations based on g CO_2 eq/t-km from Schlömer et al. (2014) and SCC from Nordhaus (2011) converted to 2013 Indian Rupees; SCC value range used is Rs. 314 – 680 per t CO_2.
[d] g CO_2 eq/t-km values for diesel heavy and medium duty trucks used.
[e] g CO_2 eq/t-km values for diesel (heavy good) and electric trains used.
[f] g CO_2 eq/t-km values for large bulk carriers/tankers used.

As expected per unit environmental costs are the lowest for coastal shipping, followed by railways and they are the highest for road freight transport. The per unit air pollution abatement cost for coastal shipping is only slightly lower than that of railways, however it is approximately seven times lower than that of road transport. The per unit GHG emission cost for coastal shipping is four times lower than that of railways and around fifty times lower than that of road transport. Air pollution abatement costs are roughly twice as high as the GHG emissions costs for road transport. The same are about four and fifteen times higher than the GHG emissions costs for railways and coastal shipping respectively[6].

[6] It may be noted that the environmental costs associated with air pollution and greenhouse gas emissions have been estimated in two different ways here. In case of air pollution, the environmental costs have been approximated with the cost of complying with emission norm, which in turn would shed light on avoided social cost of air pollution. In case of greenhouse gas emissions, on the other hand, the social cost of carbon used provides a direct measure of avoided social cost of greenhouse gas emissions.

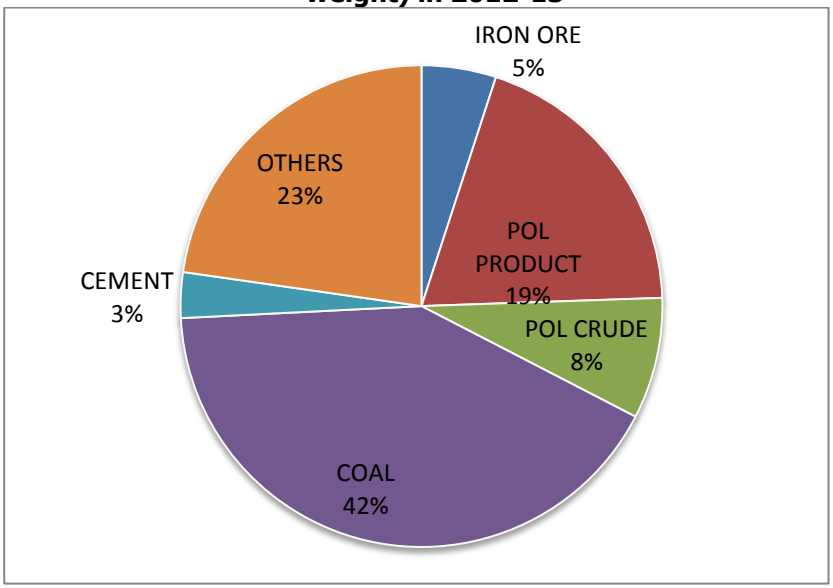
Note that the environment costs are not commodity-specific and hence the environment cost for each mode of transportation is added to the commodity-wise economic costs (the same value for all commodity groups) to arrive at the commodity-wise total costs for each mode of transportation.

Data on the commodity-wise quantity of goods transported across the maritime zones of India (T_{Szj} in equation (1)) come from the annual publication 'Statistics of the Inland Coasting Trade Consignments of India' (DGCI&S, 2012-13). This publication divides up the Indian coast into twelve maritime zones with each of the coastal States forming one zone each, the Islands of Andaman and Nicobar and Lakshadweep forming two additional zones and the Union Territory of Puducherry forming one additional zone, which gives a total of twelve zones in all. The publication gives information on the quantity of each commodity that was transported from one zone to another across all twelve zones but does not specify which port within each zone the goods were transported from and to. All commodities were grouped into the five major commodity groups for which unit cost estimates for the coastal shipping sector exist (as discussed above) and quantities thereof that were transported across the different maritime zones were aggregated. Note that quantity units varied according to the commodity in question and therefore all units were converted to tonnes using commodity-specific conversion factor units from the TTS-RITES study (Special Report 1) to enable such aggregation across commodities.

