UNIVERSITY OF PETROLEUM & ENERGY STUDIES,
DEHRADUN

DISSERTATION REPORT
ON
"BUNKER POTENTIAL ON MAJOR PORTS OF INDIA"

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT OF THE DEGREE OF
MBA (ENERGY TRADING)

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Certificate of Originality

This is to hereby state with the intention of this report is very original in every sense of the terms and conditions and it carries a sense of honour and belief and that no shortcuts have been taken and I remained both meticulous and caring during the prevalen of this research work. I have put in my point best to keep this work as informative and precise as possible.

It may be also stated here that during the preparation of this report some help has been taken from a scope of professionally shared information & knowledge, a comprehensive description of which has been mention in the references chapter of this repor .

Dated: 17th April

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Apart from the efforts of a person doing the project, the success of any project depends largely on the encouragement and guidelines of many others. I take this opportunity to express my gratitude to the people who have been instrumental in the successful completion of this project.

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BONAFIDE CERTIFICATE

This is to certify that **Mr. Sushil Madad**, student of **University of Petroleum and Energy Studies, Dehradun**, pursuing **MBA (Energy Trading)**, has successfully completed his dissertation project. As a part of his curriculum, the project report entitled, **"Bunker Potential on Major ports of India"** submitted by the student to the undersigned is an authentic record of his original work which he has carried out under my supervision and guidance. This study has not been submitted anywhere else for degree purpose.

I wish him all the best.

Dr. Prasoon Dwivedi

(Associate Professor)

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Bonafide Certificate

This is to certify that **Mr. Sushil Madad,** student of **University of Petroleum and Energy Studies, Dehradun,** pursuing **MBA Energy Trading** has successfully completed his Dissertation on **"Bunker Potential on major Ports of India"** at University of Petrolium and Energy Studies, Dehradun. As part of his curiculum, the project report entitled, **"Bunker Potential on Major ports of India"** submitted by the student to the undersigned is an authentic record of his original work which he has carried out under our supervision & guidance and the project has not formed the basis for the award of any degree/diploma/Associateship/fellowship or other similar title to any candidate of any university.

We wish him all the best.

Dr. Prasoon Dwivedi Date:
(University of Petrolium and Energy Studies, Dehradun)

Prof. Sonal Gupta
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Executive Summary

The project is undertaken to study the **Bunker Potential on major ports of India.** The aim of the project is to conduct various researches on various levels of demand, supply of the goods for import and export from the country which has direct implication on the growth of the industry. The project has analyzed the various feedbacks in the form of questionnaires filled up by the **INDUSTRY PLAYERS** like ship owners, ship brokers, ship charterers, etc. The data of import, export, shipping lines, port facilities, types of vessel called on various ports, types of cargo handled at a particular port, etc., has also been analyzed to see the growth of the industry in the past few years and on the basis of it the future performance and potential of the industry can be predicted. The performance of International Ports near India and its effect on Indian Bunker Industry has also been analyzed. The changing regulations of the Government of India have also been analyzed and its implications (pros & cons) on the Industry have also been studied.

The analysis of various factors related to the industry and SWOT (Strength, Weakness, opportunities and threat) of bunkering industry in India will help the Indian firms to take decisions and expand industry in **INDIA.**

Chapter 1: INTRODUCTION

1.1) Introduction to Bunker

1.1.1) Overview

With the effect of globalization the economy of the country is much more dependent upon the economy of another country. The country is more focused upon the growth of their economy through the export and import of goods which would ultimately have a positive impact on the overall functioning of the country. The growth of the economy is completely dependent on the economy of another country, for the same reason only most the country in the world is much more focused on the increasing the international trade. And to achieve such a objective they are increasing the facilitation to increase the trade, the government are investing more and more to improve the infrastructure and trying to remove the barriers which are there for the international trade. International agreements like GSP (Generalized System Preference) and creation of trade zones like ASEAN, NAFTA, SAFTA, etc. have been come to force to increase the international trade.

To achieve the agenda of international trade the demand of transportation by sea is increasing day by day. To help the movement of such amount of transportation of goods by sea route is preferred which is the most economical mode and feasible mode of transport. Over, the last few years the demand of marine vessels, for cargo and product transportation has increased more than tent folds and so has the vessel movement on the global scale. With this the demand of Fuel Oil and Marine Gas Oil has increased drastically.

Marine fuels or Bunker fuel includes IFO(Intermediate Fuel Oil), MGO(Marine Gas Oil) and MDO(Marine Diesel Oil). Intermediate Fuel Oil is used to run the main engine of the Ship whereas Marine Gas Oil is used to run the generators onboard a vessel to run the electrical system of the vessel.

Fuel oil is a fraction obtained from the distillation, which is either a distillate or a residue. We can see that the fuel oil is a oil which is used for a generation of heat or can also be used for the generation of power, except for oils which are having a flash point nearly equal to 40 degree Celsius. Fuel oil is made up of long hydrocarbon chains, particularly cycloalkanes, aromatics and alkanes. Fuel oil refer only to the heaviest commercial fuel that can be obtained from crude oil.

Bunker Fuel are make-up of those small molecules like the ones in propane, naptha, etc. i.e. it is fractionally distilled from crude oil. Bunker Fuel is also called as fuel oil. There are a number classifications around the world which is used to describe the fuel oil. These classifications are based on the on the chemical properties of the fuel oil lie chemical

composition, sulphur content, intended purpose, and boiling temperature. The bunker fuel is extremely viscous and highly polluting when compared to other petroleum products.

1.1.2) Bunkering

Definition: The act or a process of supplying a ship with a fuel.

Bunkering is a term used in shipping industry which is used to describe the selling and supplying the fuel (heavy, medium and light fuel, gas oil and marine diesel) to the marine vessels or ships. The process generally involves transferring fuel from one ship, Land Tank through pipelines or tank Lorries to a ship or a Marine Vessel engaged in transportation of people, cargo, oil and container service.

The bunker prices have a significant impact on the world freight level and the profitability as shipping companies, due to which the shipping companies are always on the lookout to find the optimum bunkering location for their vessel. Currently, the world market for the bunker is about 200million tons in size approximately.

For a particular voyage the bunker costs around 50-60% of the total voyage cost and with the rise in the price of the crude oil, the percentage of bunker cost to the overall voyage cost is set to increase. The bunkering was once considered to be low skill, low value activity has now evolved into highly focused shipboard operations in terms of regulatory compliance, and quality assurance which was a result of relentlessly rising price of oil and ever increasing marine environmental protection awareness.

1.1.3) Indian Scenario

The Indian Sub-Continent bunkering industry faces a greater challenge from Singapore in the east and Fujairah in the West which are the major bunkering hubs across the world. They are not strategically placed along the major sea trade route but also have a price advantage. In the past few years with the increase of Maritime Logistics, huge potentials of Bunkering has emerged in INDIA and now more and more foreign market players are entering into the Bunkering Market in India.

In the past there has been many problems in the India Bunkering Industry due to which it is still not looked as the primary bunkering hub of the world, some of these problems are:

- Government Policies
- Geographical Location
- Quality of Bunker Fuel
- Price Competitiveness

The duty and state taxes implied in the bunker fuel is quite large on the Indian ports which results in the higher cost of the Bunker Fuel on the Indian ports which is very high when compared to benchmark ports where Bunker is supplied i.e. Singapore, Rotterdam and Fujairah.

Government Policies and Administrative Policies have been the root cause of the relatively slow progress in the Bunker sector and for the uncompetitive prices compared to the other Bunkering Hubs of the world, but still India supplies bunker cargo to Singapore. The development of the infrastructure is the indicator of the growth in the bunker sector.

Ports like Mumbai, Mundra, Kandla and Cochin on the West coast of India are major potential ports where the taxes are low and have the competitive prices. Attractive prices and availability of multi supply modes on Haldia, Chennai and Tuticorine ports on the East Coast of India are an added advantage which the Indian Bunker industry has.

The difference between the Indian Bunker cost and the Bunker cost of the benchmark ports is due to the sales tax which varies from state to state. The government should take steps to recognize Bunkering as a distinct industry and come up with a common platform of minimal taxes along its ports in India so that a competitive and substantial growth of the industry can take place. State's like Gujrat and Maharashtra has realized the potential of the Bunkering and have already reduced their taxes which have a positive effect on the bunkering across the ports along these states.

1.1.4) INFRASTRUCTURE DEVELOPMENT & GOVERNMENT of INDIA INITIATIVES

The goal of the India is to become the developed nation by 2020 and to achieve such a status globally India has to grow at rate of 8% annually throughout this decade. To achieve such a growth rate the Government of India has identified that the modernization and the development of the infrastructure is at of utmost need.

- The growth and development of the ports along with the allied infrastructure is very crucial as they play a vital role in the development of the country's overall economy. About 70% by value (in dollars) and 95% by volume of India's international trade is carried out through maritime route.
- The National Maritime Development Plan (NMDP) of the Government of India has provided the vital and significant information about the Infrastructural developments which are being carried out in the sea ports across the country and their impacts which is expected on the Indian economy.
- The Bunkering Industry has welcomed the Infrastructural development program as it is expected to increase the trade volumes and which would help the bunkering industry to grow.

- The NMDP is also giving importance to the Ship Building industry and for this purpose they are reviving HSL and HDPEL, modernizing and enhancing the capacity of the public sector shipyards, setting up of two international shipyards and the strengthening of NSDRC to help it enhance its design and the research capabilities which would help it make a world class high capacity Bunker barges at lower costs rather than buying them from the foreign shipyards.
- The Government of India is further considering for tax exemptions for International tonnages.
- The low tax rates and the bonded bunkers are being made easily available at the India sea ports by Indian Public Sector Units (PSU's) which shows the government are serious to develop its ports and thus the bunkering industry.
- The recent development includes the introduction of more high capacity barges. The 380 CST fuel is now available at all Indian major sea ports; these fuels comply with ISO 8217:2005 and Marpol Annex VI.
- The conventional method of supplying the fuel by truck is being replaced by the world-class infrastructure incorporating barge, onshore storage capacity and the barge. The support services for the ship supplies such as that of spares etc. continues to get better.

INITIATIVES IN BUNKER SECTOR

- The refining capacity of India is expected to increase to 240MMTPA.
- Last year around 40,000 vessels called at Indian Ports including major and minor ports of India.
- Total bunkering volume traded during last year was almost 1.6 million MT.
- MOPS based pricing for refineries in India.
- The state governments are reducing the taxes on the Bunker Fuel to encourage the Bunkering.
- Major Ports along the coast of India are now committing to supply ISO specification bunkers.
- Plans are there to introduce IFO 500 CST in some selected ports of INDIA.

1.2) Marine fuel

1.2.1) Overview

The marine fuel industry has international network and trade relationship. The Marine fuel oil or residual fuel is widely used for trade via sea by shipping companies because of its cheaper prices and wider availability. The Marine Fuel Industry is complex as it deals with the world demand and supply. The supply chain for the marine fuels industry begins with integrated petroleum refineries. The bottoms from the atmospheric distillation and vacuum distillation unit operations are combined to form the residual fuel stock.

The major industry for bunkering is the suppliers of commodities globally and locally. Most of the bunker fuel is sold to firms that operate bunkering facilities around the world. Refiners are also into the same business of providing the bunker fuels to the industry. There are private and public companies which provide bunker facilities in India. The major public sector companies in this sector are Indian Oil Corporation Ltd., Hindustan Petroleum Corporation Ltd Etc. and the major private suppliers of bunker in India are Chemoil Adani, Gulf Petrochem, and O.W Bunker etc.

The brokers and other intermediates also play a vital role in the Bunker Industry. The major share approx. 25% of the world's bunker fuel is purchased and resold by the brokers and agents. The arbitrage activities of the firms help keep the worldwide market efficient the reason for this is the elimination and exploitation of the excess price differentials. The bunkering is the final stage of the whole process which is done while the ship is docked or directly from bunker barges at the time of anchoring of ship. There are hundreds of bunkering port and thousands of bunker supplier firms

There are many International ports which provide bunker facility all over the world. The major ports among them are Singapore in the Far East Asia, Rotterdam in U.K, Fujairah in Middle East, Los Angeles, San Francisco and many more.

The bunkering industry is majorly influenced by the Logistics and transportation sector. Another important factor is the location of the port. The bunkering ports are often strategically located along high density shipping lanes. The largest port providing bunker is Singapore port in the Far East Asia which handles more than twice the volume than the next bigger provider of the bunker in the world. There are other strategically located ports like Panama, Gibraltar, Fujairah and Colombo etc.

The problems that is there which is being faced by the Industry is demand for Gasoline in mature markets like United States, Europe and Japan. This results in reduction of residual and distillates. Despite the potential of hydro processing to treat high-sulfur residual fuels, the technology is not yet cost effective for refineries. Due to these reasons the bunker may witness shortages as the refineries continue to meet the demand of gasoline and other petrochemicals with high value.

Over 90 % of the world trade is done by the shipping industry. Without this industry the trade might not have been possible. The seaborne trade has been growing and continues to expand thus bringing benefits for the consumers by bringing the cost of bunker down. The efficiency of the ships is growing due to which the price of the freight has decreased. There are around 50,000 merchant ships being registered in more than 150 nations which trade internationally by supplying all types of cargo.

There are different types of ships in the world merchant fleet which includes:

- Container ships: These are the ships which carry most of the world's goods and products via scheduled liner services.
- Tanker Ships: These ships mainly carry the liquid cargo like crude oil, chemicals and petroleum products. The tanker ships may be similar to the bulk carriers but the deck is flush and is covered by oil pipelines and vents.
- Ferries and Cruise ships: These are used for short journeys for a mix of passengers, cars and commercial vehicles.
- Special ships: The ships are used for special functions only such as anchor, handling and supply vessel for the offshore oil industry, salvage tugs, ice breakers etc.

Shipping is the safest and environmentally stable form of commercial transport. Almost all the industries trade through seaborne routes. The shipping industry is a major industry to accept the international safety standards. The safety of the shipping is mainly regulated by various U.N agencies. The agency which regulates the safety standards is International Maritime Organization (IMO).

Regulations related to the shipping are developed at global level. As the shipping industry grows and the international trade grows the regulations are changed as per the environmental requirements.

As per the industry experts the North America would face a shortage of low sulfur residual fuel of 20 million metric tons per years by 2015 and a surplus of high-sulfur residual oil of 40 million metric tons per year (source: bunkerworld). To address these shortages the industry expects an increase in low-sulfur residual fuel oil import from South America and other areas of the world with low conversion capacity.

As far as the developing regions like Africa, Middle East, Asian Market etc. is concerned the availability of sweet crude supplies, coupled with limited conversion capacity in existing regional refineries will result in continue production of the residual fuel. As the sweet crude becomes increasingly scarce and the sulfur content of crude increases, refineries in the region will have to meet the international standards and they will have to upgrade the conversion

capacity by adding additional processing to existing facilities. This will lead to an increase in the residual fuel output of the refineries.

The major consumers of the oil as far as the developing countries are concerned are China, India, and Japan etc. These countries are competing with the U.S and European companies for depleting supplies of the world's crude oil. China is emerging as a major power in terms of share in the global market. The Energy Information Administration (EIA) predicts that china will invest in petroleum projects in countries around the world, including Canada and South America which has more than 25% of the U.S energy imports. The first deal was signed by china with Venezuela in 2004, making the beginning for procuring market share. If china's presence in the west continues to increase by acquiring petroleum resources than the shortage in residual fuel oil demand in North America will increase exponentially.

The Singapore Marine industry has shown a significant growth over the last 40 years. This is the world's largest port as far as the volume of bunker trading is concerned. This port has emerged from a small regional ship repair building center to a world class industry that serves international clients.

1.2.2) Physical Properties of Heavy Fuel Oil

The heavy fuel oil is the residual side of the distillation process. This is heavy side of the crude which is obtained as the end product of the crude. The various properties of the fuel oil are as follows:

1) Viscosity:

Viscosity is the measurement of the resistant of liquid to resist the flow and is measured in Centistokes (CST) with a quoted reference temperature. The viscosity of the fuel is required to be known for calculating the temperature range required for satisfactory injection at the fuel atomizer, and efficient combustion.

2) Density:

The Density is the relationship between mass and volume at a particular temperature which is measured in SI units of Kg/m^3. This gives the value in the range 8000-1010 kg/m^3. The density f heavy fuel oil is restricted to 991 kg/m^3 to facilitate efficient centrifuging. The density however, can be increased to 1010kg/m^3.

3) Flash Point:

The Flash point is the lowest temperature of the liquid at which it can vaporize to form an ignitable mixture in air. Measuring a flash point requires an ignition source. At this flash point the vapor may cease to burn when the source of ignition is removed. The minimum flash point for marine fuels in the machinery space of merchant ship is governed by the International Marine Organization (IMO). It is being set at 60^{*c} to minimize the risk of fire during storage and handling.

4) Pour Point:

The pour point is the lowest temperature at which a marine fuel oil can be handled without excessive amount of wax crystals forming out of solution. The pour point is an important property as it is used to check the temperature at which it can gel. At lower temperature the fuel will gel which restrict the flow of the fuel oil

5) Carbon Residue:

The end product of most of the fuels is carbon. The carbon residue property of the fuel is the tendency to form carbon deposits under high temperatures condition in an inert atmosphere, the unit of measurement can be *Conrad son Carbon Residue (CCR) or Micro Carbon Residue (MCR)*. As per the International specification the maximum permissibility of carbon residue in the fuel is 22%.

6) Water content:

To check the quality of the fuel, water level plays an important role. Normally the level of water in the fuel is very low as per the demand of the dry fuel by the users. The suppliers deliver the fuel as dry as possible i.e 0.1 % - 0.2% by volume. Water can come from a number of sources on the bunker barge and in ships bunker tanks. This may include the reasons like tank condensation, leakage of steam from heating coils, and bunker tank leakage. As per the rules laid down by International Maritime Organization the maximum water content in fuel allowed is 1% by volume.

7) Ash Content:

The Ash content is related to the amount of inorganic material in the fuel which comes out after the usage of the fuel. The Ash content is defined as the remaining after all the combustible components of the oil have been burned and are negligible. It is the incombustible material which remains after the combustion and consists of the waste material such as vanadium, sulfur, silicon, nickel, Aluminum, sodium, and iron content present in the fuel. As per the IMO the maximum limit of the ash content in the fuel allowed is 0.2% m/m.

8) Calorific Value:

The Calorific value of a fuel is the amount of heat released during combustion of the fuel. Heavy fuel oil has a net Calorific value of 38.9 MJ/Liter and a gross Calorific value of 41.2 MJ/Liter. The values are determined by using calorimeter test in the lab.

9) Specific gravity:

The Specific gravity is the ratio of the density of a particular substance compared to the density of a reference substance. It may be defined as the ratio of the weight of a volume of the substance to the weight of an equal volume of the reference substance. Mainly the reference substance is water for liquids. The Specific Gravity of the Heavy Fuel Oil is its ratio to the density of water at a specified temperature. Bunker oil Heavy fuel oil ranges between 0.95-1.03.

10) Sulphur Content:

Sulphur is soluble in water therefore it cannot be removed by centrifuge treatment. However there are chemicals that can be used to lower the Heavy Fuel Oil's Sulphur content. The corrosion to the piston can take place due to the presence of Sulphur during pre-combustion. The contamination of lube oil may take place due to the Sulphur content. Post combustion of Sulphur emits So_x to the atmosphere in exhaust gases.

11) Calculated Carbon Aromaticity Index (CCAI)

This is a reference index containing a listing of the ignition standard of heavy fuel oil. Cetane number is the equivalent reference for light oil such as diesel oil.

1.2.3) Bunker Fuel Oil

The Bunker fuel oil is the fuel used in ships. Small molecules like propane, naphtha, gasoline, jet fuels etc. which relatively has low boiling point are removed at the start of the fractional distillation process, while the bunker oil is the bottom side of the crude oil. This is denser than all the fuels. The only thing which is denser than the Bunker fuel is the carbon black and Bituminous.

The Bunker Fuel is technically any type of oil used abroad ships which got its name from the containers on ships. Fuel oil is a fraction obtained from petroleum distillation either as a distillate or as a residue. Fuel oil is any liquid petroleum product that is burned in a furnace or boiler for the generation of heat or used in an engine for the generation of power. Fuel is made of long chains of hydrocarbon specifically alkanes, cyclo alkanes and aromatics. The term fuel oil is also used sense to refer only to the heaviest commercial fuel that can be obtained from crude oil, and is heavier than gasoline and naphtha. The heavy fuel oil is derived from refinery bottoms or residues after all other fractions have been extracted from a crude oil feedstock.

1.2.4) Refining Process

Marine fuels are determined in parts by the quality of the crude oil used to create them and in part by the refining process. We begin by reviewing petroleum refining to better illuminate the differences among marine fuels.

The refining process produces various products which include marine fuels and involves the physical, thermal, and chemical separation of crude oil into its major distillation fractions, followed by further processing into finished petroleum products. The primary products of refinery are grouped into three major categories:

Fuels: motor gasoline, diesel and distillate fuel oil, liquefied petroleum gas, jet fuel, residual fuel oil, kerosene and coke.

Finished Nonfuel Products: Solvents, Lubricating oils, greases, petroleum wax, petroleum jelly, and coke

Chemical Industry Feedstock's: Naphtha, ethane, Propane, butane, ethylene, propylene, butadiene, benzene, toluene, and xylene

The refining process can be done in four major steps:

1. Distillation
2. Desulfurization
3. Refining and
4. Blending

The first step is to perform the Distillation of the crude oil which removes the corrosive salts and excess water. This is done by an atmospheric distillation column that separates the feed into the subsequent Distillation fractions. At the top of the column we get "top gases" which include light gasoline, ethane, propane and butane.

The top gases are further processed through reforming and isomerization to produce gasoline. Top gases can also be diverted to lower value uses such as liquefied petroleum gas (LPG) and petrochemical feedstock. The middle-boiling fractions include kerosene, gas oil and spindle oil, aviation fuel, diesel, and heating oil produced. The remaining non-distilled liquids are called bottoms and are the heavier fractions that require vacuum distillation at very low pressures to facilitate volatilization and separation.

The vacuum distillates and residues can be further processed through catalytic cracking and vis-breaking into low value products such as residual fuel oil, asphalt, and petroleum coke.

The lower middle distillates from which marine fuels are made may also require additional downstream processing. These fractions are treated using one of the several techniques:

Cracking/Visbreaking: This process breaks the larger hydrocarbon molecules into smaller ones

Combining: This process joins smaller hydrocarbons to create larger and more useful molecules, or reshaping them into higher value molecules, and "catalytic hydro cracking" is downstream processing method used to crack fractions that cannot be cracked in typical cracking units. These fractions include middle distillates, cycle oils, residual fuel oils, and reduced crudes. Normally the feedstock to a hydro cracking unit is first treated to eliminate any impurities

1.2.5) Marine Fuel Types

Normally the Marine fuel is divided into three major types: distillate fuel, Residual fuel and a combination of the two to create a fuel type known as "intermediate" fuel oil (IFO). The various grades of marine fuel are introduced using the colloquial industry names to group the different fuel types. The distillates and residual fuels are blended into various combinations to derive the different grades of marine fuel oil. As far as the prices are concerned the prices of the distillates are more than the intermediates, and residual fuels are the least expensive.

Fuel Type	*Fuel Grades*	*Common Industry Name*
Distillate	***DMX,DMA,DMB,DMC***	***Gas oil or Marine gas oil***
Intermediate	***IFO180, IFO380***	***Marine Diesel Fuel or Intermediate Fuel Oil***
Residual	***RMA-RML***	***Fuel oil or Residual Fuel Oil***

Distillates or residual fuel oil stocks are blended with blending components or cutter stocks to achieve internationally accepted product specifications as per the International standard, ISO 8217. These specifications define the requirement for fuel grades used in marine diesel engines. Marine fuel grades carry three letters: the first "**D**" or "**R**" specifies "Distillate fuel" and "Residual Fuel". The second "**M**" signifies "**Marine fuel**" use. The third letter designates the individual grades. Distillate marine fuels have three grades ranging from A to C. Residual marine fuels have 15 grades depicted by letters A through H, K, and L. For e.g RME-35 stands for residual Marine Fuel "E" at a maximum viscosity of 35 centistokes.

DMA is the common fuel used for Tug boats, fishing boats, crew boats, Drilling rigs, and ferry boats. The ocean-going ships that take residual fuel oil bunkers also take distillate fuels for use in auxiliary engines and sometimes for the use at port. The common fuels are DMC, IFO-180 and IFO-380, depending on the specification engines in the service. DMB is infrequently specified, and is not available in all ports and at the ports where it is not available DMA is supplied in barges.

Marine Gas Oil (MGO)

Marine gas oil is the result of blending LCO (Light Cycle Oil) with distillate oil to produce one of the highest marine fuel grades. MGO is more expensive because it is a lighter fraction and better quality fuel than diesel fuel. MGO is a best suited fuel for the faster-moving engines.

Marine Distillate Oil (MDO)

MDO is manufactured by combining kerosene, light, and heavy gas oil fractions. DMA and DMB are typically used in small-to-medium sizes marine vessels. DMC is heavier fuel oil and may sometimes be referred to as an intermediate fuel oil because it can be blended with residual fuel. MDO is manufactured by blending DMC with 10% to 15% residual fuel. MDO is more expensive than the more common intermediate fuel types.

Intermediate Fuel Oil

Residual marine fuel grade G (RMG-35) is one of the most common residual fuels used in transoceanic ships. It is mostly known as IFO380, this residual marine fuel is manufactured at the refinery and contains visbroken residue, HCO, and LCO.

IFO380 typically has a high sulfur content that approaches 5%. IFO180 is another common Intermediate Fuel Oil which has lower viscosity and metal content but same sulfur contents as IFO380.

1.2.6) Bunker Fuel Quality specification as per ISO

The bunker fuel quality is reflected by factors such as the flash point, pour point, energy content, sulfur, vanadium, aluminum, silicon, used lubricating oil, water contents, viscosity and presence of sediments in bunkers. Failing to consider such factors leads to a series of operational problems. This below table depicts the parameters of marine fuel as per the fuel quality standards for distillate marine fuels used worldwide in bunkering industry.

The market for MGO and MDO is very less in India but still ships needs these fuels. Indian refineries produce straight run fuel which has less amount of sulfur. This fuel is considered good for the life of ship engines. The total market share of IFO380 CST is 80%. The refineries in India earlier were not used to produce IFO 180 CST, but now the market share of IFO180 has been increased to 10% of the total bunker sales and market.

Table 1.1: The Marine standards are set by ISO for 180 CST and 380 CST

Parameter	Unit	Limit	DMX	DMA	DMZ	DMB
Viscosity at 40°c	mm^2/s	Max	5.5	6	6	11
Viscosity at 40°c	mm^2/s	Max	1.4	2	3	2
Micro Carbon residue at 10% Residue	%m/m	Max	0.3	0.3	0.3	-
Density at 15°C	Kg/m^3	Max	-	890	890	900
Micro carbon Residue	%m/m	Max	-	-	-	0.3
Sulfur	%m/m	Max	1	1.5	1.5	2
Water	%V/V	Max	-	-	-	0.30
Total sediment by hot filtration	%m/m	Max	-	-	-	0.10
Ash	%m/m	Max	0.01	0.01	0.01	0.01
Flash point	0°C	Min	43	60	60	60
Pour Point, summer	°C	Max	-	0	0	0
Pour Point, winter	°C	Max	-	-6	-6	0
Cloud point	°C	Max	-16	-	-	-
Calculated Cetane index		Min	45	40	40	35
Acid number	mgKOH/g	Max	0.5	0.5	0.5	0.5
Oxidation stability	g/m^3	Max	25	25	25	25
Lubricity, corrected wear scar diameter (wsd 1.4 at 60°C)	Um	Max	520	520	520	520
Hydrogen sulphide	mg/kg	Max	2	2	2	2
Appearance				Clear and bright		

Table 1.2: Marine Residual Fuels Specifications

Parameter	Unit	Limit	RMA	RMB	RMD	RME	RMG			RMK			
			10	30	80	180	180	380	500	700	380	500	700
Viscosity at 50°C	mm^2/s	Max	10	30	80	180	180	380	500	700	380	500	700
Density at 15°C	kg/m^3	Max	920	960	975	991			991			1010	
Micro Carbon Residue	%m/m	Max	2.5	10	14	15	18			20			
Aluminum + Silicon	mg/kg	Max	25	40		50	60						
Sodium	mg/kg	Max	50	100		50	100						
Ash	%m/m	Max	0.04	0.07		0.1	0.15						
Vanadium	mg/kg		Max	50		150				350			450
CCAI	-		Max	850		860				870			
Water	%V/V		Max	0.3		0.5							
Pour Point (winter)	°C		Max	6						30			
Flash point	°C		Min	60									
Sulfur	%m/m		Max	Statutory requirements									
Total Sediment	%m/m		Max	0.1									
Acid Number	mgKOH/g		Max	2.5									
Used Lubricating Oil				The fuel shall be free from ULO and shall be considered to contain ULO.									
Hydrogen Sulphide	mg/kg		Max	2									

Source: ISO,2012

1.2.7) Changes in ISO 8217:2012, 2010 compared to ISO 8217:2005

Comparison of 8217:2010 with 8217:2005

Changes for Distillates:

- A new distillate category designation DMZ has been added, due to the new technical evidence provided by engine manufacturers and users, based on the recent experiences with fuel pumps leakages and wear damage. It was accepted to insert an additional grade with an increased minimum viscosity of 3 CST at 40^0C, but otherwise identical in its characteristics to the DMA grade
- The DMC grade has been reclassified as a residual fuel RMA10 which used to be the blend of residual and distillate components

Changes for Residue:

- New grade as added designation RMA10.
- The previous RMF180 grade has been deleted
- RMG grade has been expanded to cover 4 grades 180, 380, 500 and 700
- RMH 380 and RMH 700 grades were deleted
- RMK was expanded to include 500 grade, apart from previous 380 and 700 grades

SCOPE of ISO 8217:2010 v/s ISO 8217:2005

Changes to both Distillate and Residual Fuels are:

- Acid number limits are included
- Hydrogen sulphide (H_2S) limits included

Acid number: The limits for the distillate fuels were adopted from the accepted from the accepted industry's guiding limit of 0.5 mg KOH/g. The limits for the residual fuels are set at max limit of 2.5 mg KOH/g

H_2S- The new limit has been applied which will allow the industry to gain global presence of the prevailing levels and with the new test method.

Changes for Distillate Fuels only:

1) **DMA-** minimum viscosity is increased to 2 CST at 40^0C.
2) **DMZ-** minimum viscosity introduced at 3 CST at 40^0C.
3) **DMB-** minimum viscosity introduced at 2 CST at 40^0C.

4) Appearance has been modified due to the fact that in some countries the distillate fuels are dyed and are not transparent. For such fuels water content shall be determined by KF and be in compliance of 200 mg/kg limit.
5) **Oxidation stability-** It was introduced because the refinery processes used to manufacture distillate fuels can lead to products which may be of limited oxidation stability. In addition, today's non-marine distillate fuels can contain a significant amount of bio-derived components, which might impact on the oxidation stability of the fuel. Also the transportation of pure Distillate fuels and distillate fuels containing bio derived material like Fame, especially through multi product pipeline installations, have shown that some Fame is transferred into the pure Distillate Fuels.
6) **Lubricity-** This lubricity requirement has been included and is applicable to clear and bright D/Fs with low sulfur content below 500 mg/kg. The lubricity limit is based on the existing requirements for high speed automotive and heavy duty industrial diesel engines, of 520 wear scar diameter.

Changes for Residual Fuels only are:

1) **Stability-** To assess stability potential total sediment (TSP) has been assigned as the reference test method. Accelerated Total Sediment (TSA) has been added as an alternative test method.
2) **Sulfur-** The sulfur limits are not included because of the continuous change in the international limits of sulfur content.
3) Ash limit has been reduced for RMA10- from 0.05 to 0.040 mass%, for RMB30, RMD80 and RME180- from 0.100 to 0.070 mass%, for all grades of RMG- from 0.150 to 0.100 mass%, no change for RMK grades- at 0.150 mass%
4) **VANADIUM limits were reduced**
   For RMA10- from100 to 50 mg/kg
   For RMB30 grade- no change at 150 mg/kg
   For RMD80 grade- from 350 to 150 mg/kg
   For RME180 grade- from 200 to 150 mg/kg
   All RMG grades – at 350 mg/kg
   For all grades of RMK – from 600 to 450 mg/kg
5) **Aluminum and Silicon limits are reduced**
   For RMA10- same at 25 mg/kg
   For RMB30 and RMD80- from 80 mg/kg to 40 mg/kg
   For RME180- from 80 to 50 mg/kg for all grades of RMG and RMK- from 80 to 60 mg/kg
6) **Sodium Content** – It is added to all residual fuel grades at 100 mg/kg with the exception of RMA10 and RME 180 where the limit is set at 50 mg/kg.
7) **ULO-** Due to changes to lubricating oils formulations improved criteria for assessing the presence of ULO in marine fuels has been included. The new approach to the limit has

been derived from extensive statistics survey reports. The new combination of elements will not trigger incorrect identification of ULO.

8) **Calculated Carbon Aromaticity (CCAI)**

From the specification point of view it is difficult to describe the enormity of the task at hand. The chemistry of residual fuel is complex of the oil barrel and some of the components of the final blend are rather resultants than controlled fractions. Furthermore, the various specifications grades of the residual fuels are not blended at the refineries and therefore different cutter stocks of unknown chemistry available to today's supply chain are added. CCAI has been added as in order to avoid fuels with uncharacteristic density-viscosity relationship. The basis for including CCAI was as a subtitle for a minimum viscosity limit. The CCAI limit included in the marine fuels standard is there to prevent abnormal or peculiar fuel blends from finding their way into the market. It is recognized that CCAI of 870 is not a guarantee to pose no risk for engines, but neither is a lower value such as 860.

Comparison of 8217:2012 with 8217:2010

The 5th edition of the ISO 8217 marine fuel standard was released on 15th August 2012. This is the latest edition, which is referred to as ISO 8217:2012 and this edition has only few changes as compared to the ISO 8217:2010 standard.

- The pour point limits for DMX gas oil are removed from the table as in 2005
- The test method for Hydrogen Sulphide (H_2S) has been updated to IP 570-12A. With this the accuracy of the test has been improved with limits being changed to 2.00 mg/kg
- The clause 2 "Nominative references" no longer states the reference year for the test method

Customer shifting to ISO8217:2012 from ISO8217:2010 will not experience any changes except for the reference to the specification as parameters and limits remain unchanged.

DNVPS' documentation and test reports will be progressively updated during the coming months.

- "Hydrogen Sulphide (H_2S) in liquid phase and oxidation stability (OS), will be tested at cargo source under the responsibility of the cargo provider, who shall provide a certificate of quality stating that the test values are within the limits set down in the ISO 8217:2010 specification."
- DNVPS is of the opinion that ISO 8217:2012 marine fuel specification offers greater protection to fuel buyers than the previous ISO8217:2005 edition. Ship operators are expected to adopt this as soon as possible.

1.2.8) Bunker Fuel Quality Issues

Bunker fuel's quality has been a major concern for the ship owners, bunker suppliers and Traders. The disputes in the bunker supply leads to claims that is a burden on the supplier, as they not only have to pay for the damages caused to the ship's engines but also tend to lose their reputation as suppliers. As bunkers are the residues from refining activities, the quality of bunkers from sophisticated refiners is compromised because such refiners are able to extract a greater quantity of clean petroleum products, hence leaving behind the residual bunker with poorer quality. Local blending of bunker gives more room for quality discrepancies as compared to importing bunkers in the packaged and finished form. Fraud and negligence of different parties involved may also affect bunker quality.

Bunker quality problems can be resolved by implementing strict monitoring system, international standards and practices as well as improving technical support such as testing labs, equipment and well-trained bunker specialists.

Market transparency of this industry also plays an important role, the degree of corruption and collusion in the bunkering market has been plagued by malpractice. These dishonest practices lead to unethical acts of bribery among various parties including surveyors, chief engineers and barge operators. This results in discrepancies in bunker quantity and quality, which in turn disrupts operations and increases costs to ship operators and managers. Market transparency is affected by the characteristics of the bunker market. For instance, intense competition among suppliers may encourage unscrupulous behavior in the pursuit of higher profits as compared to cases of monopolistic markets

1.2.9) MARPOL

MARPOL is the International Convention for the Preservation of Pollution from Ships. The International Convention for the Prevention of Pollution from Ships (MARPOL) is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. This convention was adopted on 2 November 1973 at IMO. The tanker accident in 1976-77 led to the adoption of Protocol of 1978. This was done as 1973 MARPOL convention had not entered into force. The 1978 MARPOL Protocol absorbed the parent convention. The combined instrument entered into force on 2 October 1983. In 1997, a Protocol was adopted to amend the Convention and a new Annex VI was added which entered into force on 19 May 2005.

MARPOL has been updated by amendments through the years to prevent and minimize pollution from ships both accidental pollution and accident from routine operations. Till now six Annex has been included in MARPOL which are as follows:

ANNEX I: Regulations for the prevention of pollution by OIL (2 October 1983)

This annex covers the prevention of ocean from pollution caused due to the oil from operational measures as well as from accidental discharges, the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls which was revised in 2001 and 2003

Annex II Regulations for the control of pollution by Noxious Liquid substances in Bulk (2 October 1983)

This Annex gives the details of the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk. Some 250 substances were evaluated and included in the list appended to the convention. The discharge of their residue is allowed only to the reception facilities upto certain concentrations and conditions. In any case no discharge of any residue containing noxious substance is permitted within 12 miles of the nearest land.

Annex III Prevention of Pollution by Harmful Substances Carried by sea in Packaged Form (1 July 1992)

This annex contains the general requirements for the issuing of detailed standards on packing, marking, labeling, documentation, stowage, quantity limitations, exceptions and notifications. For the purpose of this Annex, "Harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Appendix of Annex III.

ANNEX IV Prevention of Pollution by Sewage from ships (27 September 2003)

This requirement to control pollution of the sea by sewage, the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than 12 nautical miles from the nearest land. In July 2011, IMO adopted the most recent amendments to MARPOL Annex IV which are expected to enter into force on 1 January 2013. The amendments introduced the Baltic Sea as a special area under Annex IV and add new discharge requirements for passenger ships while in a special area.

Annex V Prevention of Pollution by Garbage from Ships (31 December 1988)

This Annex deals in different types of garbage and specifies the distance from land and the manner in which the may be disposed of. The most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics. In July 2011, IMO adopted extensive amendments to Annex V which are expected to enter into the sea, except as provided otherwise, under specification circumstances.

Annex VI Prevention of Air Pollution from Ships (19 may 2005)

This Annex sets the limits on sulfur oxide and nitrogen oxide emissions from ships exhausts and prohibits deliberate emissions of ozone depleting substances, designated emission control areas set more stringent standards for Sox, NOx and particulate matter. In 2011, after extensive work and debate, IMO adopted ground breaking mandatory technical and operational energy efficiency measures which will significantly reduce the amount of greenhouse gas emissions from ships, these measures were included in Annex VI.

Chapter2: Indian Shipping Scenario

2.1) Overview

India has a great advantage of having a coastal line of approx. 7500kms when compared to other countries of South East Asia. It has 12 major ports, 13 intermediate port and 187 small ports. Therefore the volume of trade is huge at the Indian ports and hence the potential of Bunker demand is very high.

Along the West coast of India the number of major port is six and more than 15 intermediate port. There are many small ports like Mandvi, Okha, Magadalla, Bhavnagar, Hazira and Jafarbad Port etc. which have a great potential to serve the increasing International Trade of India. These ports have a great future ahead because there are many refineries which are supposed to be commissioned in coming years. Also the setup of thermal power plant by the states to meet its ever increasing electricity demand have increased the importance of these ports as the coal is mainly brought from Indonesia and Australia along with South Africa. Hence the export and import is all set to increase along the ports of West Coast hence the bunker demand is going to increase.

The Infrastructure development in India is also increasing at a rapid pace and thus allowing not only the Domestic but the International Bunker Market to grow. Along the Indian West coast line numerous new projects are underway as per the shipping Ministry and NMDP.

The first bunkering in India was done by Bharat Petroleum Corporation (BPC) a public sector company which is the second largest oil company now, with activities like refining, storing, marketing and distribution of petroleum, commissioned a barge loading facility at its Irimpanam installation on the Chitrapuzha River at Kochi, Kerala state. BPC opened its first exclusive international bunkering terminal at the Jawaharlal Nehru Port, Mumbai last year. These moves are part of a plan to expand its bunkering operation right across the ports of India. In addition to Bharat Petroleum, the country's two largest refiners, Indian Oil Corporation (IOC), and Hindustan Petroleum Corporation are also involved in bunkering.

With time the bunkering industry of India has grown by many folds and many International players like Chemoil Adani, Gulf Petrochem and Modest & Parsons etc. have come to India and has increased the proficiency in the Bunker Industry of India which was in the hand of PSU only. With many state governments like Gujarat have withdrawn/less the VAT on Bunker Fuel or is planning to do so, the industry is all to grow at a higher pace.

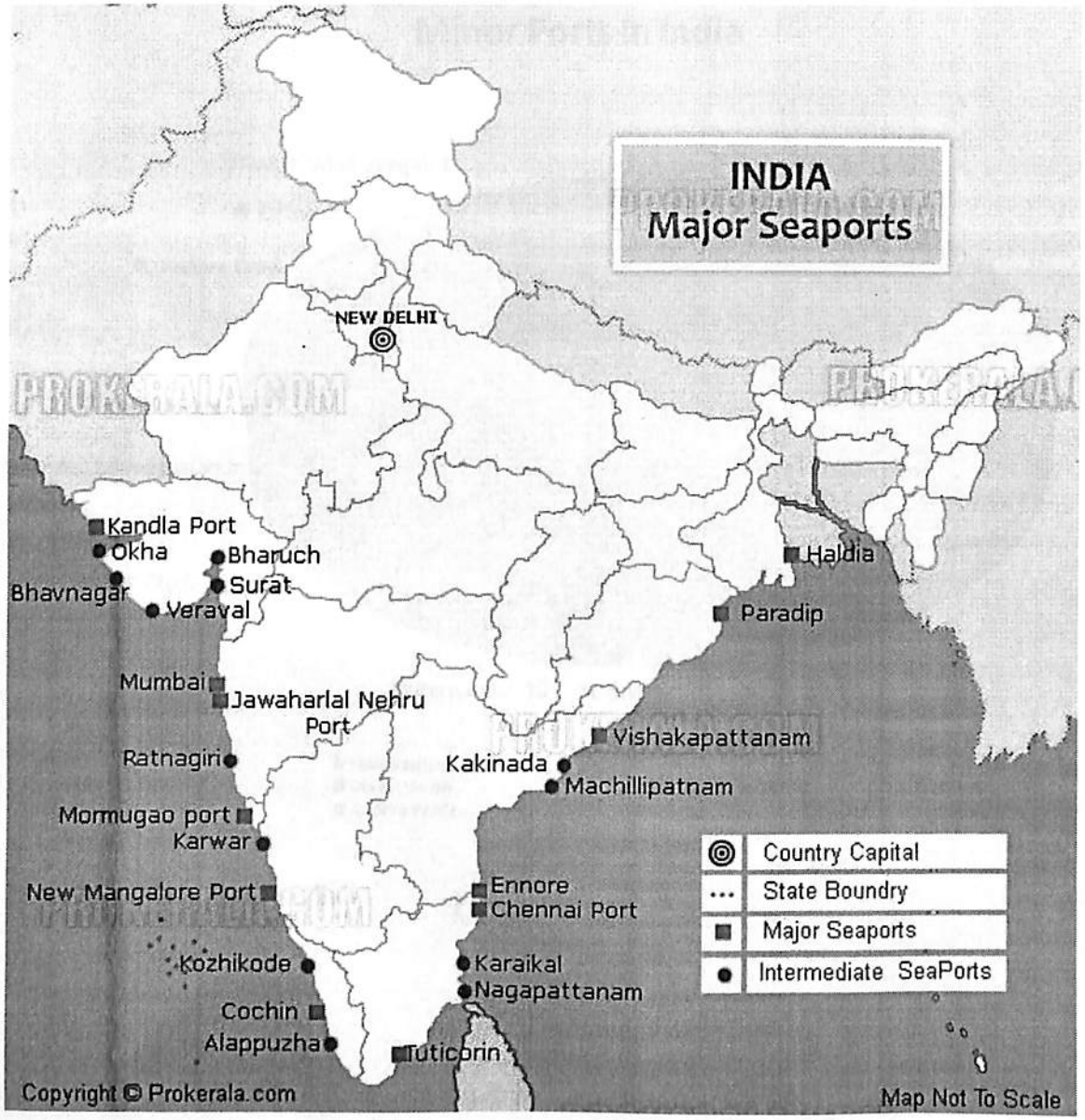


Figure 2.1: Major Ports of India

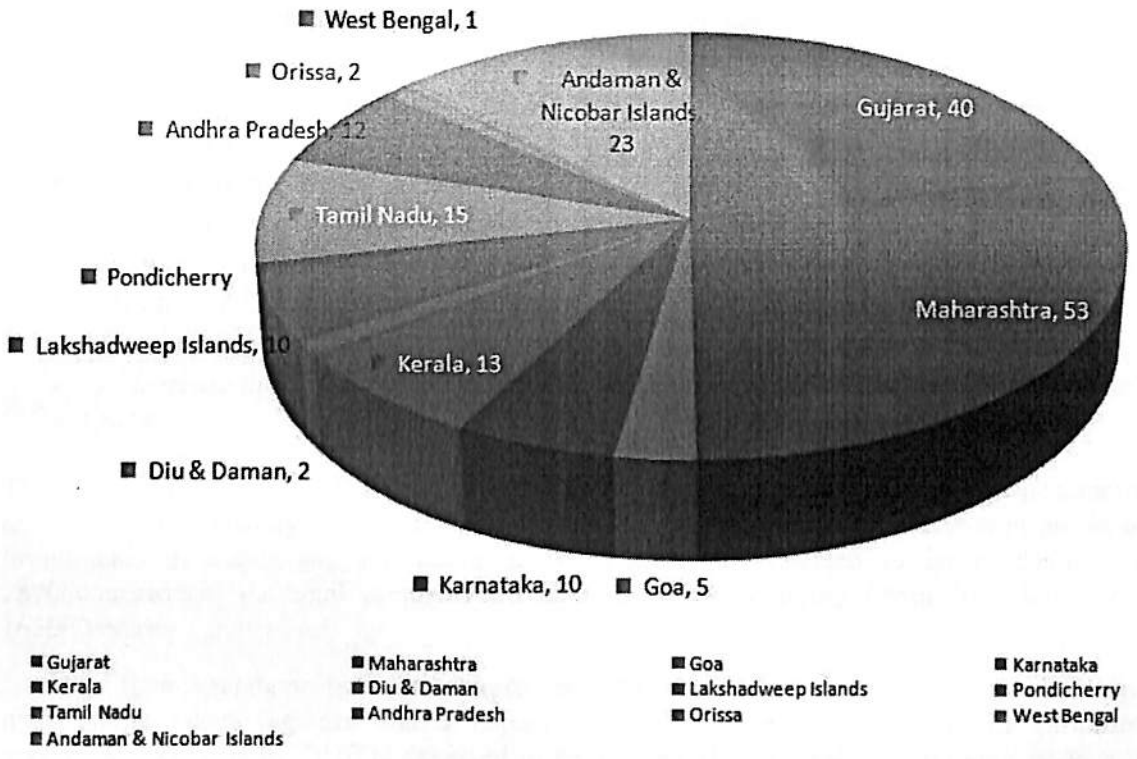


Figure 2.2: Minor ports of India

2.2) Maritime Agenda 2010-2020 (Highlights)

- *165000 Crore Rupees Investment Envisaged in Shipping Sector by 2020*
- *To create a port capacity of around 3200 MT to handle the expected traffic of about 2500 MT by 2020.*
- *To bring Indian ports at par with the best international ports in terms of performance and capacity.*
- *To increase the tonnage under the Indian flag and Indian control and also the share of Indian ships in our EXIM trade.*
- *To promote coastal shipping as it will help in decongesting our roads and is environment friendly.*
- *To increase India's share in global ship building to 5% from the present 1%.*
- *To increase the share of Indian seafarers in the global shipping industry to at least 9% by 2015.*

The Ministry envisages an estimated traffic of 2495 MMT in all ports including the non-metro ones. The total capacity of all these ports is expected to be 3280 MMT. The total proposed investments in major and non-major ports by 2020 is expected to be approximately 287000 crores and the total proposed investments in the shipping sector by 2020 – Rs. 165000 crores.