The cargo mix of commodities transported via coastal shipping (by quantity) in the year 2012-13 is depicted in Figure 2. The bulk of goods transported along coastal waters was coal (some 12.8 million tonnes (MT)), followed by POL (approximately 8.5 MT) and other commodities (about 7 MT), which include food grains, fruits and vegetables, salt, inorganic chemicals, plastic, rubber, wood, ceramic and iron and steel articles, electrical machinery and equipment, road vehicles,

boats and barges, parts of aircrafts, among others. The total quantity of goods transported was roughly 30.8 MT in 2012-13.

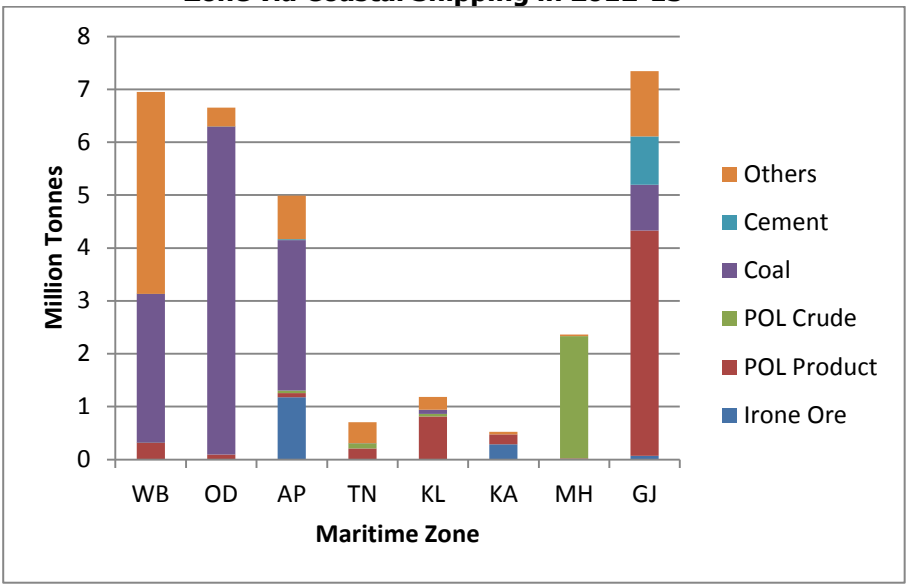
Figure 2: Cargo Mix of Commodities on Coastal Shipping (by weight) in 2012-13



Source: DGCI&S (2012-13).

In terms of the quantity of total goods that were sent outwards from each maritime zone to the others, Gujarat transported the highest quantity of goods transported during 2012-13, followed by West Bengal, Odisha and Andhra Pradesh (see Figure 3). Goa, Puducherry and Andaman and Nicobar Islands transported less than twenty thousand tonnes each and were thus excluded from the figure below. Lakshadweep did not transport any goods to other maritime zones during this period.

Figure 3: Commodity-Wise Quantity of Goods Sent by Maritime Zone via Coastal Shipping in 2012-13