The Maritime Agenda projects a total traffic of 2494.95 million tonnes for all major and non-major ports taken together and a capacity of 3280.04 million tonnes. The proposed investments in ports by 2020 is expected to be 119449.41 crore and in non-major ports it is 167930.84 crore.

The agenda for the decade for the Ports are:

- *Create Port capacity of 3200 M.T. for handling about 2500 M.T. of cargo*
- *Improve Port performance on par with the best in the world.*
- *Increase tonnage both under the Indian flag as well as Indian control.*
- *Increase Coastal Shipping and facilitate hassle-free multimodal transport*
- *Increase India's share in global ship building to 5%.*
- *Promote use of the inland waterways for cargo movement*
- *Increase India's share of seafarer to 9% of the global strength by 2015*
- *Implementation of the Port development projects*
- *Develop Two New Major Ports one each on east and west coasts.*

- *Full mechanisation of cargo handling and movement*
- *Major Ports to have draft of not less than 14 metres and hub ports 17 metres*
- *A new policy on dredging*
- *Identification and implementation of projects for rail, road and inland waterway connectivity to ports*
- *Development of two hub ports on each of the West and the East coasts – Mumbai (JNPT), Kochi, Chennai and Visakhapatnam*
- *Port Policy Measures*
- *Corporatisation of Major Ports*
- *New Land Policy for Major Ports*
- *New Policy on captive berths*
- *Establishing a Port Regulator for all ports for setting, monitoring and regulating service levels and technical & performance standards*
- *New Policy on dredging*
- *Shifting of transhipment of Indian containers from foreign ports to Indian ports*
- *Policy on co-operation and competition amongst Indian Ports*
- *Establishing 'Indian Ports Global' for overseas investments by Indian Ports*

The agenda for the decade for Shipping are:

- *Increase in Indian tonnage through necessary policy interventions*
- *Declaration of Coastal Shipping Policy*
- *Establishment of a 'Freight Exchange'*
- *Creation of Ombudsman/ Tribunals for Shipping matters*
- *Formation of an independent Marine Casualty Investigation Cell*
- *Establishing a P & I Club in India*
- *SCI to have ambitious vessel acquisition plans to lead the growth in Indian tonnage*
- *Introduction of passenger ferry services between India and nearby countries*
- *Ro-Ro Ferry service in Gulf of Kutch, Gulf of Cambay and other suitable places*
- *Strengthening of capacity for Port State Control and Flag State Inspections*

- *Promotion of multi-modal transport operations for door to door delivery*
- *Promotion of Salvage Company in India, with Viability Gap Funding if required*
- *Introduction of new Shipbuilding Subsidy Scheme*
- *Grant of Infrastructure Status to shipbuilding industry*
- *Purchase preference for Indian shipyards in procurement of ships by Government through global tenders*
- *Expansion of Cochin Shipyard*

For Inland Waterways the agenda envisages:

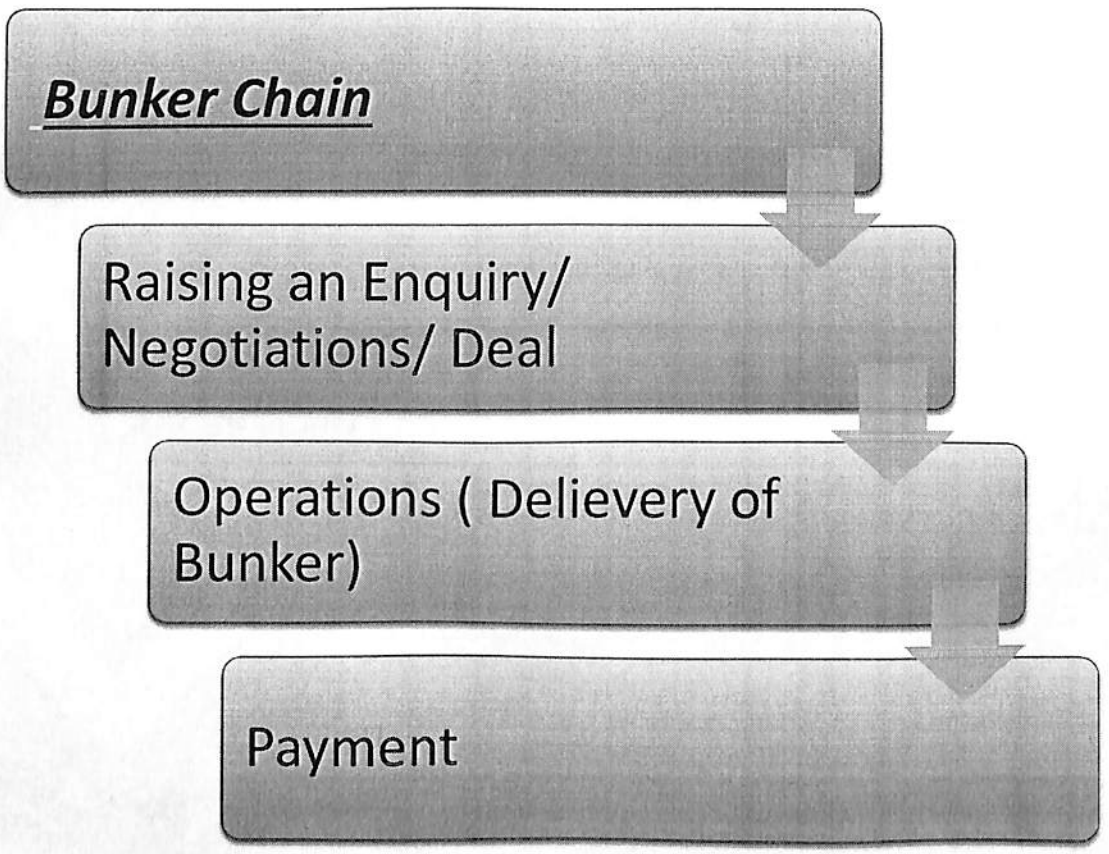
- *Development of IWT infrastructure*
- *Declaration of River Barak as National Waterway no.6*
- *Development of National Waterways 4 & 5*
- *Extension of National Waterway No. 3 in Kerala*

The agenda also envisages:

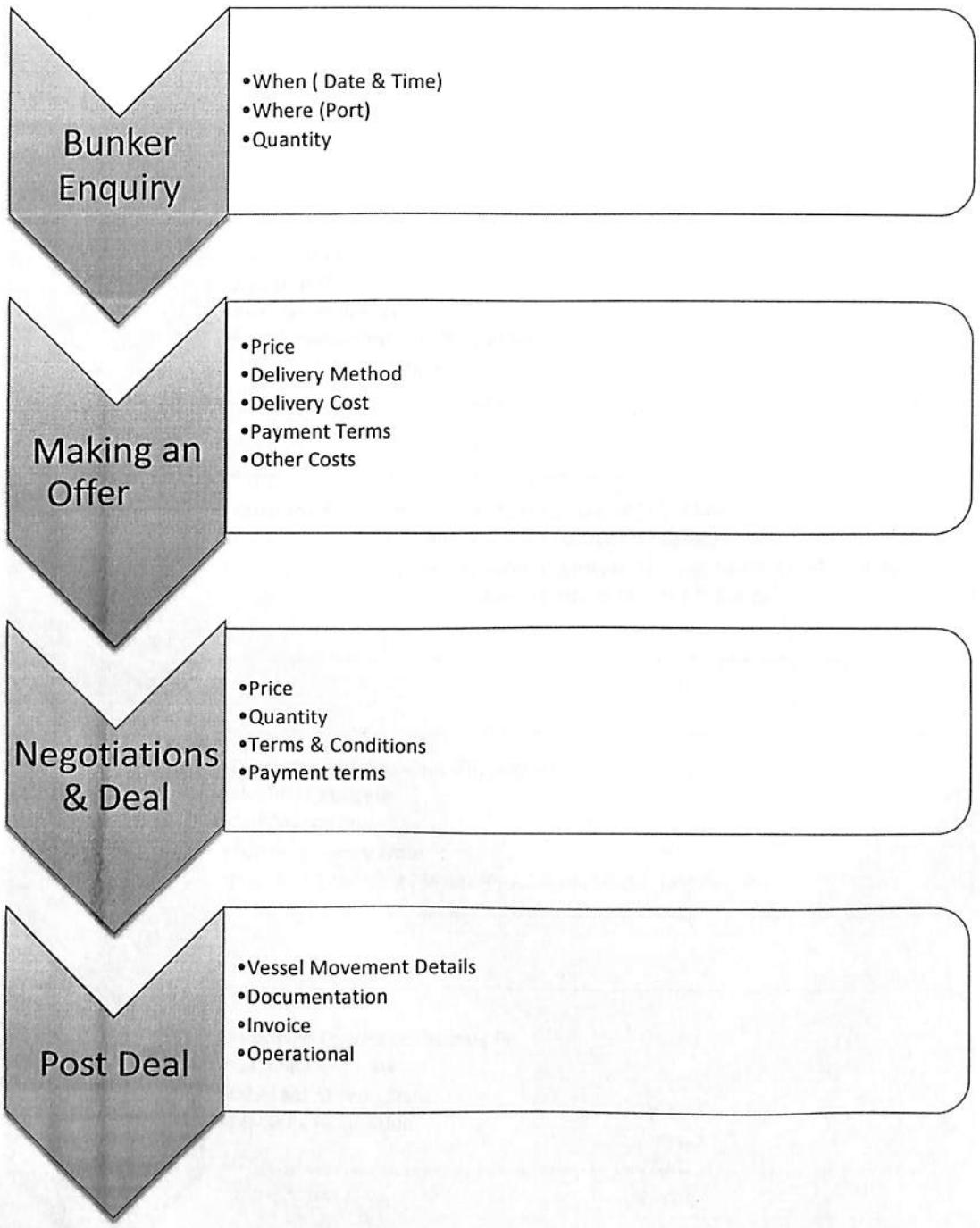
- *Enactment of a new Indian Ports Act replacing Indian Ports Act 1908 and the Major Port Trusts Act 1963*
- *Enactment of Admiralty Act*
- *Enactment of Shipping Trade Practices Act*
- *Review of the law on the Multimodal Transportation of Goods*
- *Revision of the law on Lighthouses and Lightships*
- *Amendment of Merchant Shipping Act*
- *Control of piracy through concerted international action*
- *Bilateral maritime agreements with selected countries/regions for mutual benefit*
- *A framework for cooperation between Indian ports and those in other countries*
- *Collaboration of IMU with top global academic institutions in the maritime sector*
- *Renewal and strengthening of Indo-Bangladesh Protocol on Inland Water Transport*

Chapter 3: Bunker Chain

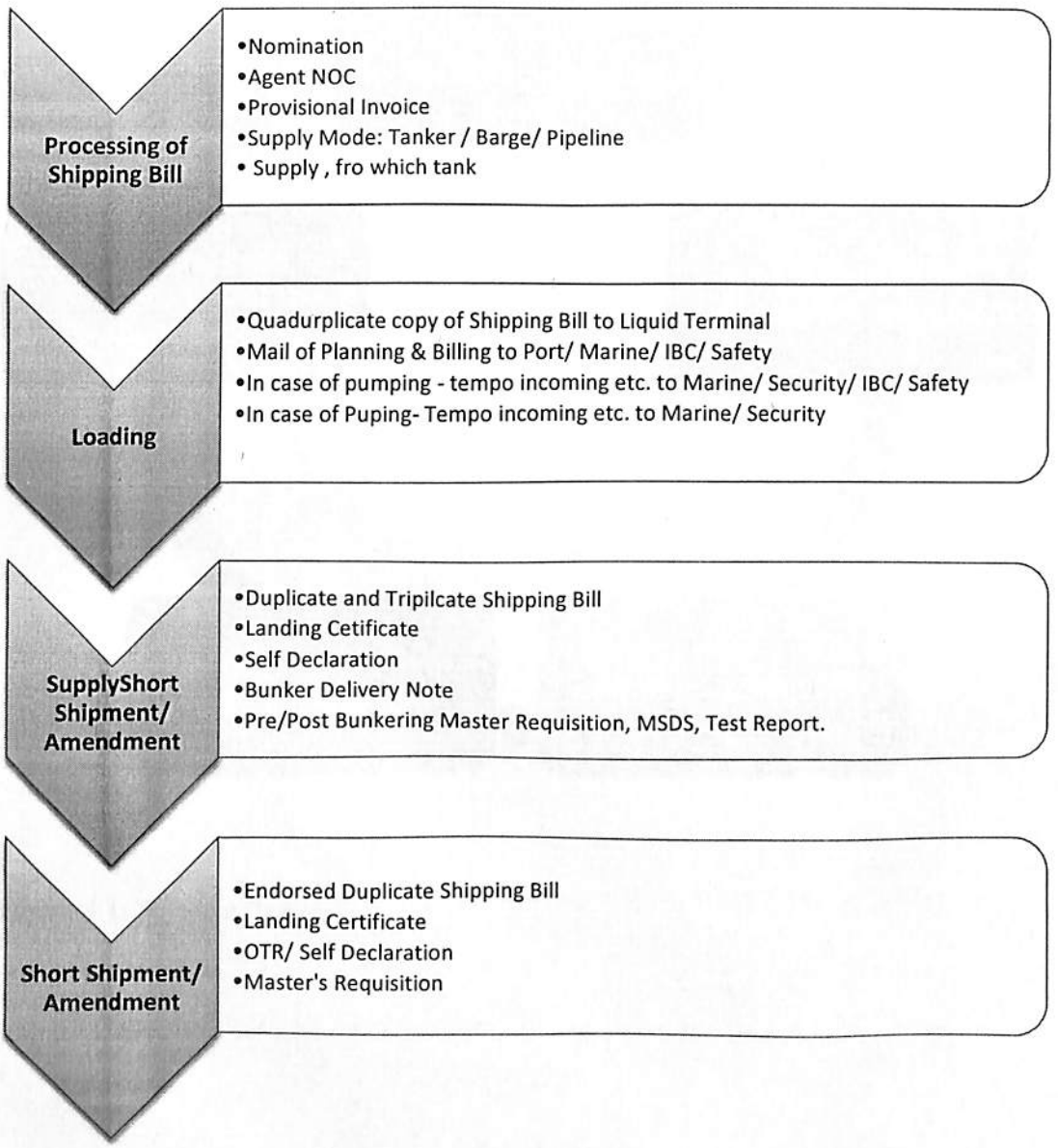
Main Bunker Chain:



1. *Raising an Enquiry/ Negotiations / Deal or Commercial Terms:*


Bunker Enquiry
•When (Date & Time)
•Where (Port)
•Quantity
Making an Offer
•Price
•Delivery Method
•Delivery Cost
•Payment Terms
•Other Costs
Negotiations & Deal
•Price
•Quantity
•Terms & Conditions
•Payment terms
Post Deal
•Vessel Movement Details
•Documentation
•Invoice
•Operational

2. Operations:



3. Payment:

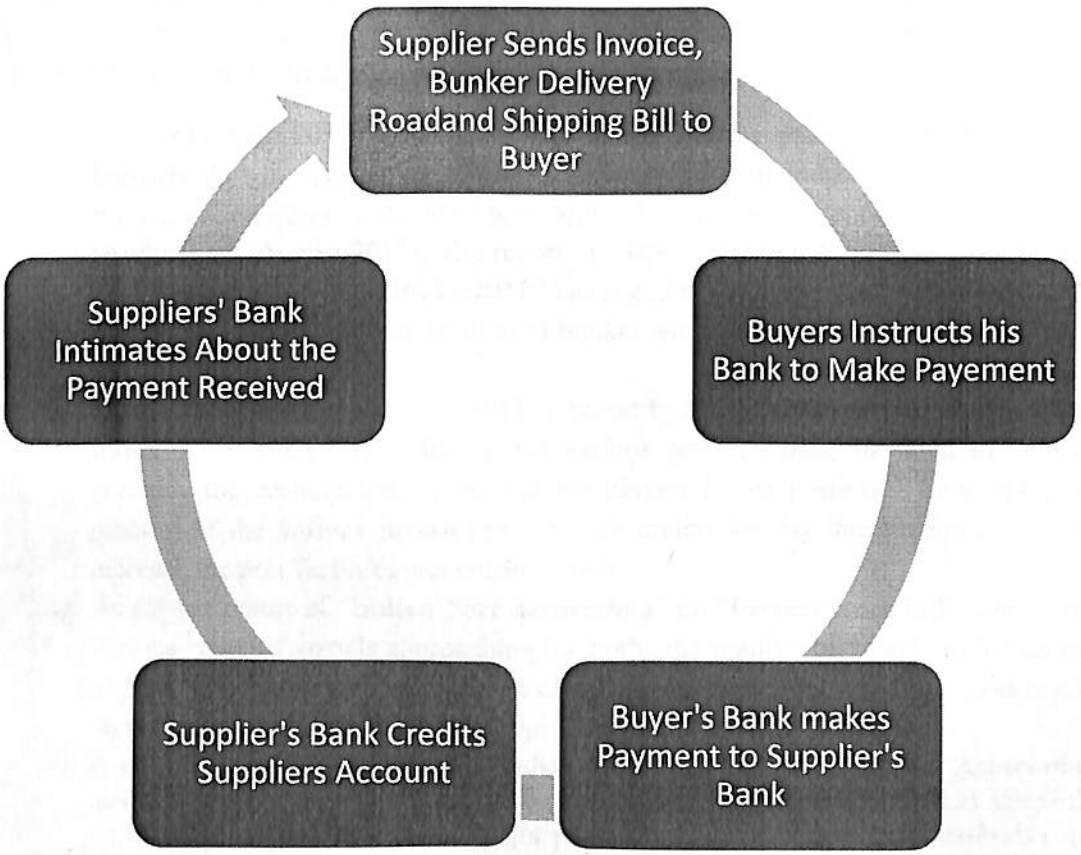


Figure 3.1: Payment Process

Chapter 4: Literature Review

The literature review has been taken from reports of various ministries. The reports have been taken from various ministries as the bunker industry has not set up so far in India so there are hardly any research papers available on Bunker Potential, thus the reports of the different ministries has been referred.

1) (Giannakouros, 2012)"This report has stated various problems faced by the bunker Industry and the issues related to the management of bunker. The issues of quality, infrastructure, quantity etc. have been primarily stated in the report.
2) (Andreassen, August,2012), The report by **"DNV Petroleum services, August,2012"** on **"Implementation of ISO8217:2012"** has stated the various standards of Marine fuel and has compared the ISO specification of bunker with the previously followed specifications of 2010 and 2005.
3) **"Indian mineral yearbook of 2011"** a report by **"Indian Bureau of Mines, Ministry of mines government of India"** stated various port facilities, the kind of ship channel projects, the participation of the various players in the ports etc. This report has also mentioned the various investment schemes undertaken by the government of India to increase the port facilities and enhance trade.
4) As per the report of **"Indian Port Association"** on **"Performance indicators, 2013"** the various types of vessels approaching the ports, the number of vessels called on the ports of India and the cargo wise break up of vessels has been focused. This report has focused on the number of vessels called on the Indian ports.
5) A magazine on "Cargo traffic at Indian Ports,2013" by **"Indian Port Association"** has also done analysis of the cargo traffic at Indian ports .This magazine has stated the year wise cargo traffic at minor and major ports of India. Traffic handled vis-à-vis capacity a major port has been stated in the magazine.
6) (Government, "REDUCTION OF GHG EMISSIONS FROM SHIPS", December, 2011) **"REDUCTION OF GHG EMISSIONS FROM SHIPS"** This document discusses the possible impact of Market-Based Measures (MBM) for international shipping on India's shipping trade. The document also suggests maintaining consonance in GHG reduction measures between IMO and UNFCCC to protect the interest of the shipping industry.
7) (Government, "Maritime agenga: 2010-2020", January, 2011) This report has focused on the initiatives which the government of India is about to take. This report has an agenda in which the government will invest on ports to improve the infrastructure and increase the cargo handling capacity of the ports.

Chapter 5: Objective

The overall objective of research is to study the potential of **INDIAN BUNKER INDUSTRY** and how it is growing in INDIA. The export, import, facilities available at the port, types of the vessel called at a particular port, types of a cargo handled at a particular port etc., data are analyzed. Along with secondary data from various sources like internet primary data were obtained by the major players of the shipping industry i.e. ship brokers, charterers, ship owners, etc. and it was also analyzed to give an overall view of the future scenario of the BUNKER MARKET IN INDIA. The pricing by MOPS, the export import policy of the government of India and the Shipping Ministry has also been studied and its implications on the shipping industry and growth of the bunker industry has been predicted which would help the organizations to plan and expand their business across various major ports of the INDIA.

To analyze the performance of the INDIAN BUNKER MARKET the performance of various international ports nearby has also been considered and a comparative outlook is presented the research, which would ultimately give us the PROS and CONS of the INDIA SHIPPING INDUSTRY.

Objectives of the study:

1) To study the potential of Bunker Market on Major ports of India.
2) To generate the formula for calculating the future sales of bunker in India.
3) To Study the market gap on major ports of India.
4) To study the tax policy of India and Singapore.

Areas to be covered:

1. The export import, types of vessel called, annual traffic etc. and individual ports to be covered up.
2. Analyzing the data provided by the various players of the Shipping Industry and predicts the future of the bunker industry in future.
3. The policy of the Indian Shipping Ministry and the EXPORT IMPORT country wise as per of the Ministry of Commerce is also studied and based on the policies the expected growth of shipping cargos are predicted which have an indirect implication of the growth of the Bunker Market in India.

Chapter 6: Research Methodology

The research project on **The Potential of Bunker Market on major ports in India is** new for the INDIAN Bunker market. The research methodology to precede the research will be **Analytical.** The primary data will be collected from various sources like questionnaires, telephone, E-mails etc. that represent the shipping industry. The secondary data was collected from sources like internet and the available data with the industry players. The primary and secondary data were critically analyzed using tools like regression, weighted average etc. to predict the future of the Bunker Market in India and will help **bunkering Industry** to take decision about the expansion plan of bunkering chain in INDIA.