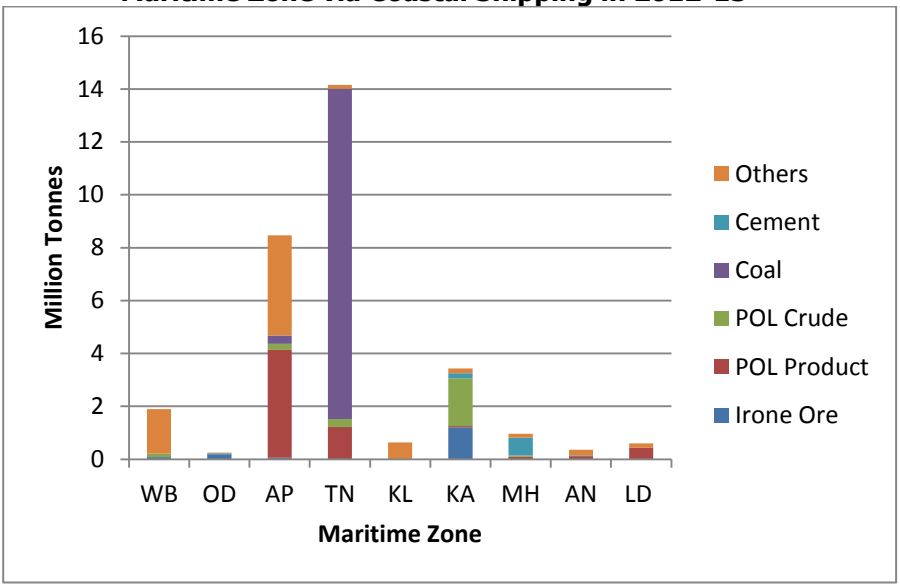
Source: DGCI&S (2012-13).

Figure 3 also shows that the highest quantity of POL product and cement that was transported was sent from Gujarat (almost 4.3 and 0.9 MT respectively); the highest quantity of Coal transported was sent from Odisha (approximately 6.2 MT) followed by West Bengal and Andhra Pradesh (about 2.8 MT each); the highest quantity of POL crude transported was sent from Maharashtra (close to 2.3 MT); the highest quantity of Iron ore transported was sent from Andhra Pradesh (almost 1.2 MT); and, the highest quantity of other goods transported to other maritime zones was sent from West Bengal (about 3.8 MT).

Looking at the maritime zone that received the highest quantity of goods that were transported via coastal shipping, Tamil Nadu received close to 14 MT of goods, which is significantly higher than the quantity of goods received by any other maritime zone via coastal shipping (Figure 4). No goods at all were shipped to Gujarat, Goa and Puducherry in 2012-13. The destination for almost all of the coal transported via coastal

shipping is Tamil Nadu (some 12.5 MT). Andhra Pradesh was a major destination for the transportation of POL product and other goods (approximately 4.1 and 3.8 MT respectively); Karnataka for iron ore and POL crude (almost 1.2 and 1.8 MT); and, Maharashtra for cement (about 0.7 MT).

Figure 4: Commodity-Wise Quantity of Goods Received by Maritime Zone via Coastal Shipping in 2012-13



Source: DGCI&S (2012-13).

Given that the information on the port of origin and port of destination of goods transported within maritime zones is missing from the DGCI&S data, a representative port was selected in each of the twelve maritime zones and the distance (D_z in equation (1)) between that representative port in a particular maritime zone and the representative ports in other maritime zones was calculated for each mode of transportation. A representative port in each maritime zone was chosen on the basis of the amount of total coastal traffic it handled (i.e. the highest quantity of traffic handled both in terms of loading and

unloading) among all major, intermediate and minor ports during the year 2012-13 (MoS, 2014; Tables 2-4). Naturally major ports handle more coastal traffic (in terms of quantity of goods) than minor ports and they were the natural choice of representative ports in maritime zones. If there is more than one major port in a particular maritime zone then the one that handled the highest tonnage of traffic was chosen as the representative port in that zone. In some cases, goods were transported internally within maritime zones (for e.g., in West Bengal, Andhra Pradesh and Tamil Nadu), thus, a second representative port was chosen, again on the basis of the quantity of coastal traffic handled by the port as well as its distance to the first representative port. That is, the port farthest to the first representative port was chosen since goods travelling short distances within a maritime zone are unlikely to be transported via shipping. Note however that inter-maritime zone transport distances are based on distances between the first representative ports chosen in each maritime zone. The representative ports selected in each maritime zone are listed below in Table 3.

Table 3: Representative Ports in the Coastal Shipping Maritime Zones

Maritime Zone	Representative Port	
	(1)	*(2)**
West Bengal	Haldia	Kolkata
Odisha	Paradip	-
Andhra Pradesh	Visakhapatnam	Krishnapatnam
Tamil Nadu	Chennai	V. O. Chidambaranar (Tuticorin)
Kerala	Cochin	-
Karnataka	New Mangalore	-
Maharashtra	Mumbai	-
Gujarat	Kandla	-
Goa	Mormugao	-
Puducherry	Puducherry	-
Andaman & Nicobar Islands	Port Blair	-
Lakshadweep	Kavaratti	-

Note: * Only for internal (intra-maritime zone) transportation. Goods were not transported internally via coastal shipping within other maritime zones in 2012-13.

Sea distances between representative ports were calculated with the help of the Sea Rates port distance calculator[7]; road distances were calculated in Google Maps[8]; and rail distances were the distances between the main railway stations closest to the representative ports in each maritime zone and were obtained from the Indian Railways website[9]. Not surprisingly road and rail distances are shorter than sea distances when travelling across the country from the East- to the West-Coast (or vice-versa). However, when travelling along a particular coast, sea distances between ports tend to be shorter than road or rail distances, which are more or less similar between all pairs of representative ports. Note that since road and rail transport systems are not available from the mainland to the islands, sea distances to islands are used for road and rail transport as well. That is, it is assumed that if

[7] http://www.searates.com/reference/portdistance/

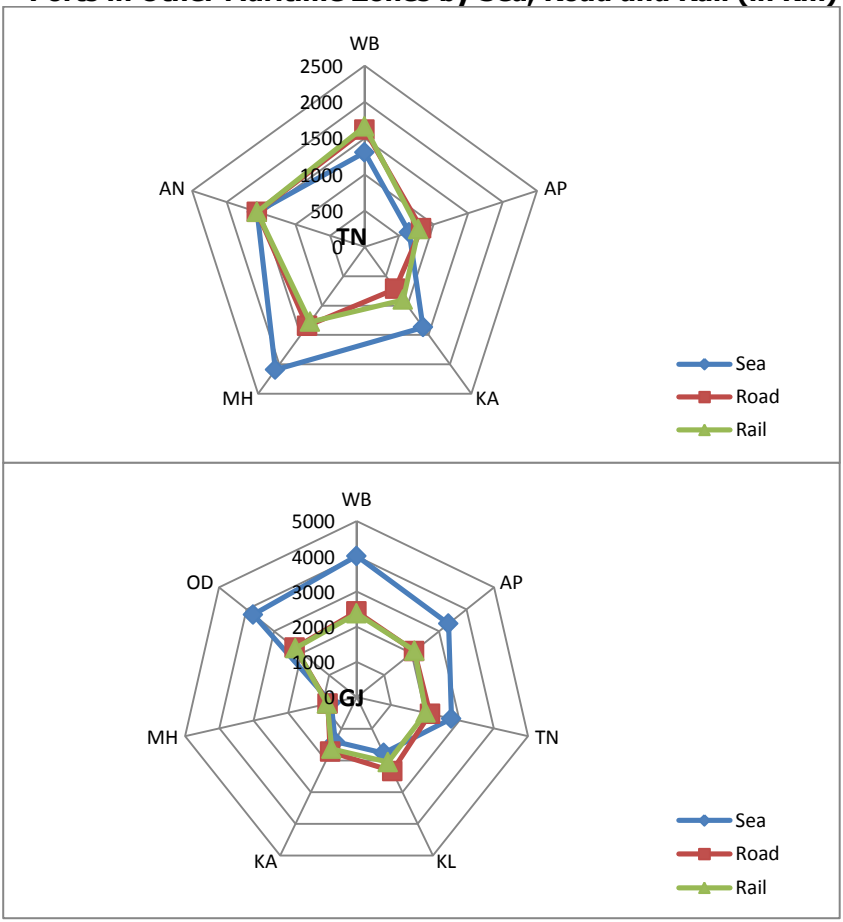
[8] https://www.google.co.in/maps/

[9] http://indiarailinfo.com/

there was a road between the mainland and a particular island, the distance between the two would be the same as that of the sea route distance.