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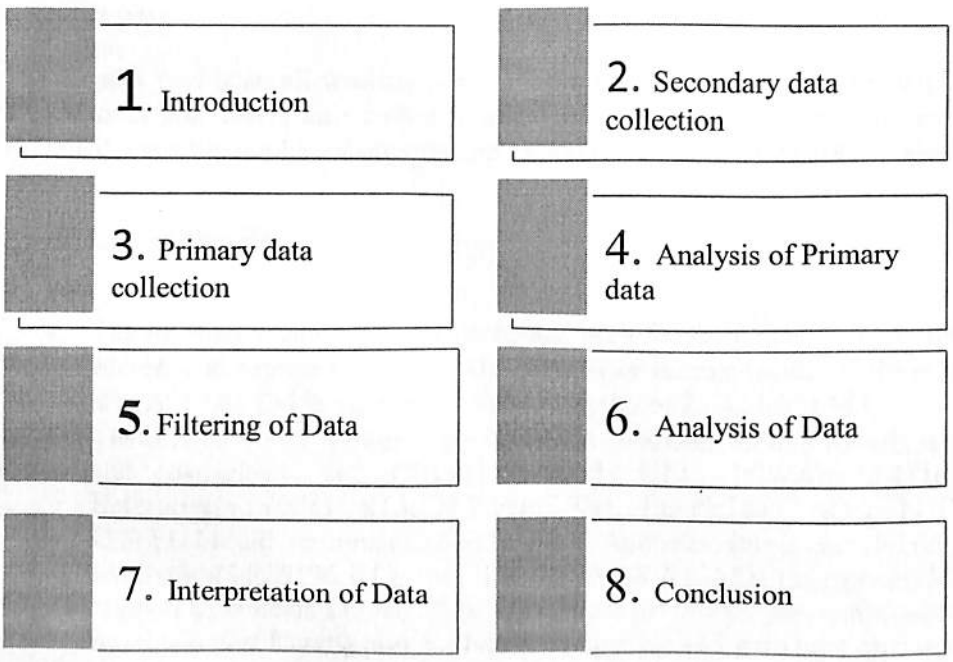


Chapter7: Data Analysis

There are mainly 13 major ports in India along with 187 minor and intermediate ports. The major ports of India handle more than 70 % of the total traffic at the ports. Among the major ports Kandla port in Gujrat handles the maximum traffic as per the Ministry of shipping. There are various major ports in India like Kandla, Mumbai, JNPT, Murmogao, and Cochin on the western coastal region of India. The major ports on the Eastern coast of India include Tuticorine, Vizag, Haldia, Kolkata, Ennore, Chennai etc.

7.1) Performance of different Major Ports of India

The ports on the Indian coast which plays a significant role for handling of traffic are as follows:

7.1.1 KANDLA, Gujrat

The port of Kandla is located in the Gujrat State. This port has handled the major share of the Indian traffic at ports. As per the port authorities and the Ministry of shipping, Kandla port has been considered as the port which has handled 93.3 million tons of total cargo in the last financial year.

The Kandla Port is an all-weather port, i.e all types of the cargo can be handled in all weathers. The Kandla port offers an excellence and vast Dry cargo storage facilities inside the Custom Bounded areas for storage of imports and exports of cargo at competitive rates.

Facilities at the Port:

- The existing facilities in dry cargo are Ware house Open with an area of 1.44 lakhs sq. Meters and capacity of 3.83 lakhs. The other storage facility is the storage space with an area of 10.65 Lakhs sq. meters and a capacity of 23.42 lakhs MT.
- The private liquid storage capacity is also available around Kandla complex no. of tanks and capacities as, CRL(112,247000 KL), FSWAI(132,271650 KL), Kesar Enterprise(44,90081 KL), N.P.Patel Pvt. Ltd.(9,38497 KL), FOCT(21,39263 KL), USTTL-Liquid terminal(22,63022 KL), Agencies cargo care ltd.(27, 50000 KL), J.K Synthetics(14,25176 KL), IMC ltd. (4, 25288 KL), J.R Enterprise(15,25320 KL), INDO Nippon Chemicals Ltd. etc. Their few more private players contributing in this. The total no of takers at Kandla port for liquid storage are 465 with total capacity of 9,80,508 KL
- The Public companies which operate at Kandla port as far as the liquid storage is concerned are IOCL(38, 575838 KL), BPCL(21,230000 KL), HPCL(28, 204000 KL) and few more including IOC-LPG,IFFCO, NDDB which has a total 109 tankers with a capacity of 12,08,369 KL.

Strategies of the Port

There are number of port strategies which have been worked upon or planned in near future. The facilities such as deepening of the Draft upto 14 meters, Installing an Eight ELL cranes to handle 20/25 tons of cargo, development of container terminal on BOT basis and privatization of various port services etc..

Location :

The Kandla port is located in Gujrat in the Kandla Creek and it is located 90 kms from the mouth of the Gulf of Kutch

Latitude: $23^0 01'$ N

Longitude: 70^0 13'E

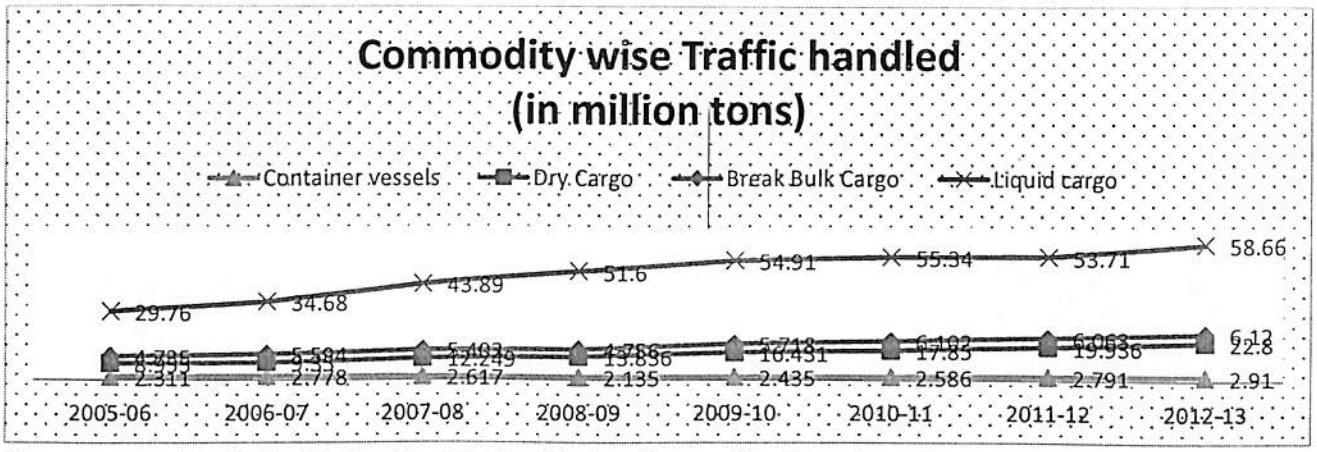
Commodities handled at the Port:

1. Dry Cargo (Fertilizers, Raw material, Cement, ores and minerals, granites, metals, wood cotton, salt, jute products, sugar, arms and ammunition etc.)
2. Container Cargo
3. Break Bulk Cargo
4. Liquid Cargo (Crude, POL products, Edible oil etc.)

Performance of the PORT

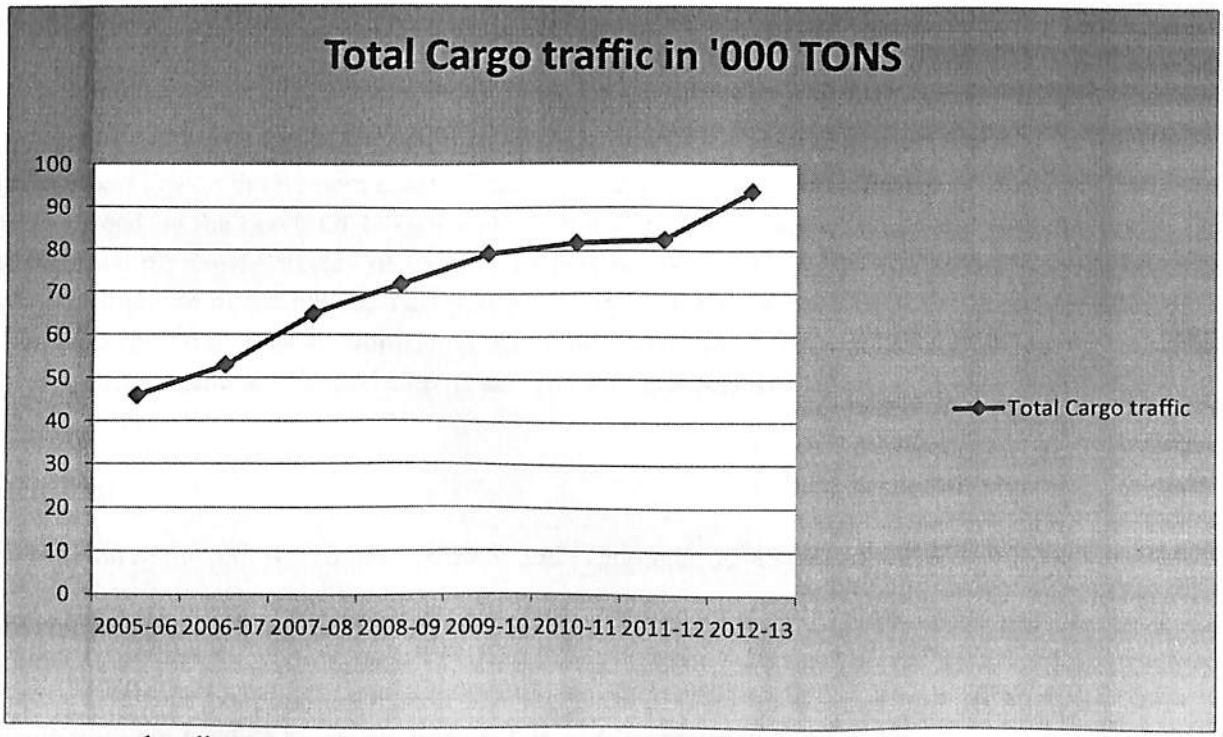
Kandla port has 23 berths and handled about 93.6 MT of cargo in the last financial year which is more than its 100% efficiency. This port has been the major port which handled the largest amount of cargo in the last year among all the ports in India.

Table 7.1.1: Commodity wise Traffic Handled (in million tons)



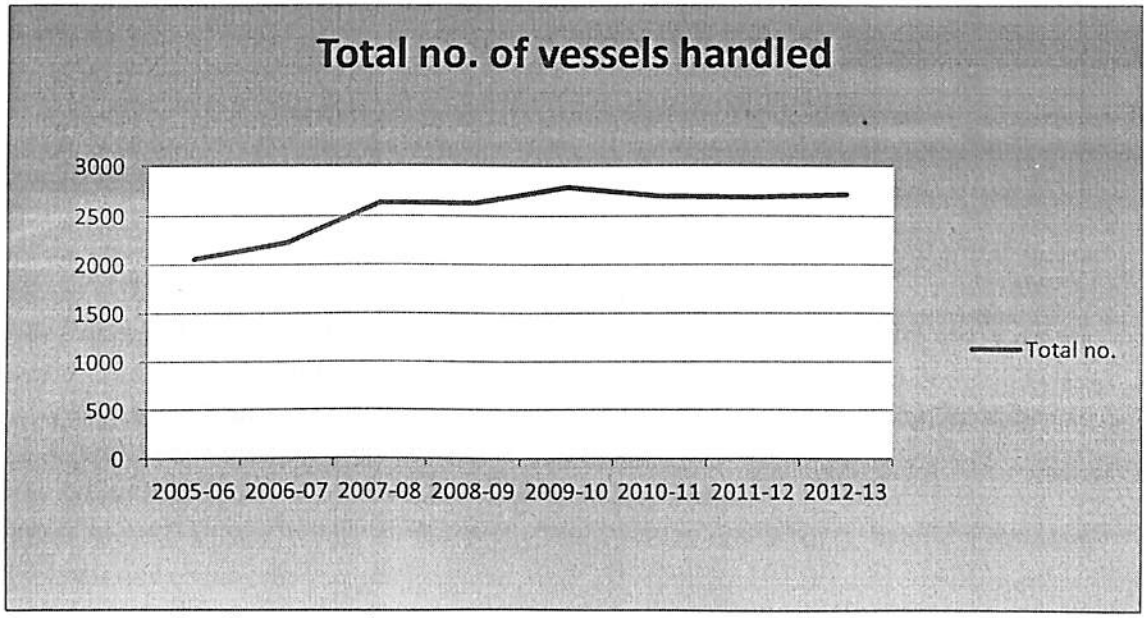
Source: www.ipa.nic.in (Indian Port Authorities) and www.Kandlaportgov.in

Table 7.1.2: Total Cargo Traffic in '000 tons at Kandla Port



Source: www.kandlaport.gov.in

Table 7.1.3: Total no. of Vessels Handled



Source: www.kandlaport.gov.in

7.1.2 MUMBAI PORT, Maharashtra

Mumbai port lies on the western coast of India on the natural deep water harbor of Mumbai. The port is owned by the Govt. Of INDIA and is administered by Mumbai Port trust. Mumbai port has been the principal gateway of India. This port has played a vital role in the economic and trade development of the nation. This port has accepted the changing shipping trends to handle different cargo from bulk to unitization and containerization. Tis port has developed special berths to handle general POL and Chemicals. The Mumbai port trust comes under the ministry of shipping, India.

Location:

The location of the port is Latitude: $18^{0}56.3'$ and Longitude: $72^{0}45.9'$.

Commodities handled:

There are various commodities handled at the port. It is an all-weather port so all types of commodities are handled here including the Dry and liquid cargo.

The commodities include

- Dry Cargo like steel, iron ore etc.
- Break bulk cargo is also handled at the port such as Fertilizers and liquids.
- Container cargo facility is also available at the port which can handle the cargoes like woods, cloths, cotton etc.
- Liquid cargo includes crude oil, oils, edible oils etc.

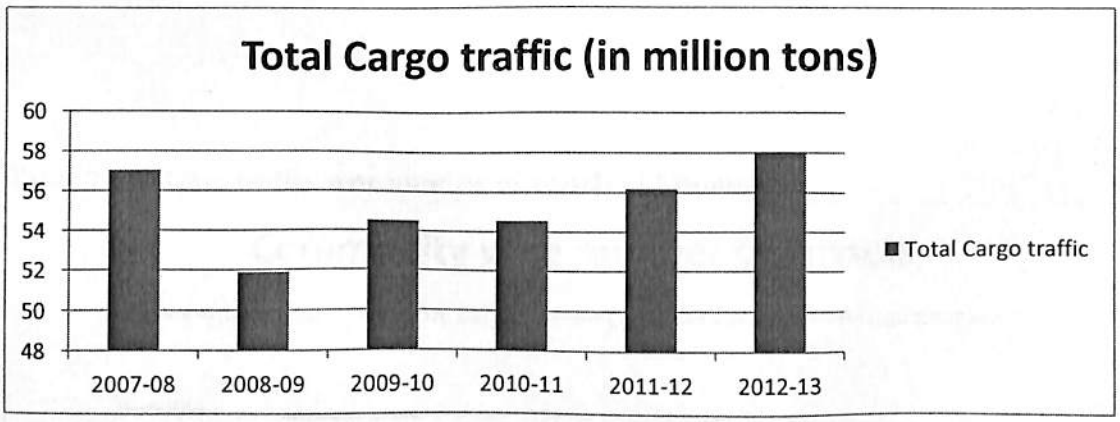
Facilities at the Port:

This port is an autonomous body formed by the Govt. Of India under the ministry of shipping, to look after the Mumbai port and all the services and activities associated with the port. The Port is a natural deep water port that has been on the maritime route since centuries.

- There are three main Docks named as Princess Docks and Victoria Docks and Indira Docks. All these are enclosed and are wet natural docks.
- The Princess dock has eight berths, Victoria docks has 14 berths and Indira docks has 21 berths. The minimum draft in these three docks is b/w 21 feet and 23 feet
- At Victoria and Princess the ships can depart only at high tides but at Indira the ships can be departed any time as it is operated by a lock system.
- The Island in the port called JawaharDweep includes 4 jetties.
- There are 63 anchor points at the port. These jetties are used to handle Petroleum Products and chemicals.

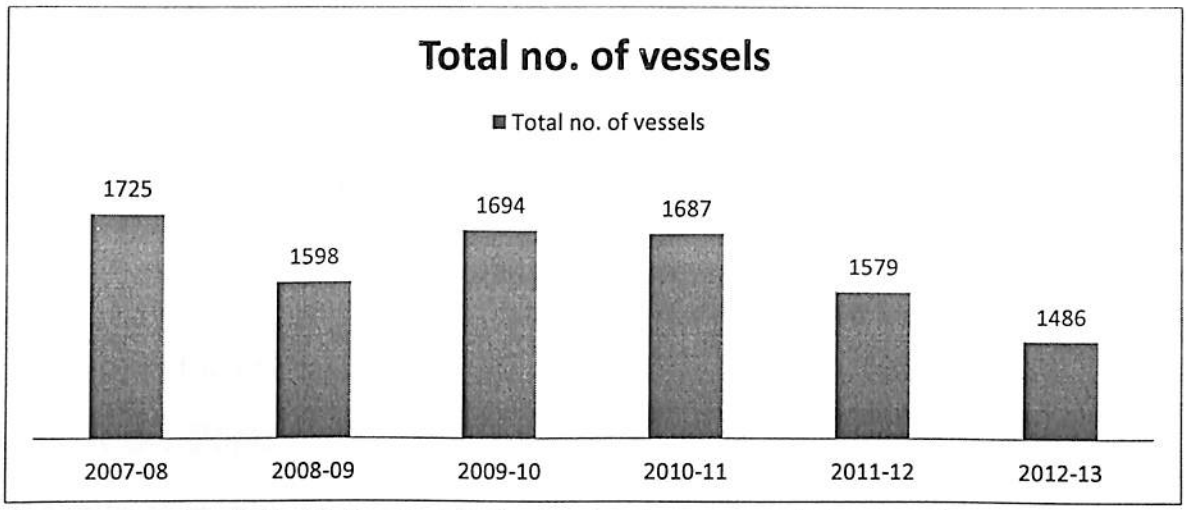
Performance of the Port:

Table 7.1.4: Total cargo traffic at Mumbai



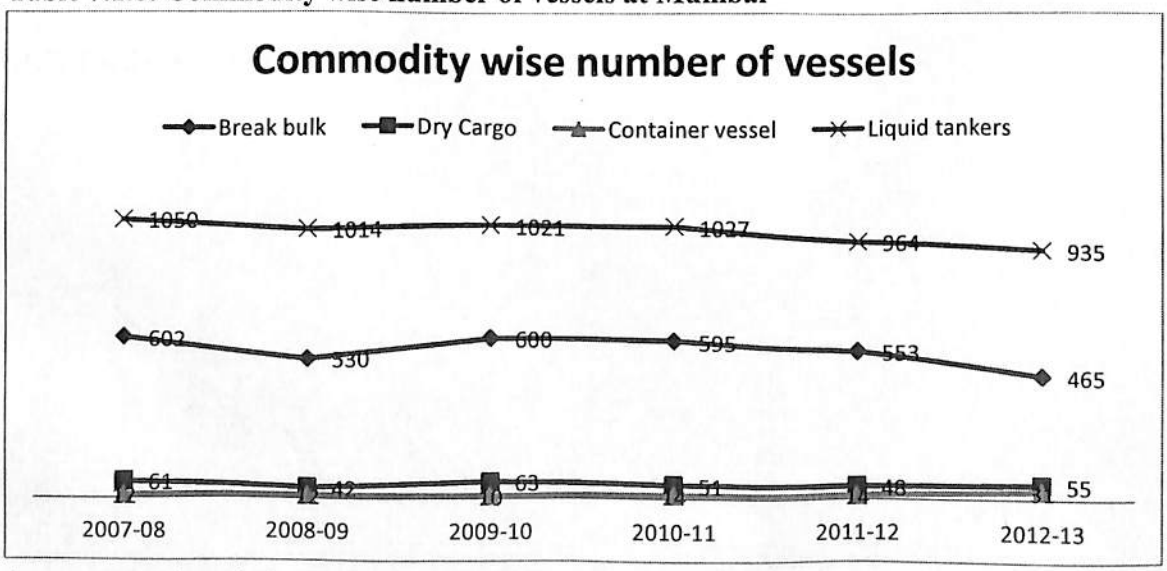
Source: www.ipa.nic.in (Indian Port Authorities) and www.mumbaiport.gov.in

Table 7.1.5: Total number of vessels at Mumbai



Source: www.ipa.nic.in (Indian Port Authorities) and www.mumbaiport.gov.in

Table 7.1.6: Commodity wise number of vessels at Mumbai



Source: www.ipa.nic.in (Indian Port Authorities) and www.mumbaiport.gov.in

7.1.3) NHAVA SHEVA (J.N.P.T), Maharashtra

JNPT port is India's biggest container port which handles more than 50% of the total container traffic of India. The port has a target of handling more than 10 million TEU's by the end of 2014-15. This port is an all-weather port and can handle any kind of commodity. This is situated on the eastern shore of Mumbai harbor south and a common channel wit Mumbai port upto the point of entry of the channel.

Location:

The port is located at Latitude 18 56' 46" N and longitude 72 57' 31" E, Maharashtra.

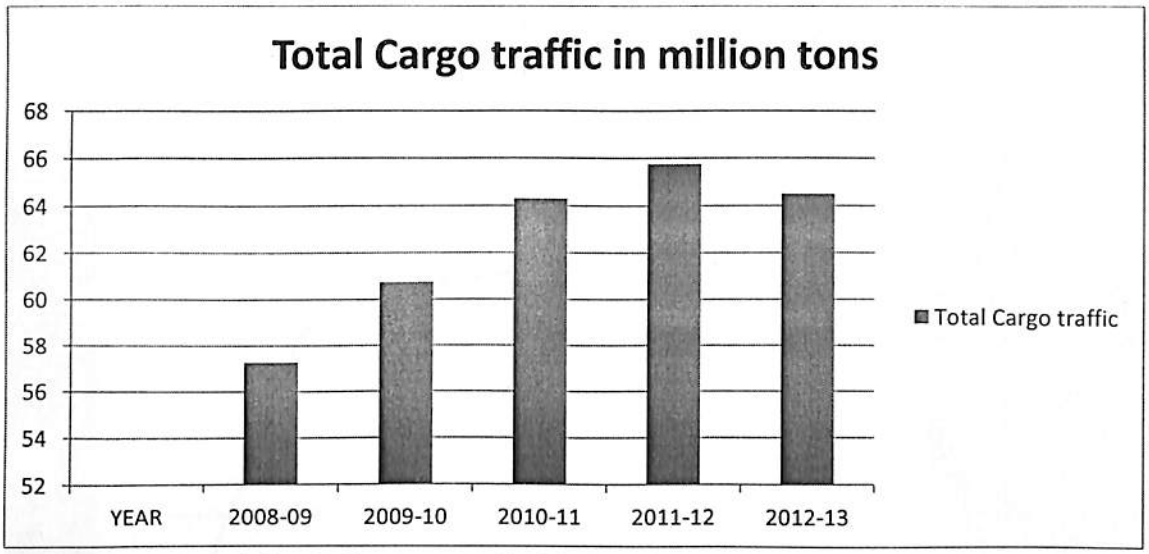
Facilities at the Port:

- The designed channel depth is 11 meters. The depth at the berth is 13.5 meters. The channel width is 250 meters at the entry point.
- The port presently handles only third generation and fourth generation container vessels.

Port Performance:

The performance of the port has been considered by analyzing the data available on the port websites.

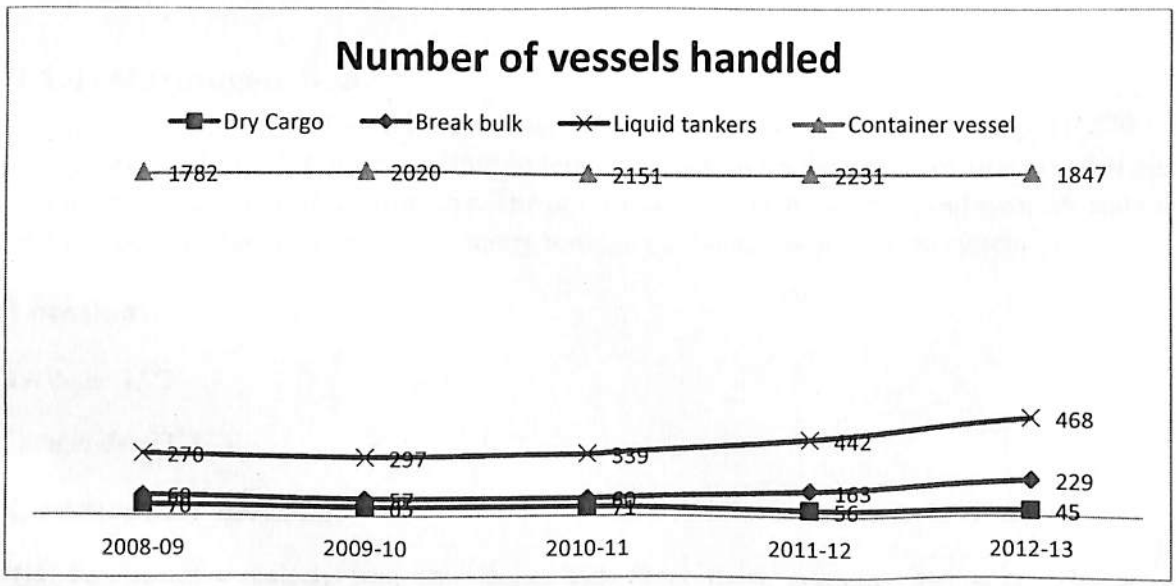
Table 7.1.7: Total cargo traffic at JNPT



Source: www.ipa.nic.in (Indian Port Authorities) and www.mumbaiport.gov.in

This graph shows how the cargo traffic has grown over the years on Mumbai port. With the expansion of J.N.P.T port there has been a reduction in traffic handled at Mumbai port.

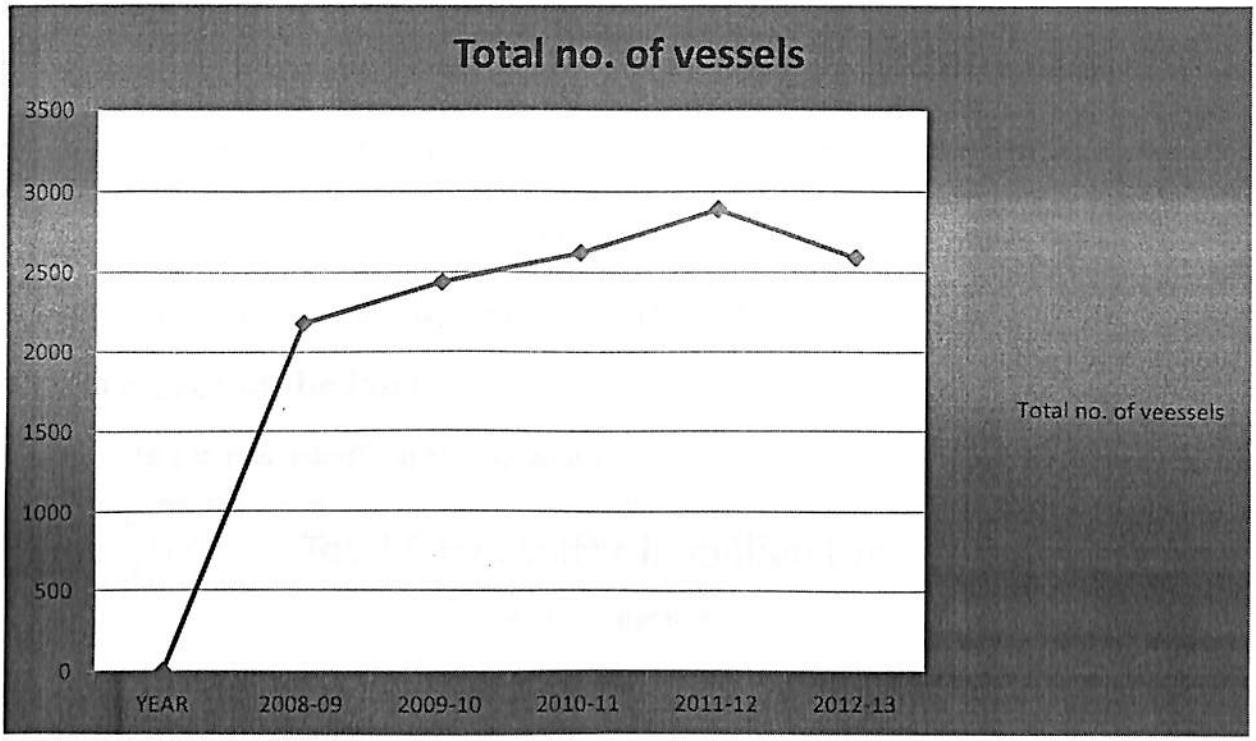
Table 7.1.8: Number of Vessels Handled at JNPT



Source: www.ipa.nic.in (Indian Port Authorities) and www.mumbaiport.gov.in

As far as the number of vessels at Mumbai port is concerned this graph shows a stagnant growth over the years in the traffic. There has been a reduction in the total number of vessels handled at Mumbai port as per the Indian Port Authorities.

Table 7.1.9: Total number of vessels at JNPT



Source: www.ipa.nic.in (Indian Port Authorities) and www.mumbaiport.gov.in

7.1.4) Mormugao, Goa

Mormugao port is situated on the west coast of India in the state Goa which is approx. 370 km from south of Mumbai. Before the court orders of restriction on the export of Iron ore, this port was the major exporter of the Iron Ore. The port is well connected with the rail-network and this port is accessible for any part of the country through the broad gauge railway system.

Location:

Latitude: $15^0 25'N$

Longitude: $73^0 47'E$

Commodities handled:

The Port handles majorly Iron Ore along with Steel slabs, Alumina, Pet coke, Met coke, Limestone, Coal etc.

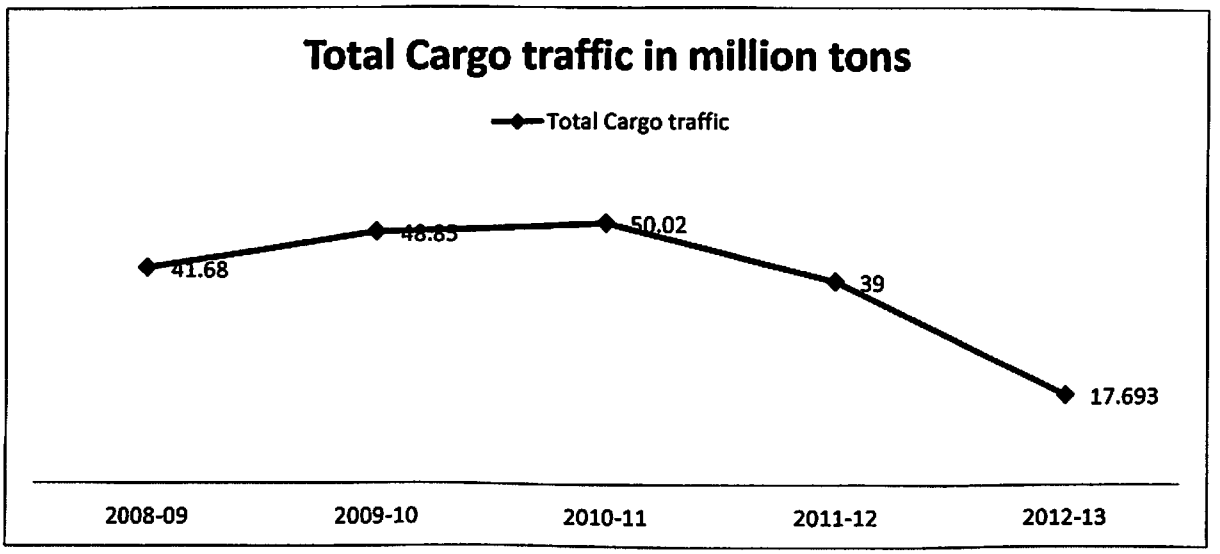
Facilities:

- Berth no. 1, 2, 3, and 4: These have Modern ship repair complex with floating dry dock facilities.

- Berth no. 5 and 6: The Coal handling facility is available
- Berth no. 7: This is an Upcoming terminal for handling coal cargo with a capacity of 5.5 million tons in near future
- Berth no 8: This berth Handles petroleum product of about 1.5 million tons. This berth also handles phosphoric acid, caustic soda and molasses.
- Berth no. 9: Berth 9 has fully mechanized Ore handling plant.
- Berth no. 10 and 11: Multi-purpose general cargo berth and handles other cargo like coal, fertilizers, and Alumina, pig iron, cement and timber logs.

Performance of the Port:

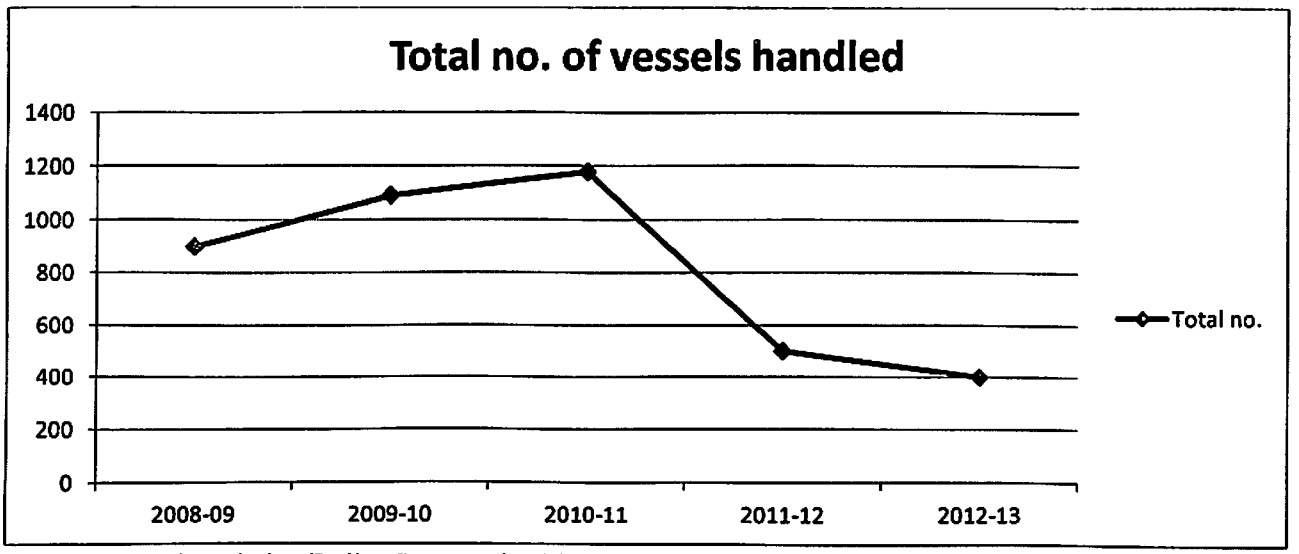
Table 7.1.10 Total cargo traffic at Murmogao port



Source: www.ipa.nic.in (Indian Port Authorities) and www.mumagaoport.gov.in

With the orders of Supreme Court on restriction for Exports of Iron Ore, There has been a huge decrease in the traffic because of which the number of vessels is also decreased on this port. This has happened because this port majorly handles the Iron ore business.

Table 7.1.11: Total number of vessels handled



Source: www.ipa.nic.in (Indian Port Authorities) and www.murmagaoport.gov.in

7.1.5) New Manglore Port trust (NMPT):

Manglore port is an all-weather port situated in the Manglore city of state Karnataka in south India 170 nautical miles south of Mormugao. This port has 15 berths which can handle all types of cargo like Dry cargo, liquid cargo, break bulk and container. NMPT is an ISO 9001:2000 port and in the process of ISO 14001 certification

Location:

Latitude: $12^0$55'5" N

Longitude: $74^0$48'5"E

Commodity Handled:

Various types of commodities are handled at the port like Iron Ore, Coal, Logs, fertilizers, Urea, Granite etc.

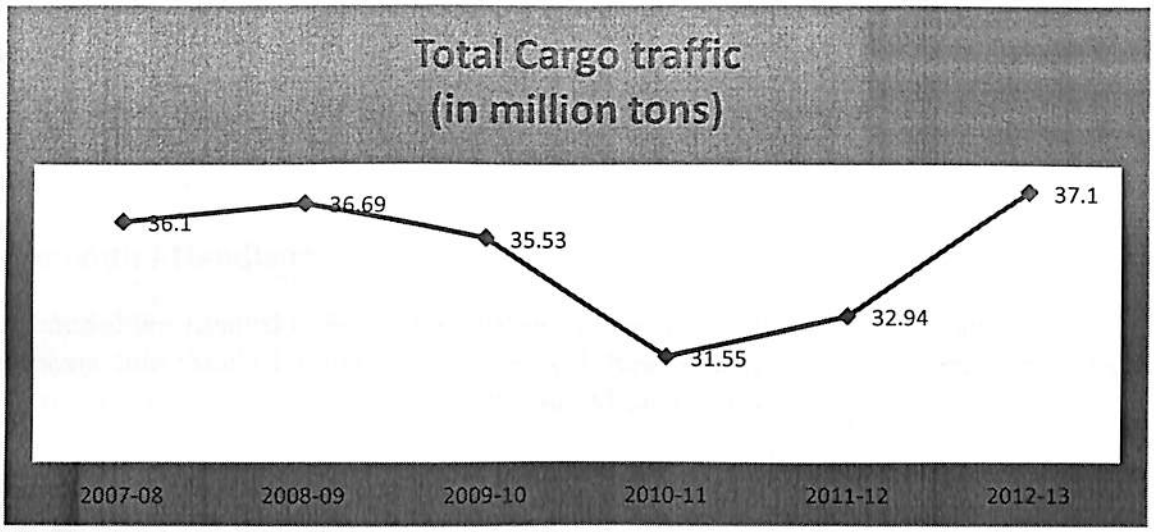
Facilities at the port:

- There are 15 number of berths available at the port premises
- Berth number 1,2,3,4,5,6,7 and 14 are for handling general cargo and liquid ammonia with draft size of range 7-14 meters
- Berth number 8 handles Iron ore the draft available is 12.50 m with LOA 300 m
- Berth 9 and 10 handles POL/LPG and Crude/POL Products with draft of 10.50m and 14.00m and the LOA of 330m and 320m respectively
- Berth number 11 and 12 also handles crude/Pol
- Berth 14 is a deep draft to handle general cargo with draft of 14.00m and LOA of 350 m

- Berth 15 handles coal with draft 14m and LOA of 300m

Performance of the Port

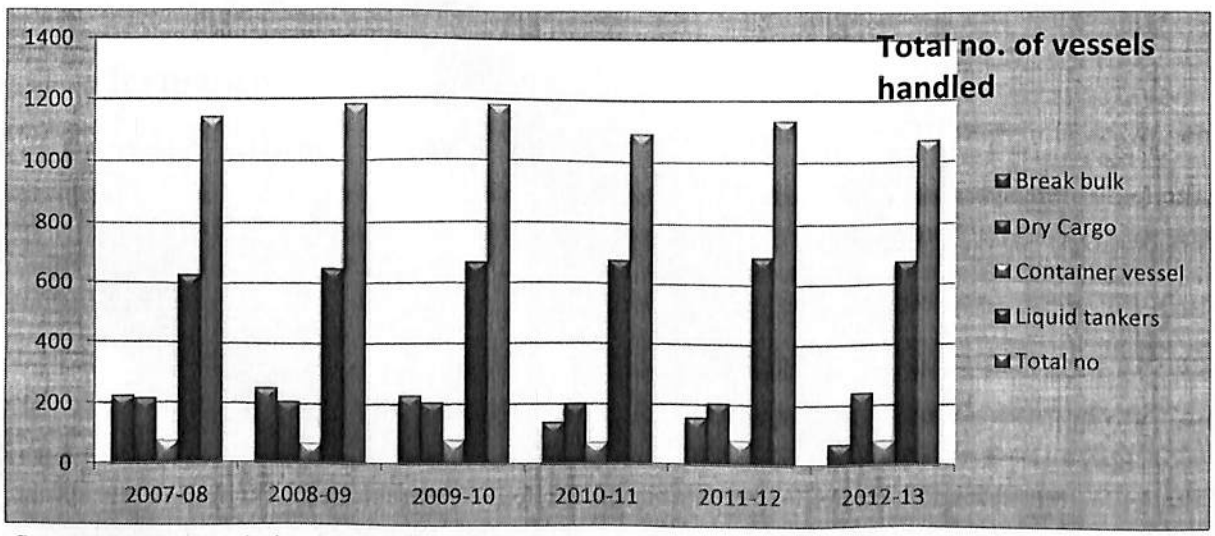
Total 7.1.10: Total Cargo traffic at Manglore port



Source: www.ipa.nic.in (Indian Port Authorities) and www.newmangaloreport.gov.in

The total cargo traffic at New Manglore port has been on the increasing trend. Though it reduced a bit during the 2010-11 but gained momentum again during 2012-13

Table 7.1.11: Total number of vessels handles at New Manglore



Source: www.ipa.nic.in (Indian Port Authorities) and www.newmangaloreport.gov.in

The number of vessels handled at the port over the years has been stagnant. This has been due to the policies and tax structures at the port.

7.1.6) Cochin Port, Kerala

Cochin port is situated on the west coast of India and is 10 nautical miles away from the direct sea route of Australia and Far East from Europe. This is the maritime gateway to peninsular India. Cochin is the fastest growing logistic Centre. The port is promoting a major Liquid terminal, bulk terminal and maritime industries in its port based SEZs.

Location:

Latitude: $9^0$58'N

Longitude: $76^0$14'E

Commodities Handled:

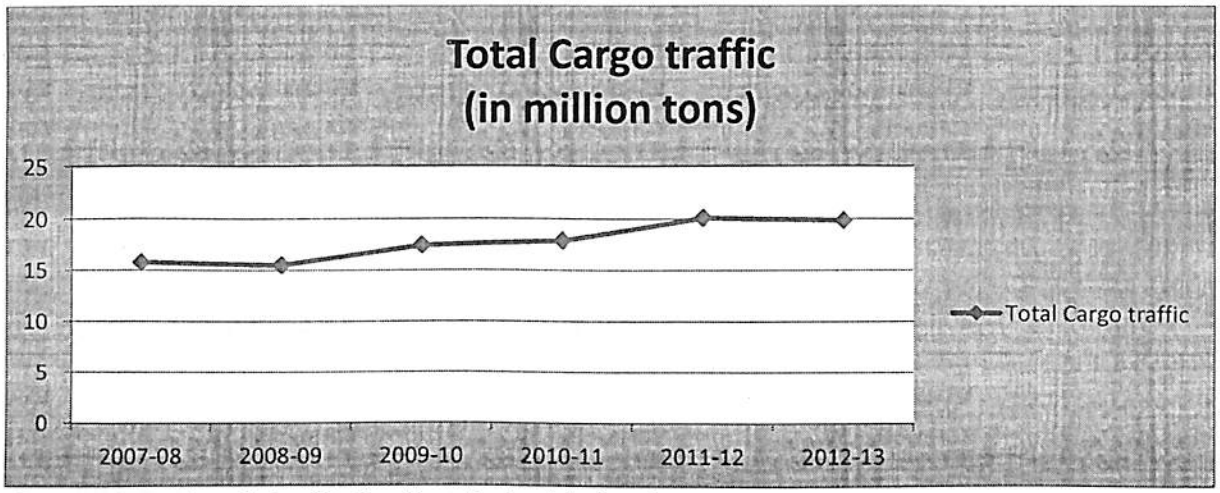
The commodities handled at the port are categorized as Liquid bulk, Dry bulk and containers. The commodities handled at the port include Coal, Raw Material and Fertilizers, Steel Cargo, Raw cashew, Zinc, Rock Phosphate/sulfur, Potash, Wheat, Crude etc.

Facilities at the Port:

- The port has facility of SPM with a draft of 22.50m with LOA 370m
- The port has COT (Cochin Oil Terminal), NTB (North Tanker Berth), STB (South Tanker Berth) and Fertilizer Berth with draft of 12.50m,9.14m,9.14m and 10.70m respectively
- There is an open space availability of 3500 sq. meter inside the Eranakulam wharf and an open space in North end side of Eranakulam wharf

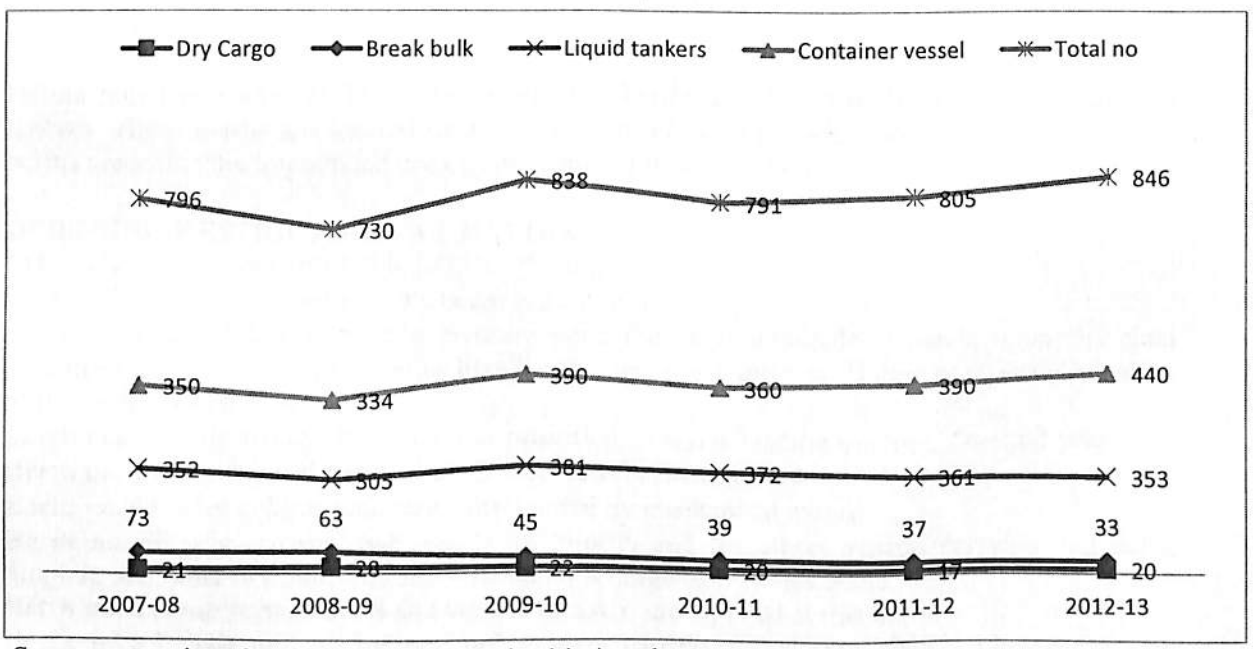
Port Performance:

Table 8.12: Total Cargo traffic at Cochin port



Source: www.ipa.nic.in (Indian Port Authorities) and www.cochineport.com

Table 7.1.13: Total number of vessels at Cochin Port



Source: www.ipa.nic.in (Indian Port Authorities) and www.cochineport.com

The number of container vessels has increased at a greater rate as compared to the other types of vessels handled. The potential of cochin port is much more because of its strategic loction.

7.1.7) Kolkata and Haldia Port, Bengal

Calcutta is a riverine port situated on the left bank of the river Hoogly, 130 kms above the entrance to the river off Sagar Island in the Bay of Bengal. Pilotage is compulsory for all vessels of over 200 NRT. Calcutta dock system comprises of Kidderpore Docks (KPD), Netaji Subhash

Docks (NSD) and Buj Buj. There are 18 operational berths at KPD and 10 at NSD and there are 6 wharves for liquid berths.

Location:
Latitude: 22 32'53 N"
Longitude: 88 18' 5" E.