By way of an example, Figure 5 shows the distances from Chennai port in Tamil Nadu (left graph) and Kandla port in Gujarat (right graph) to representative ports in other maritime zones by the three modes of transportation. In both cases it is apparent that sea distances are longer than road or rail distances when travelling to zones on the opposite coast but they are shorter than road or rail distances when travelling to destinations along the same coast as the port of origin. Naturally sea, road and rail distances to Port Blair in the Andaman and Nicobar Islands from Chennai port are exactly the same since sea distance was assumed for the road and rail distances as well. The difference between road and rail distances is also negligible for almost all pairs of journeys in both graphs.

Figure 5: Distance from Tamil Nadu (left) and Gujarat (right) to Ports in Other Maritime Zones by Sea, Road and Rail (in Km)



RESULTS AND DISCUSSION

The benefits of coastal shipping as estimated by equation (1) above are presented in Table 4. Since the costs saved by transporting goods via coastal shipping as opposed to transporting goods by the two alternative modes of transportation, namely road and rail, were both calculated, a range of cost savings values were obtained. The value range for the total benefits of coastal shipping is Rs. 16 – 62 billion (in 2012-13 prices). The value at the lower end of the range corresponds to the total costs saved in relation to rail transport and the value at the higher end of the range corresponds to the total costs saved vis-a-vis road transport. In other words, transporting goods via road is the most costly mode of transportation. Note that total costs saved are nothing but a sum of the economic and environmental costs saved. The environmental benefits of coastal shipping, including savings in terms of both air pollution abatement and GHG emissions reductions, amount to approximately Rs. 0.2 – 11 billion. In physical terms, GHG emissions reductions are estimated in the range of 1.2 – 22.1 lakh tonnes of carbon for the year 2012-13. Environmental costs saved by coastal shipping account for a modest 1.4 percent of total costs saved over rail transport, however they account for a significant 18 percent of total costs saved over road transport. There are GHG emissions reduction gains to be had by transporting all major commodities by coastal shipping as opposed to road and rail transport. Similarly, there are air pollution abatement savings to be had by transporting all major commodities by coastal shipping as opposed to road transport. However it seems to have been cheaper to transport iron ore and POL product by rail rather than by coastal shipping as indicated by the negative sign on the air pollution abatement cost saving estimates of those two commodities. In other words, the benefits foregone by transporting iron ore and POL product by coastal shipping instead of rail amounts to about Rs. 0.12 billion in 2012-13.

Table 4: Benefits of Coastal Shipping over Road and Rail Transportation (in 2012-13 Rupees Billion per Year)

Commodities	Cost Savings over Road Transport				Cost Savings over Rail Transport			
	Total	Economic	Environmental		Total	Economic	Environmental	
			Air Pollution Abatement	*GHG Emissions*			*Air Pollution Abatement*	*GHG Emissions*
Iron Ore	3.78	3.19	0.37	0.23	1.66	1.65	-0.01	0.01
POL Product	13.38	10.80	1.58	1.00	0.76	0.83	-0.11	0.04
POL Crude	4.68	3.98	0.44	0.26	1.34	1.33	0.00	0.01
Coal	26.07	21.45	2.94	1.69	8.10	7.92	0.09	0.09
Cement	1.50	1.23	0.18	0.10	0.42	0.40	0.00	0.01
Others	12.43	10.38	1.30	0.76	3.58	3.51	0.04	0.04
Total	**61.85**	51.02	6.80	4.03	**15.86**	15.63	0.02	0.21
(% Total)	(100)	(82.5)	(11.0)	(6.5)	(100)	(98.6)	(0.1)	(1.3)

It is important to note that coastal shipping does not provide 'end-to-end' connectivity, i.e. it cannot be solely relied upon to transport goods from the starting location to the final destination. Therefore, the coastal shipping costs in reality may include some additional costs that are incurred as a result of the movement of goods from the port to the final destination, presumably through links to road and rail networks. These additional 'last mile connectivity' costs incurred by the coastal shipping sector are not accounted for in this analysis and hence the cost savings presented in Table 4 may be seen as overestimates.