Commodities Handled:

The main commodities handled at the Kolkata & Haldia Port are:
1. Coal
2. Iron Ore
3. POL
4. Fertilizers
5. Metals

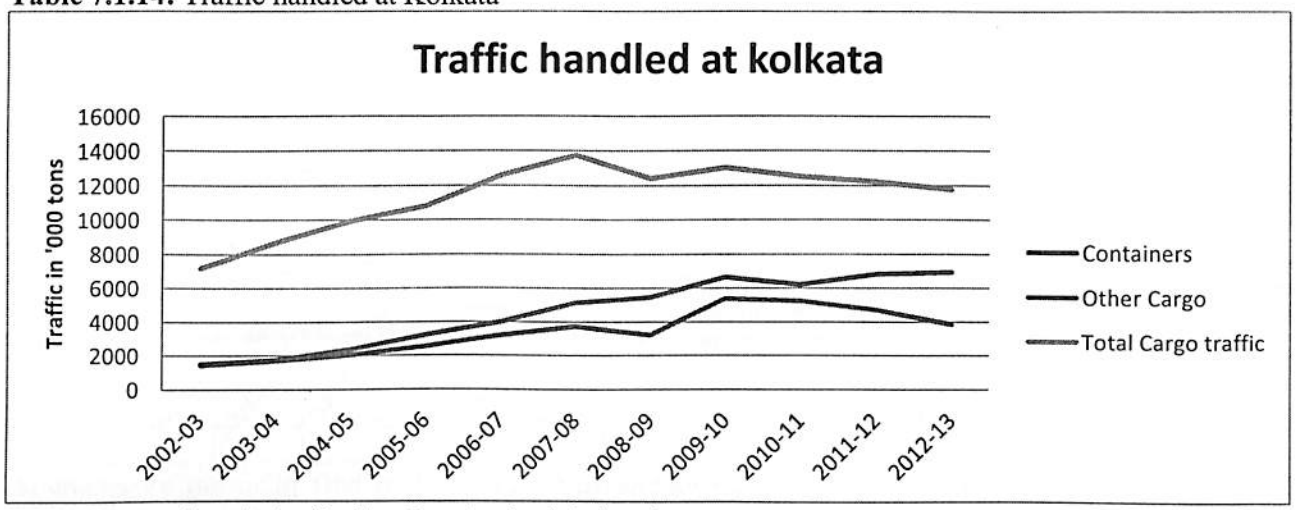
Facilities at the port:

Haldia port has a total of 15 berths of which 3 berths are dedicated for oil / petroleum and tankers. These berths are located on the river and outside the lock system. The remaining 12 berths are inside the impounded dock system, and of these two berths

BERTHING RESTRICTIONS AT HALDIA
LOA: The Maximum permissible LOA is 230 mtrs
BEAM: The Maximum permissible beam is 32.2 mtrs.
DRAFT: Since Haldia port is a riverine port, the draft available depends upon the tidal variations. However, the draft varies between 8 mtrs. & 9.5 mtrs. At Haldia port, the bifurcation of the berths is as follows:
Berth nos. 3 is mechanical berth and has priority for vessels loading iron ore, Thermal coal.
Berth no. 4 is mechanical berth which is reserved for thermal coal vessels
Berth no. 4a is for coking coal vessel discharged by mechanical means
Berth no. 4b is given for coal vessels on priority and for others vessels carrying met coke, Sulphur, and other dry bulk cargoes – manual discharge using ships gears.
Berth no. 5 is mechanical berth and vessels of SAIL are handled at this berth.
Berth no.6,7: The priority for non pol product carriers i.e. carbon black / phosphoric acid tankers. If vacant other vessels carrying coal, Sulphur, rock phosphate can work.
Berth no 8: MOU berth of Tata Steel for handling coking coal, lime stone vessels. General cargo berth (9 to 11s) : total length of general cargo berth is about 700 mtrs and port accepts 3 to 4 vessels depending on vessels LOA. 2 container vessels get berthing priority and all other general cargo Vessels basis arrival sequence at sand heads and subject to vessels / cargo readiness.
Berth no 12 : Private berth of TMILL for handling TATA cargo (steel , limestone Etc.) Vessels with food grains are not handled at 3 , 4b , 5 , 6 , 7 & 8.

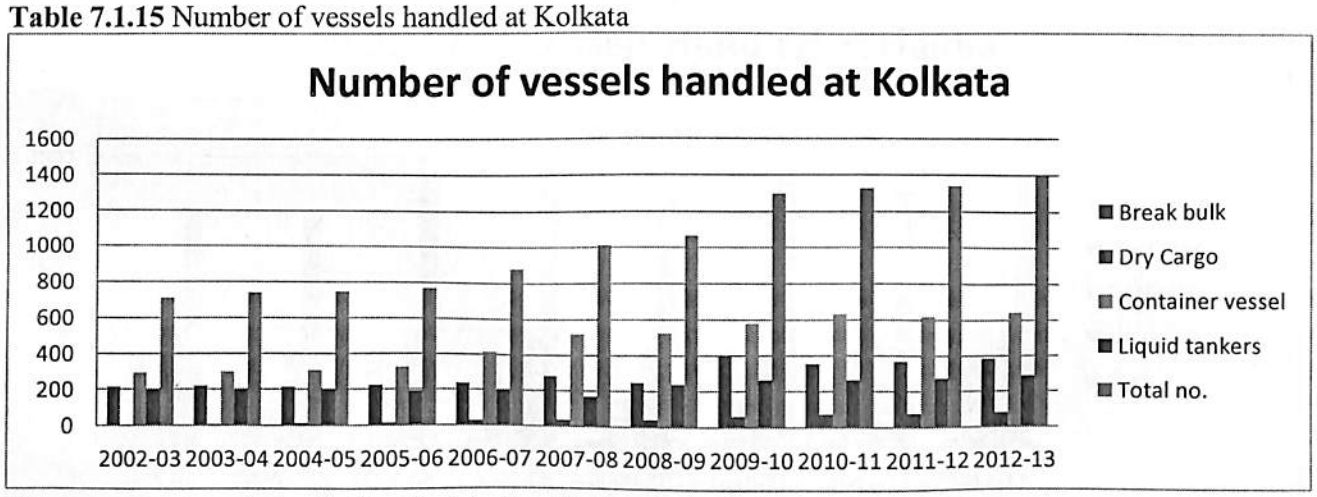
Performance of the port:

Table 7.1.14: Traffic handled at Kolkata



Source: www.ipa.nic.in (Indian Port Authorities) and www.kolkattaporttrust.gov.in

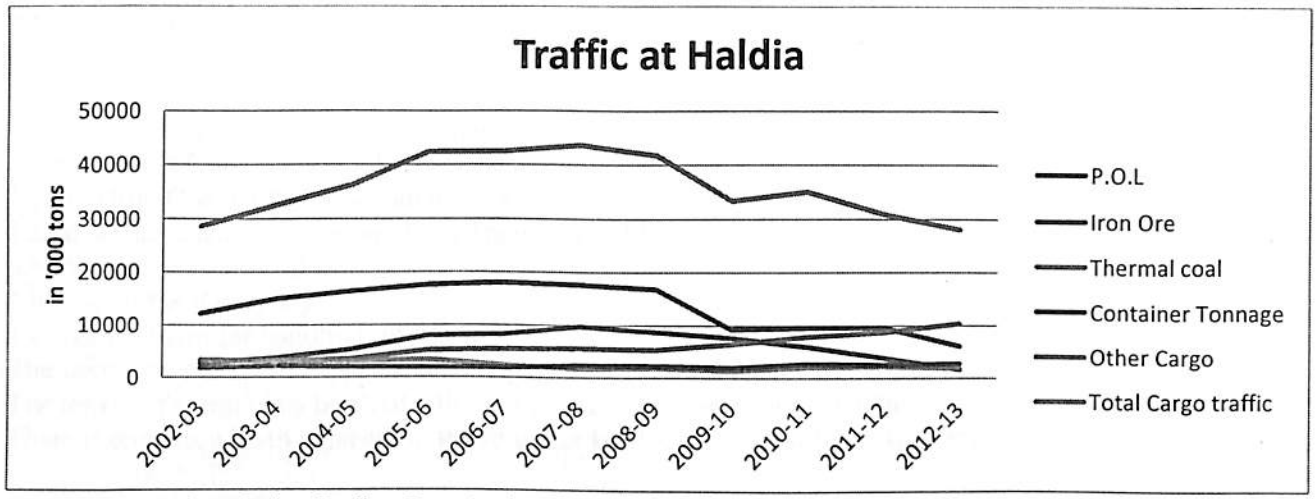
Table 7.1.15 Number of vessels handled at Kolkata



Source: www.ipa.nic.in (Indian Port Authorities) and www.kolkattaporttrust.gov.in

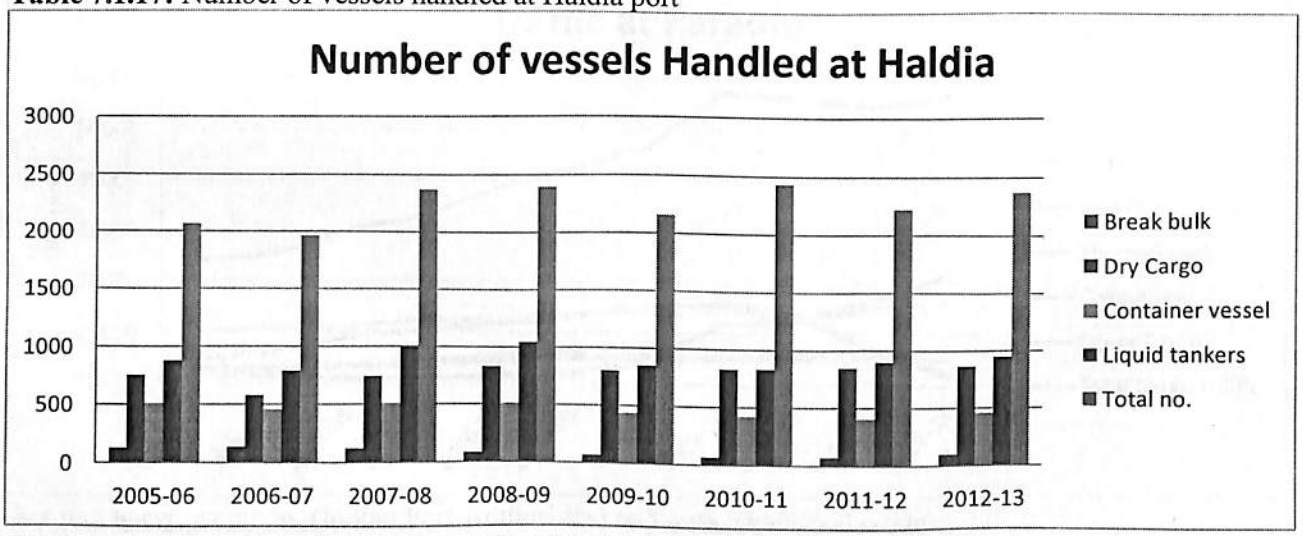
The traffic at the Kolkata port has been increasing due to its strategic location. There are various factors such as handling of coal at this port. This is due to the fact that most of the coal reserves are available on the eastern part of the country.

Table 7.1.16: Traffic handled at Haldia Port



Source: www.ipa.nic.in (Indian Port Authorities) and www.kolkattaporttrust.gov.in

Table 7.1.17: Number of vessels handled at Haldia port



Source: www.ipa.nic.in (Indian Port Authorities) and www.haldia-dock.gov.in

7.1.8) Paradip Port

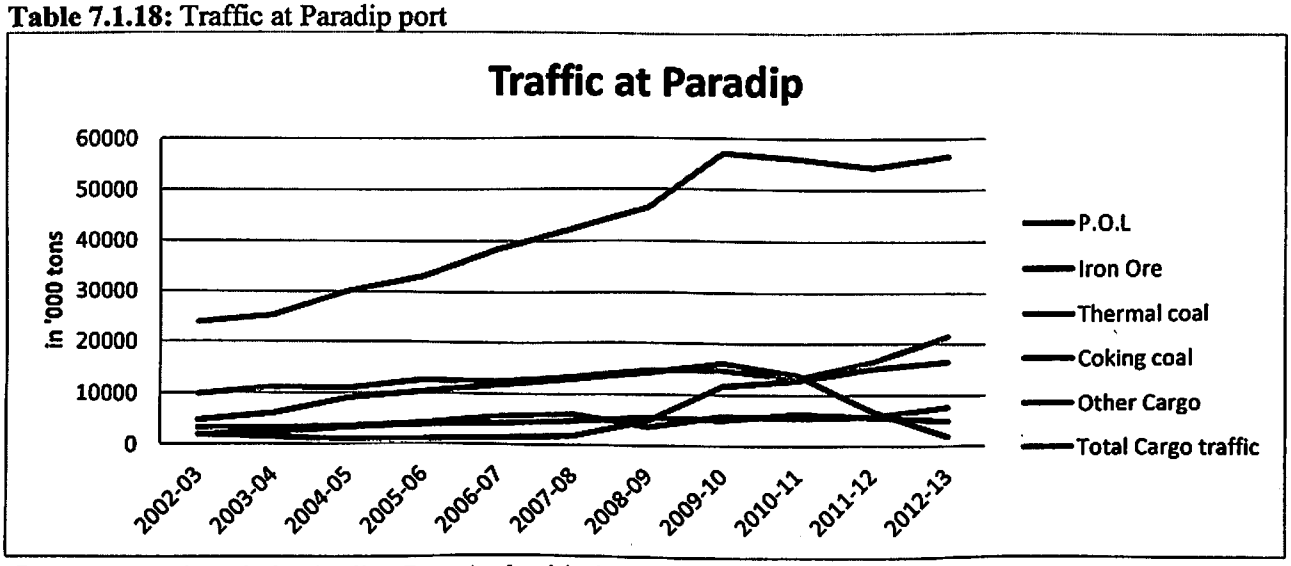
Paradip is one of the major ports of India and is the main out-let of the sea-borne trade on the East Coast of India. The port location is:
Latitude 20 – 15' – 55.44"N
Longitude 86 – 40' – 34.62" N

PARADIP PORT BERTH FACILITIES: PARADIP PORT HAS TOTAL 14 BERTHS.

2 berths are devoted for fertilizer vessels worked by Oswal Fertiliser [FB-II] [Oswal Fertilizers has now been taken over by IFFCO] and Paradip Phosphates Ltd [FB-I]. The discharge of fertilizers is done by the receivers by Two Shore Gantry cranes. The discharge of fertilizers by PPL is done by Shore unloader installed on the jetty.
1 berth (South Quay) is for tankers / general / bulk cargo
1 berth (Iron Ore Berth) has a conveyor belt system to load iron ore
2 coal berths exclusively for handling Thermal Coal vessels
3 berths on the Central Quay
3 berths on the East Quay
1 exclusive berth for handling oil cargo
The berths on the central quay and east quay cater to the general cargo and bulk cargo vessels. The length of continuous berth of 640 mtrs is available at east quay and 460 mtrs at central quay. There is one more berth adjacent to the fertilizer berth called "multipurpose berth".

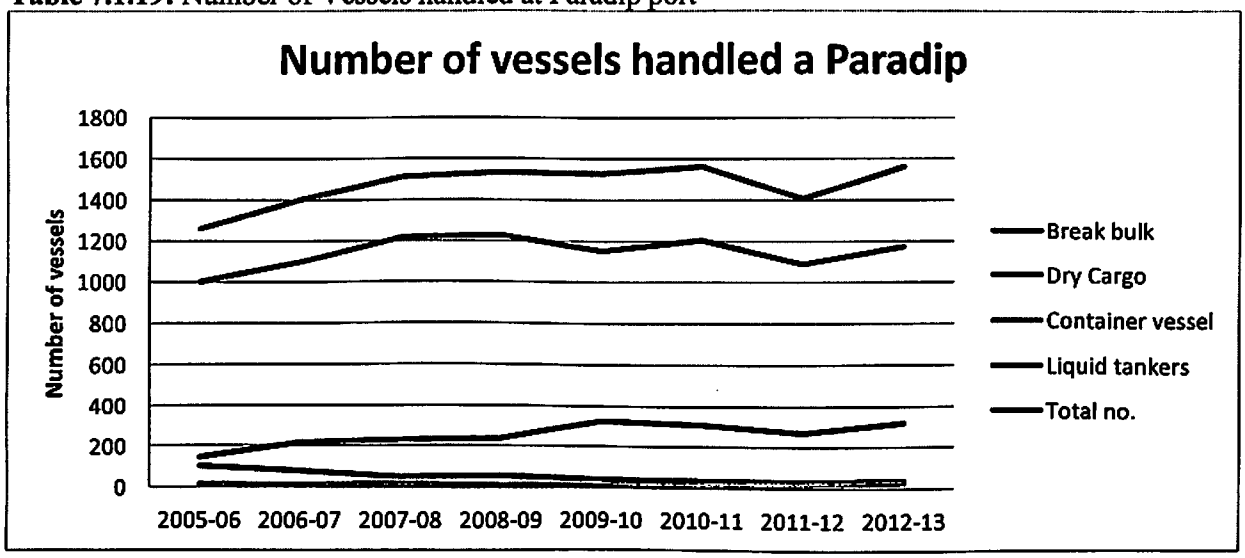
Performance of the port

Table 7.1.18: Traffic at Paradip port



Source: www.ipa.nic.in (Indian Port Authorities) and www.paradipport.gov.in
The number of vessels handled at the port has increased and so thus the traffic handled at the port has been increased. It has been increased because of its strategic location on eastern coast of India.

Table 7.1.19: Number of Vessels handled at Paradip port



Source: www.ipa.nic.in (Indian Port Authorities) and www.paradipport.gov.in

7.1.10) VISAKHAPATNAM PORT

Vizag is located between Calcutta and Madras on the east coast of India on
Latitude: 17" 41'North
and longitude: 83 18' east.

PILOTAGE
Pilotage is compulsory. Pilot boards incoming ships and disembarks outgoing ships, east of the outer channel light buoys.

PORT RESTRICTIONS
Max allowable dimensions / draft inner harbour
LOA/BEAM/DRAFT (ON HIGH WATER) – 195 MTRS / 32.26 MTRS / 10.06 MTRS

Outer harbour restrictions:
GENERAL CARGO BERTH:
The maximum permissible length is 270 mtrs and permissible beam – 42 mtrs. The maximum Permissible draft is 14.5 mtrs.

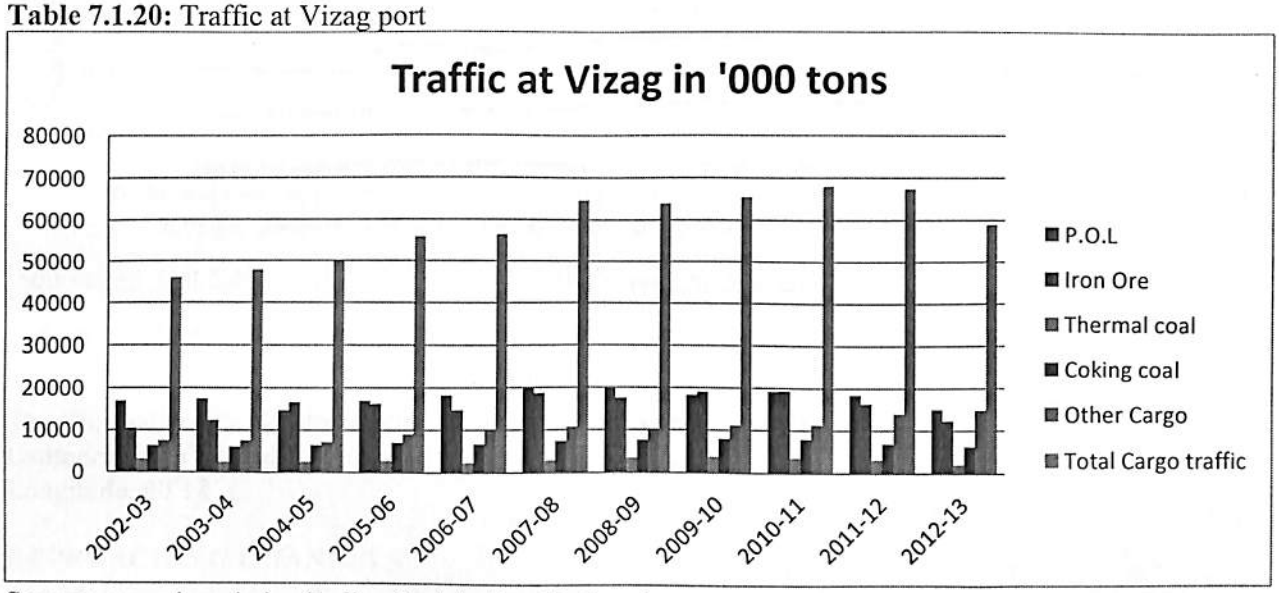
IRON ORE BERTH (Berth No. 1 & 2)
The maximum permissible length is 270 mtrs and permissible beam – 48 mtrs. The maximum Permissible draft is 16.5 mtrs. Air draft restrictions are 17 mtrs (maximum from water level). The arrival draft of the vessel should not be less than 9 mtrs fore and 11 mtrs aft.

NIGHT NAVIGATION FACILITIES:

Inward movements round the clock navigation for ships of LOA upto 182.88 mtrs and draft 9.14 mtrs except in case of ships carry LPG and ammonia. Outward movements round the clock navigation for ship sailing from inner harbor (irrespective of size) except for ships carrying LPG and ammonia.

Performance of the port

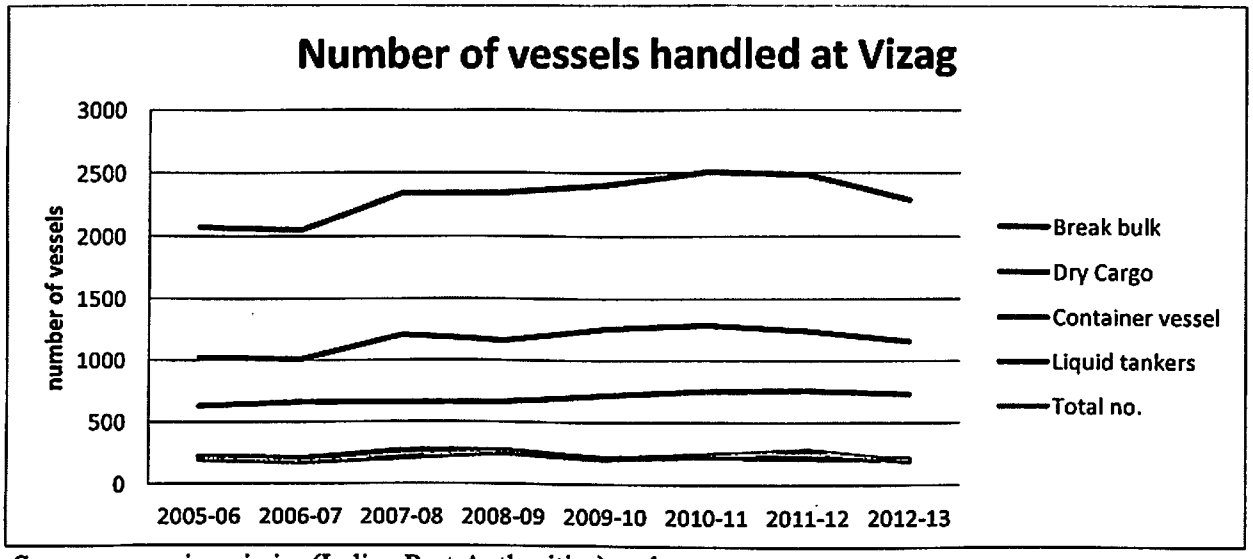
Table 7.1.20: Traffic at Vizag port



Source: www.ipa.nic.in (Indian Port Authorities) and www.vizagport.com

This table shows that how the cargo wise traffic has been handled at the Vizag port. Though this port has shown a bit of growth from 2005-06 but now has a stagnant growth as far as the traffic is concerned.

Table 7.1.21 Number of vessels handled at Vizag port



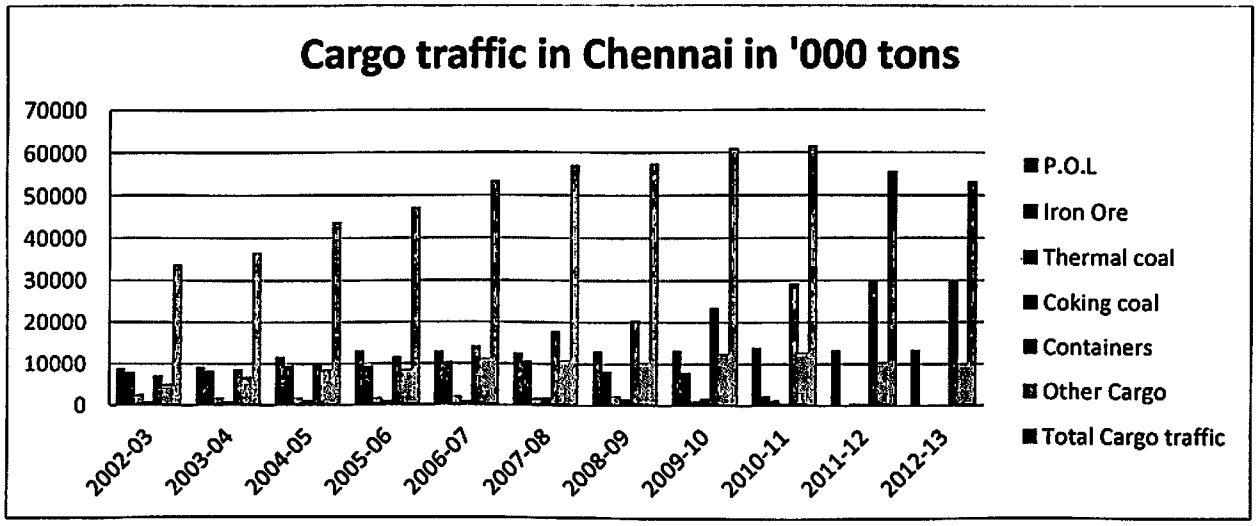
Source: www.ipa.nic.in (Indian Port Authorities) and www.vizagport.com

7.1.11) CHENNAI PORT

The Chennai port is situated on the east coast of India and located on:
Latitude: 13 06' N and
Longitude: 80 18' E.

APPROACHING CHANNELS
The approach channel to the port has two sections.
1. The entrance channel within the protection of outer arm.
2. The outer channel beyond the protection of outer arm.
The port signal station maintains continuous watch on channel 16 at north quay for communication with ships.

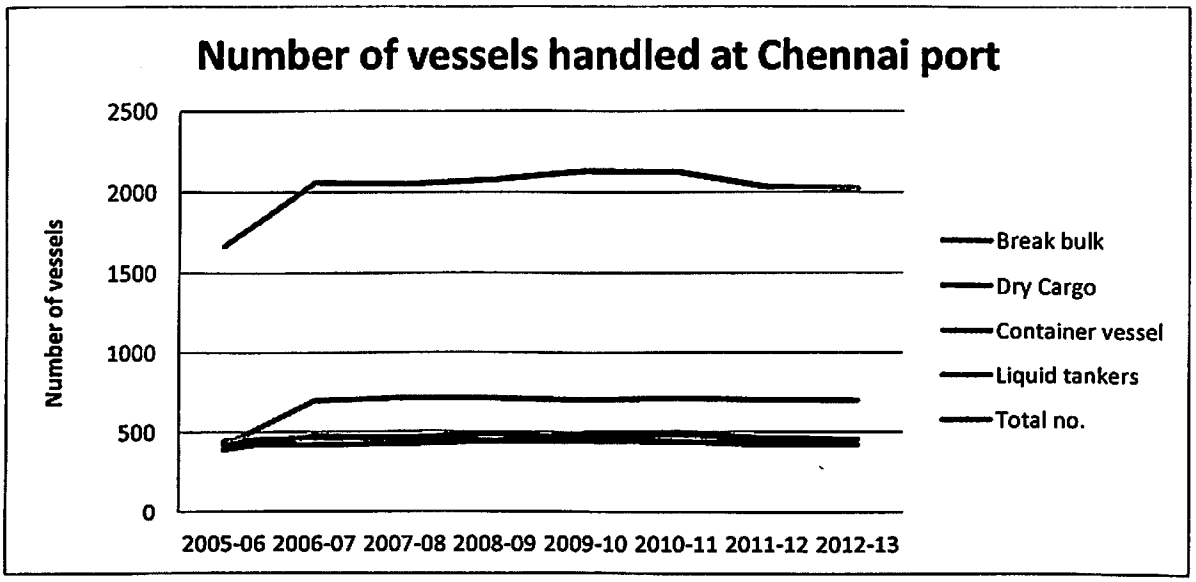
Performance of the Port
Table 7.1.22: Cargo traffic at Chennai Port



Source: www.ipa.nic.in (Indian Port Authorities) and www.Chennaiport.com

This port has shown a significant growth since 2002-03 but in recent years the cargo traffic has declined because of Ennore port handling more traffic.

Table 7.1.23: Number of Vessels Handled at Chennai Port



Source: www.ipa.nic.in (Indian Port Authorities) and www.Chennaiport.com

This port was considered the major port in terms of handling of traffic on the south eastern coast of India, but with the increase in traffic at the Ennore port has lost the traffic and so thus the bunker consumption.

7.1.12) TUTICORINE PORT

Tuticorine port is situated on the east coast of India about 540 kms south west of Chennai
Located on:
Latitude – 8 45' N and
Longitude – 78 13' E

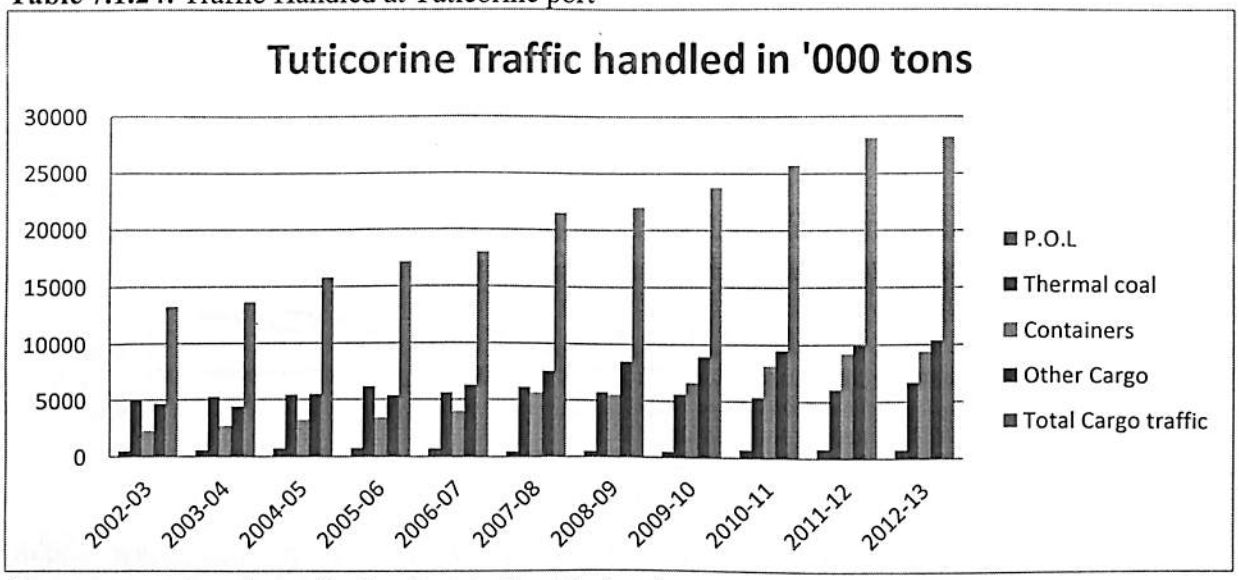
BERTHING RESTRICTIONS

LOA AND DRAFT - AS MENTIONED BELOW
BEAM - NO RESTRICTIONS
NIGHT NAVIGATION - AVAILABLE ROUND THE CLOCK.
EXCEPT DEEP DRAFTED TANKER VESSELS.
Pilotage is compulsory.
LOA & DRAFT RESTRICTIONS BERTHS: MAX DFT LOA
NO. 1 9.30 M 168 M
NO. 2 9.30 M 168 M
NO. 3 10.70 M 192 M
NO. 4 10.70 M 192 M
NO. 5 & 6 9.30 M 168 M
NO. 7 10.90 M 190 TO 275 M (CONTAINER TERMINAL)
NO. 8 10.90 M 275 M – FOR CLEAN CARGOES ONLY.
SHALLOW BERTH 5.85 M 110 M
OIL JETTY 10.70 M 150 TO 228 M
COAL JETYY 1 10.90 M 235 M

COAL JETTY 2 10.90 M 235 M
PASSENGER JETTY 4.50 M 90 M

PERFORMANCE OF THE PORT

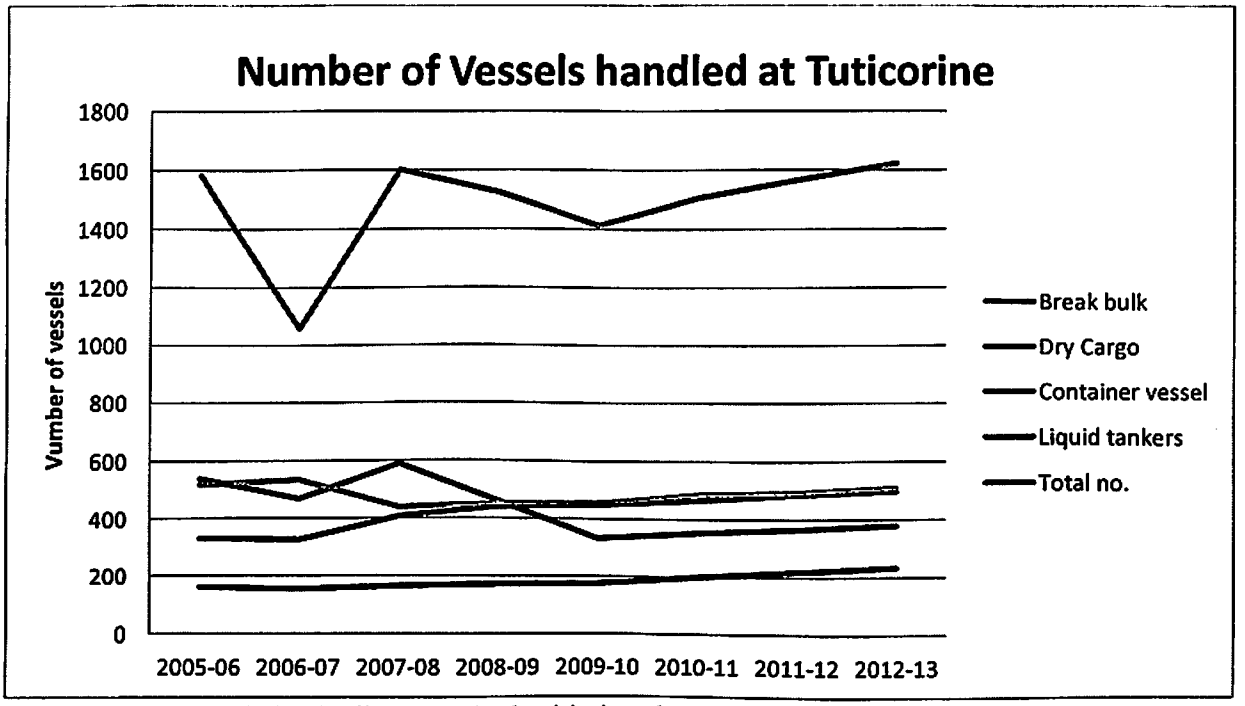
Table 7.1.24: Traffic Handled at Tuticorine port



Source: www.ipa.nic.in (Indian Port Authorities) and www.vocport.gov.in

Because of the strategic location of Tuticorine port on the southern coast of India, it lies on the world route and thus has the huge potential in terms of the bunker consumption. If a little infrastructure development like pipeline facility for bunker can be developed than it will be good for the port.

Table 7.1.25: Number of Vessels handles at Tuticorine



Source: www.ipa.nic.in (Indian Port Authorities) and www.vocport.gov.in

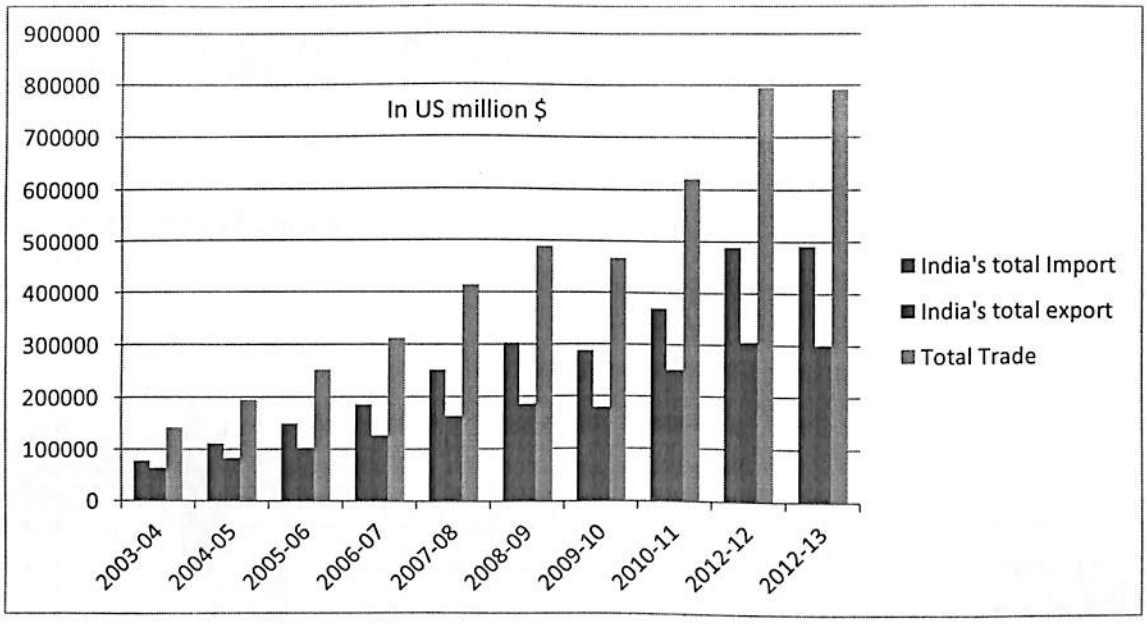
Because of the strategic location of this port there has been a significant growth in traffic with little ups and down in number of vessels handled. The number of break bulk vessels has reduced because of the draft availability issue and government policies.

7.2) Secondary Data Analysis

7.2.1) India's Trade (Last 10 years)

India has been more focused on the Import side rather than the export side which is also a reason for the current account deficit.

Table 7.2.1: India's trade (last 10 years)



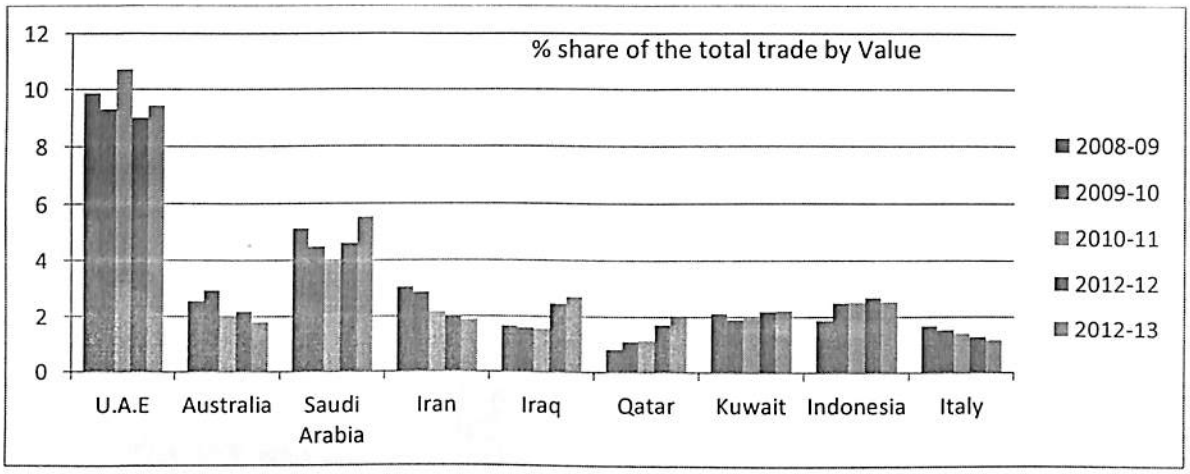
Source: Ministry of Commerce India

The total trade of India has been more on import side as compared to the exports. The major percentage of imports mainly contains of the crude oil from the Middle-East.

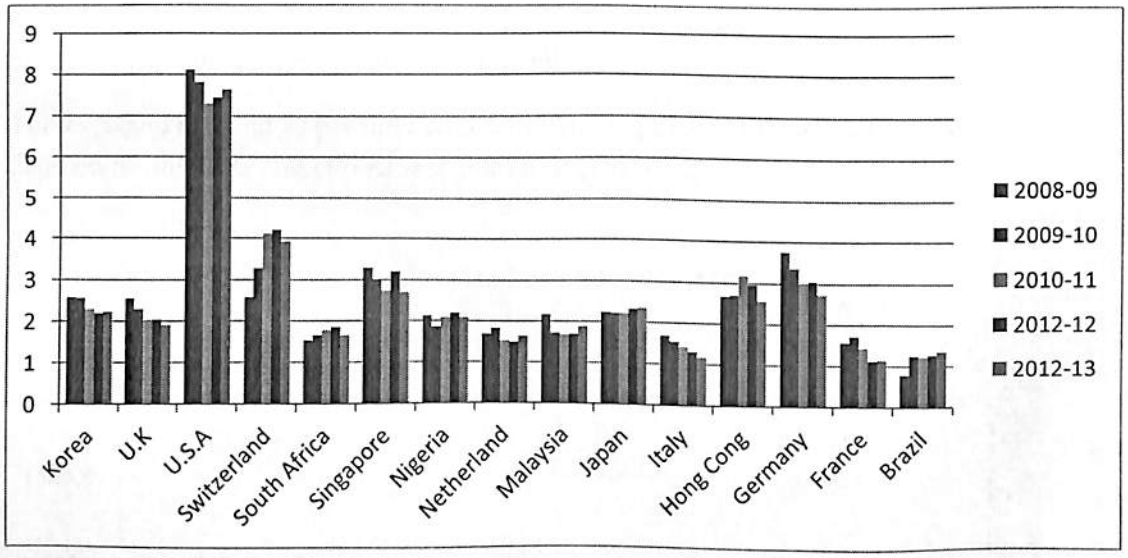
7.2.2) Country's share of Trade with India

India has a global Presence as far as the commerciality is concerned. India has friendly relations with the countries and tradeoff has seen a growth so far.

Table 7.2.1: Country's share of trade with India



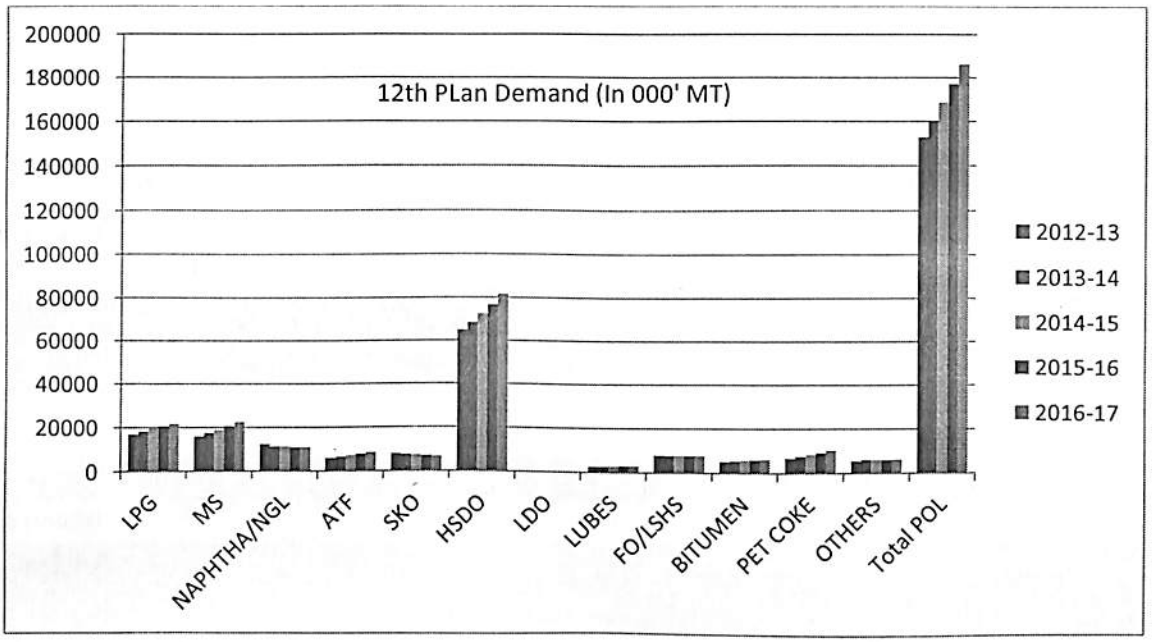
Source: Ministry of Commerce, India



Source: Ministry of Commerce, India

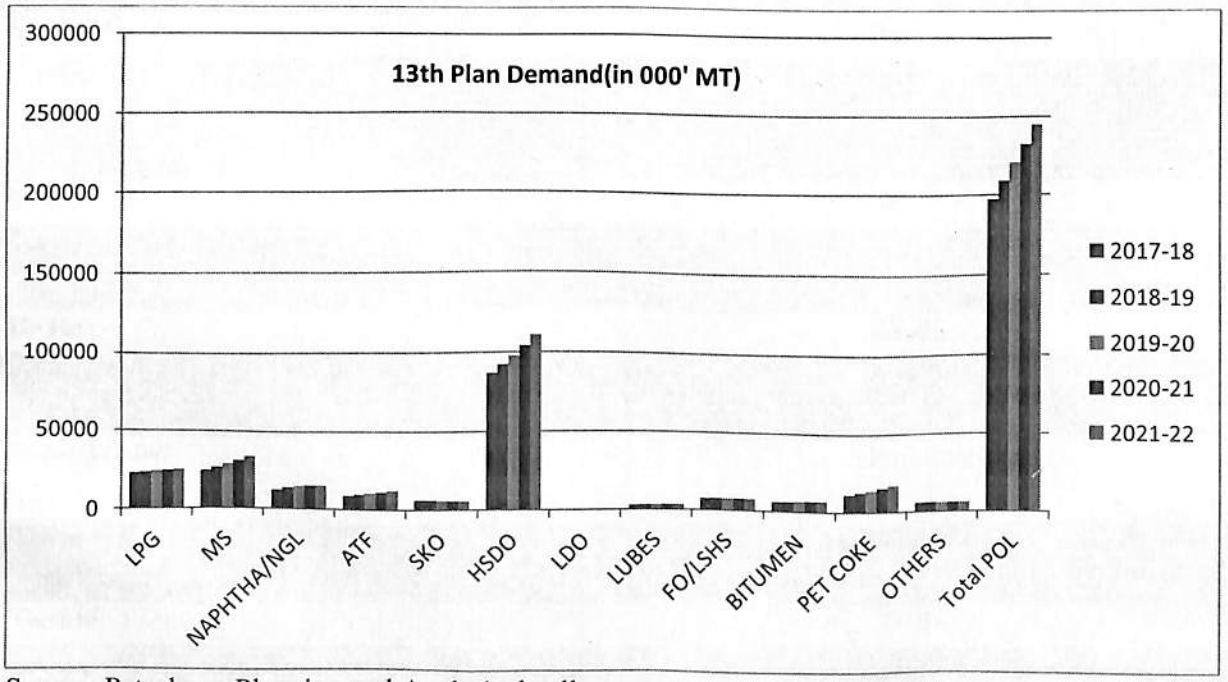
7.2.3) Expected Demand 12th and 13th year plan