In addition to the economic and environmental benefits of coastal shipping, there are other social benefits of transporting goods by sea rather than by land. Transporting goods by sea as opposed to roads would lead to less congestion on roads by freight traffic, which would in turn lead to free movement of passenger traffic and subsequently a reduction in passenger travel times. Moreover, as noted in the introduction, road accidents are a common occurrence in India leading to significant losses in terms of human fatalities, injuries to people and damage to property. Thus, a modal shift from road to sea transport would lead to a reduction in the number of accidents occurring on roads and a consequent reduction in the economic loss to society.

The TTS-RITES study presented some estimates of unit accident costs for road and rail transport borrowing these values from AITD (2002), which estimated accident cost as the sum of real resource costs, such as vehicle damage, medical expenditure, police costs and the discounted value of the victim's future output. In addition, the AITD study also accounted for the pain, grief and suffering of those involved in road accidents by valuing these intangible costs by the willingness to pay approach. The unit accident costs based on the above approach and adjusted to 2012-13 prices are Rs. 0.061 per tonne-km for road transport and Rs. 0.001 per tonne-km for rail transport.

The total cost savings values in Table 4 are an underestimate of the true value of the benefits of coastal shipping due to the non-inclusion of social costs of transportation as discussed above. However the unit road and rail accident costs (as estimated by the AITD study) as a proportion of total resource costs may be used to scale the cost savings estimates upwards to at least partially account for the social benefits derived from transporting goods via sea as opposed to land. This leads to an estimate of Rs. 16 – 64 billion (2012-13 prices). Since rail accident costs are negligible, the benefit derived from a modal shift from sea to rail (i.e. a change in the lower-bound estimate) is insignificant. The inclusion of road accident costs leads to an increase in the benefits of coastal shipping vis-a-vis road transport to the tune of Rs. 2 billion. Note that accident costs for coastal shipping are not readily available so they have been assumed as zero here although this may not be the case in reality. Having said that, the number of road accidents far outweigh the number of shipping accidents in India in any given year, however in some cases the latter may cause greater and often more sudden damage or distress. It is also important to note that all the monetary values derived above pertain to the quantity of goods transported via coastal shipping in the year 2012-13. In other words, if the amount of goods transported via sea as opposed to land changes, the monetary values would also change accordingly.

As noted in the introduction, only 7 percent of total domestic freight is transported by sea in India. The share of coastal shipping in the overall domestic cargo movement is significantly lower than that of road and rail (54 and 39 percent respectively). Insufficient infrastructure and the absence of favourable policies are largely responsible for the low share of coastal shipping in domestic freight transportation in India. In particular, the following bottlenecks in the coastal shipping sector have been identified by KPMG (2014) (see also Sundar and Jaswal, 2007):

a. The provision of concessional freight fares by the railways on the transportation of large volumes of goods over long distances gives tough competition to coastal shipping;

b. The absence of concessional and long-duration finance for the acquisition of coastal vessels creates significant debt servicing burden on ship owners. The typical interest rate charged to ship owners is between 12-14 percent annually for an average period of seven years. This makes coastal freight uncompetitive vis-a-vis road and rail freight as ship owners are forced to pass on the effects of high financing costs to the end users;

c. High operating costs in coastal shipping as a result of high duties/taxes on bunker fuel and the high manning scale of coastal vessels may render coastal shipping uncompetitive vis-a-vis road and rail transportation; and

d. Inadequate facilities at ports for coastal vessels including the absence of dedicated berths for coastal shipping, leading to long waiting times at major ports, and the absence of quality handling facilities at minor ports, poses challenges to coastal vessel operators and may even lead to an increase in the costs of coastal shipping. Moreover, connectivity between the hinterland and minor ports is not as strong as it is for major ports.

If some or all of the bottlenecks in the coastal shipping sector are eliminated, the share of coastal shipping in the overall domestic cargo movement would rise from its current level of 7 percent. It was noted in the introduction that the share of coastal shipping in domestic freight transportation in India increased from 3 percent in 1986-87 to 7 percent in 2007-08 (TTS-RITES). Assuming that the rise in the share of coastal shipping in the future, due to the absence of bottlenecks in the coastal shipping sector, is similar to its growth rate in the past twenty years or so, a doubling of the share of coastal shipping (i.e. 14 percent) could be

expected by the year 2030. In this case, the benefits of coastal shipping would also double to roughly Rs. 32 – 128 billion in 2012-13 prices, and GHG emissions reductions would increase to about 2.3 – 44.2 lakh tonnes of carbon per annum.

Table 5: Value of Coastal Shipping in 2012-13 Rs. Billion

Category of Benefits	Cost Savings Over Road Transport	Cost Savings Over Rail Transport
Baseline Value (Economic + Environmental Costs)	61.85	15.86
Inclusion of Social (Accident) Costs	63.80	15.88
Increase in the Share of Coastal Shipping	127.59	31.76

Table 5 presents the range of values for the benefits of coastal shipping as estimated in this study, a) under the baseline scenario (i.e. considering economic and environmental costs only); b) with the inclusion of accident costs in addition to the baseline costs; and c) with the removal of bottlenecks in the coastal shipping sector that would lead to an increase in the share of coastal shipping in the overall cargo movement. It is important to note that the first two categories of benefits are currently realisable (estimated for the year 2012-13), whereas the third category of benefits is hypothetical since an increase in the share of coastal shipping would occur only if the bottlenecks in the coastal shipping sector are dealt with effectively by the government. In addition to this, India also needs a viable national scheme to incentivise and support a modal shift of freight from road and rail transport to coastal shipping (and inland waterways). Some developed countries have already adopted schemes that provide incentives to companies to switch from road transport to rail or water on the grounds that this shift would generate social benefits that would offset the cost of the financial incentives provided. In the UK, the Mode Shift Revenue Support Scheme assists companies with the operating costs associated with running rail or

inland water freight transport instead of road, where the former modes of transportation are more expensive than road transport[10]. The European Union's Marco Polo Programme, which is currently the largest and most comprehensive modal shift programme in the world, is designed to ease road congestion and its attendant pollution by providing companies with financial support to shift freight from roads to greener modes of transportation like railways, sea-routes and inland waterways[11]. The state government of Kerala, as part of its effort to decongest roads, has initiated a scheme to divert cargo from roads to coastal shipping wherein an incentive of Rs. 1 per tonne per kilometre is provided to both shippers and ship owners for cargo transported along its coast (MoS, 2014). The target is to divert at least 20 percent of the cargo currently moved by road to coastal shipping by 2015 and 40 percent by 2020. At the national-level, government and policy makers are increasingly deliberating the need to promote coastal shipping in India (NTDPC, 2014; MoS, 2014). The Ministry of Shipping recently released a 'vision document' for Coastal Shipping, Tourism and Regional Development that sets the goal of increasing the share of coastal shipping in India's modal cargo mix from 7 percent to 10 percent by 2019-2020 through subsidies and the promotion of cruise tourism[12]. Consequently, the ministry has taken several initiatives that include tax exemption on bunker fuels, service tax parity with other modes of transportation, relaxed cabotage for special vessels, development of new ports etc. to encourage the transportation of goods by coastal shipping[13]. This is a step in the right direction and continued effort in terms of both infrastructure development and the creation of favourable policies (particularly an incentive scheme for a modal shift to water transportation) may lead to coastal shipping becoming a feasible and preferred alternative mode of

[10] See the Guide to Mode Shift Revenue Support Scheme, Department of Transport, London (April 2015) for more details – https://www.gov.uk/government/publications/mode-shift-revenue-support-msrs-scheme-2015-to-2020

[11] See http://ec.europa.eu/transport/marcopolo/ for more information.

[12] See http://pibmumbai.gov.in/scripts/detail.asp?releaseId=E2015PR2194

[13] See http://pib.nic.in/newsite/PrintRelease.aspx?relid=134023 for more information.

freight transportation in India in the long-run. The analysis presented in this study makes a strong case for why this would be beneficial to the country.

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