Table 7.2.3: Expected demand 12th and 13th year plan



Source: Petroleum Planning and Analysis cell

The expected demand as per the Petroleum planning and analytical cell has been increasing. The demand for the LPG and HSDO is expected to grow highly



Source: Petroleum Planning and Analytical cell

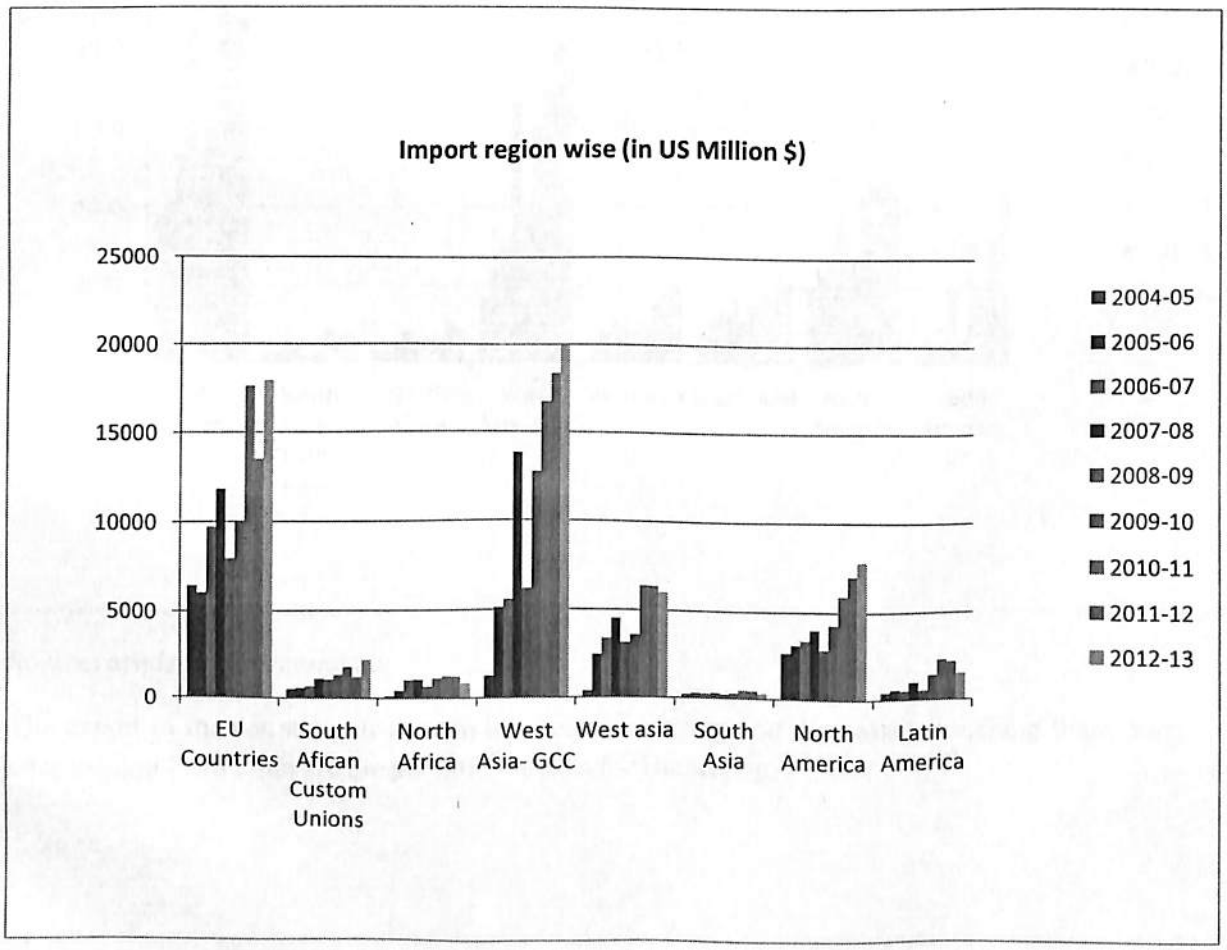
7.2.4) Potential Vessels Called on the Ports of India

Name of Potential Vessel	Commodity
Selecta	Barley (In Bulk)
Nakati Kalkavan	Rice
River Globe	Wheat
Tharinee Naree	Barley
Queen Busan	Salt
Provider	SBM
Naghmeh	Rice
Bonnie Venture	Rice Bags
Sai Sunrise	Rice
Abba	Maize
Alabama Belle	Wheat
Sanko Marble	Rice
Sea Lord	Rice/wheat/ Sugar
Bulk Avanti	Salt
Sakizaya Wisdom	Wheat
He He	Kaolin
Flinter Ridhi	Agri Products
Rome Trader	Proj. cargo
Dynamic Ocean	Wheat cargo
Vicente	GR/BL
Apostolos II	B'Nite &GR/MR BL

Bahjat	Agri Products
Nabil H	Rice bags
Rochestar castle	GR, BL
Star Norita	Salt
Oriental Marguerite	Castor Oil

7.2.5) Major Trade region wise and Routes Taken

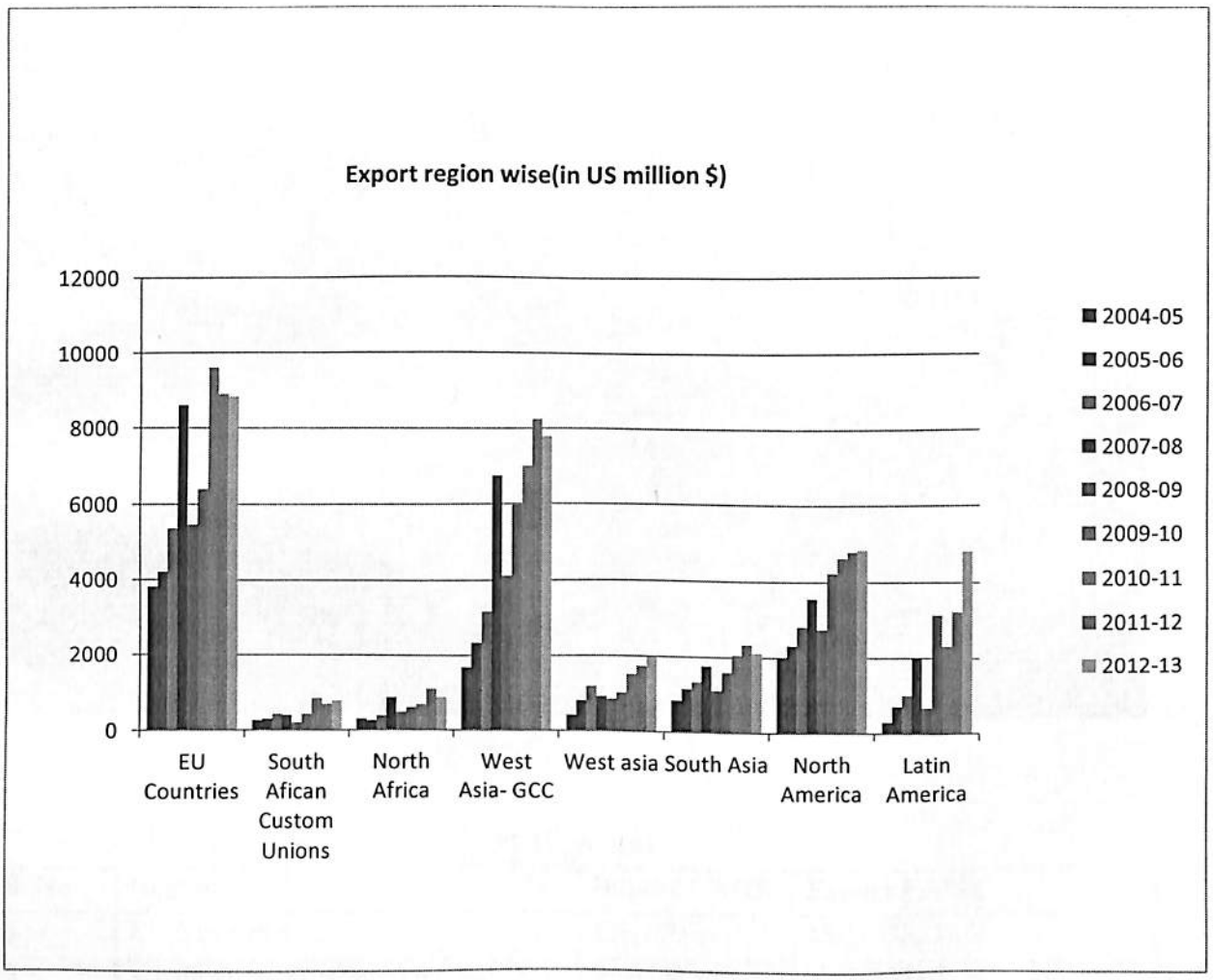
Table 7.2.4: Region wise imports of India(in U.S $)



Source: Ministry of Commerce

India's trade has shown a significant growth in European Union countries, Gulf countries and North America.

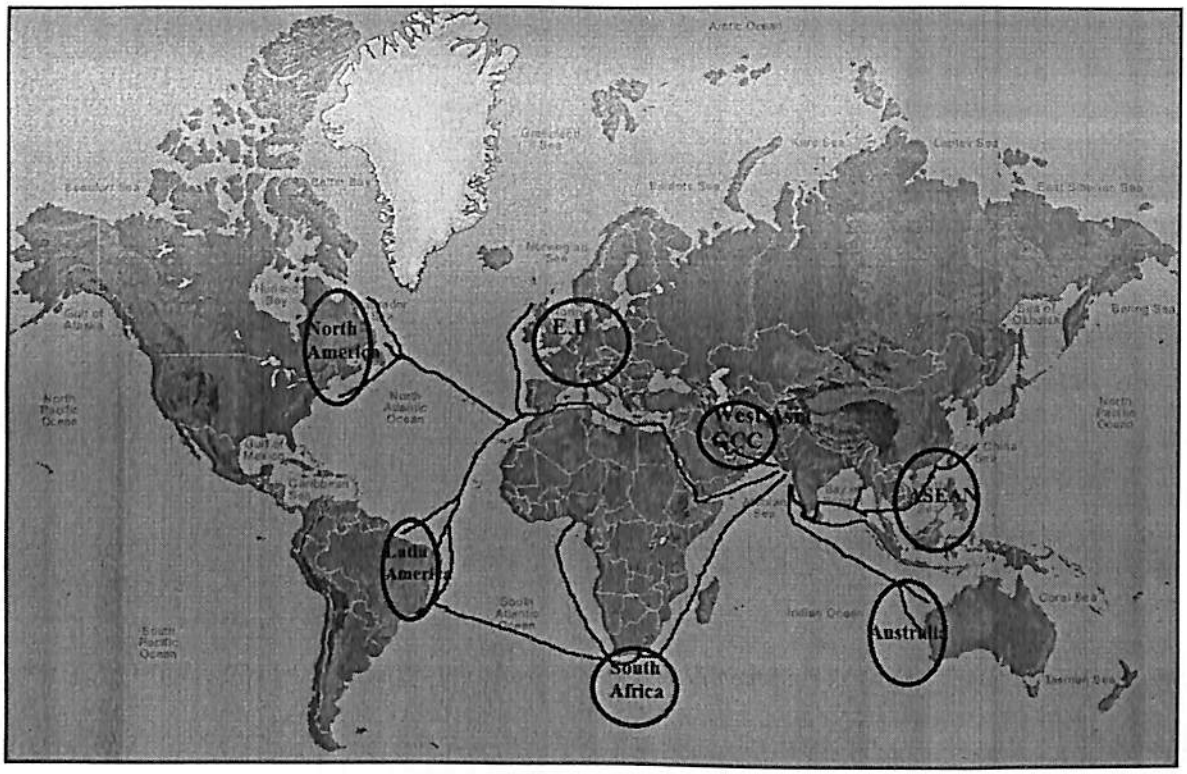
Table 7.2.5: Region wise Export of India



Source: Ministry of Commerce

The export to the countries in Europe has been increasing and the vessels touching these ports after loading from India are the potential vessels for Bunkering.

Figure 7.2.1: Major Trading Routes



7.2.6) Region wise trade CAGR (Last 10 years)

S. No	Region	Import CAGR	Export CAGR
1	EU Countries	17.1179 %	13.37638532 %
2	South African Custom Unions	21.9695 %	22.20503107 %
3	North Africa	44.8493 %	21.89624485 %
4	West-Asia- GCC	61.7929 %	24.82398449 %
5	West Asia	77.43493 %	23.09379 %
6	South Asia	8.71677 %	13.880267 %
7	North America	14.9347 %	12.08975 %
8	Latin America	29.07058 %	70.9519 %

7.2.7) Present Bunker Facilities

PORT	CARGO VOLUME(million tons)	NO. OF VESSEL CALLS	BUNKER PRODUCTS	SUPPLY MODE	Price
Mundra	70	2800	IFO380/IFO180/MGO(ISO Spec)	By Barge, Pipeline	Competitive
Mumbai	58.03	1486	IFO380/IFO180/MGO(ISO/Indian Spec)	By Barge	Competitive
JNPT	64.5	2589	IFO380/IFO180/MGO(ISO/Indian Spec)	By Barge	Competitive
Murmogao	17.69	400	Limited Supply(Indian spec)	By Barge and Pipeline	High prices
New Manglore	37.03	1071	Limited supply (Indian spec)	By Trucks	High prices
Cochin	19.84	846	IFO180/MGO(Indian spec)	By Barge	Moderate
Kandla	93.62	2712	IFO380/IFO180/MGO(ISO/Indian Spec)	By Barge, Pipeline, Trucks	Competitive
Haldia	47	2490	IFO 180/MGO(ISO spec)	By Barge	High prices
Paradip	57	1500	Limited supply(Indian spec)	By Trucks	High Prices
Vizag	66	2400	IFO180/IFO380/MGO	By trucks and Barges	High Price
Chennai	61	2100	IFO180/IFO380/MGO(Indian Spec)	By Barge	Competitive
Tuticorin	24	1400	IFO180/IFO380/MGO	By Trucks	High Prices

PORT	Draft Available		Berths Facilities						
	Min.	Max.	POL and Other Liquids	Iron Ore	Coal	Fertilizer	Containers	General break Bulk Cargo	Total
Mumbai	8	10.5	5	-	-	-	2	24	31
JNPT	-	12.5	2	-	-	-	9	1	12
Murmogao		14.0	1	1 + Tran shipper	-	-	-	4	6 + Tran shipper
New Manglore	7	14	4	1	-	-	-	8	13
Cochin	9.14	12.5	3 + SPM	-	-	1	3	9	16 + SPM

Kandla	9.1	12.0	8 + 3SBM	-	-	-	2	11	21 + 3 SBM
Kolkata	5.1	8.5							33
Haldia	6.1	8.1							17
Paradip	11	13							14
Vizag	10.9	11							18
Chennai	8.5	17.4							24

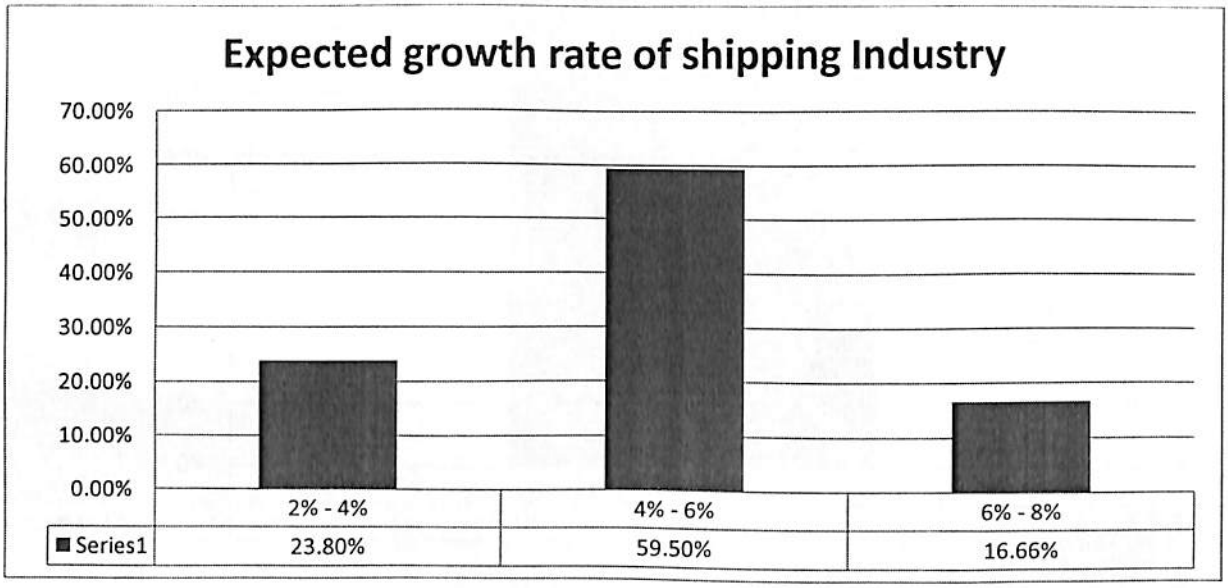
Source: www.ibm.gov.in

7.3) Primary Data Analysis

7.3.1) Expected Growth rate of the shipping Industry

The primary data has been collected from Ship Owners, Shipping Agents, Bunker Traders and Industry Experts. The analysis has been done on the basis of the number of responses given by the respondents.

Table 7.3.1: Expected growth rate of Shipping Industry



Weighted Average Sum = (3*10 + 5*25 + 7*7) / 42

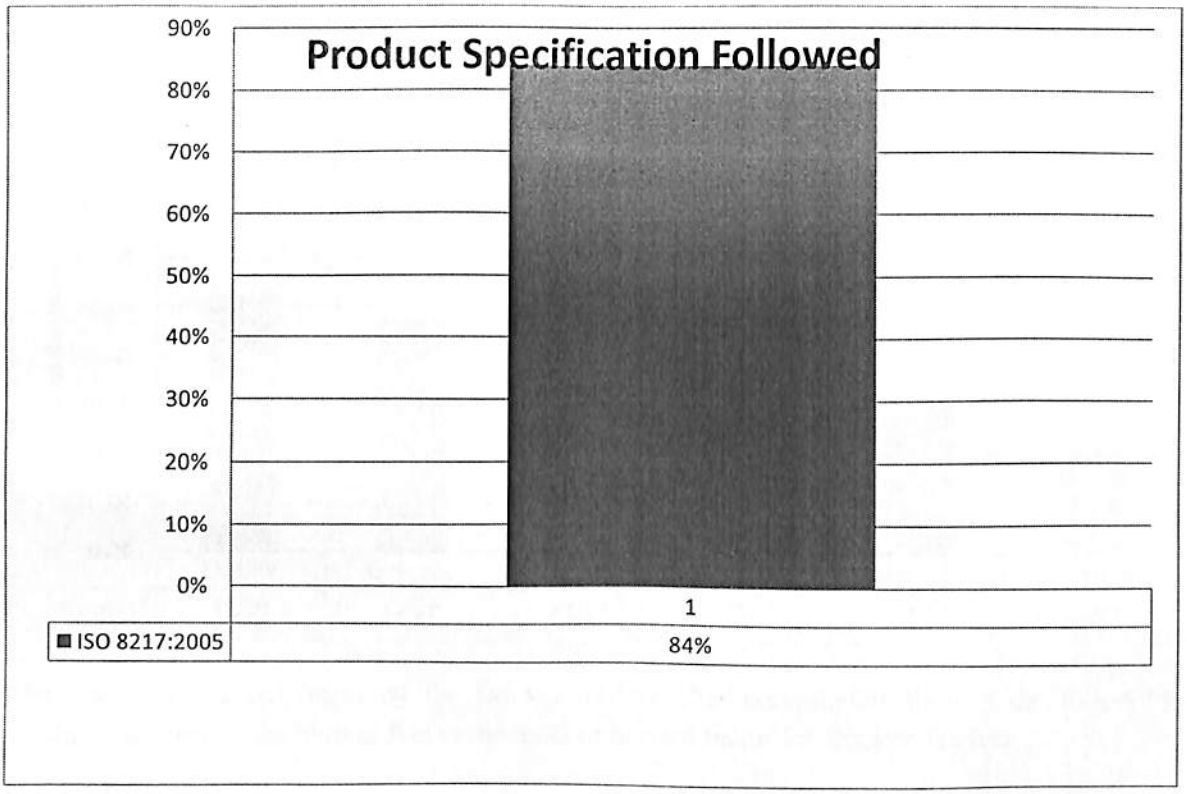
= 4.857 %

The weighted average has been calculated by taking the average of the selected option and multiplying the value by the respective responses and then adding all and dividing by the total number of responses.

7.3.2) Product Specification of Bunker Followed

As per the primary survey it was found that majorly the ISO8217:2005 specification is followed in India as far as Bunker Fuel is concerned.

Table 7.3.2: Product specification followed

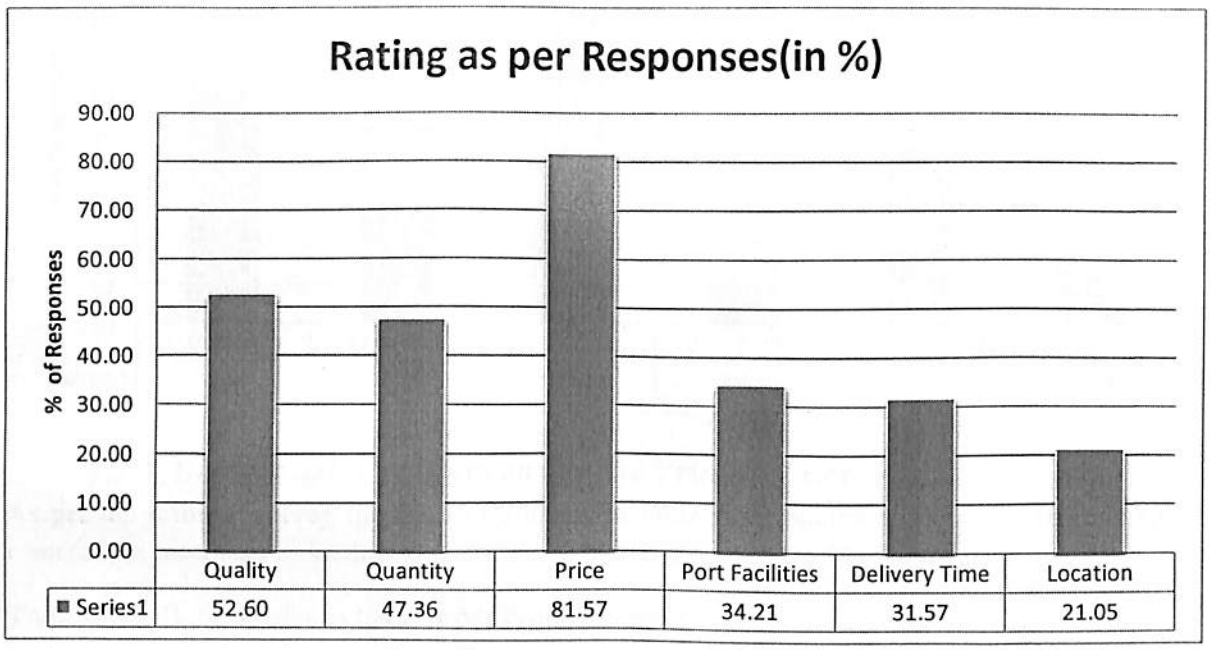


During the survey it was found that 84% the ISO 8217:2005 specification is followed. The reason for this is that there are few changes to the previous grades and moreover the facilities are not available at Indian ports to check the fuel specifications of ISO 8217:2010 and ISO 8217:2012.

7.3.3) Ratings of Important Factors for Bunker:

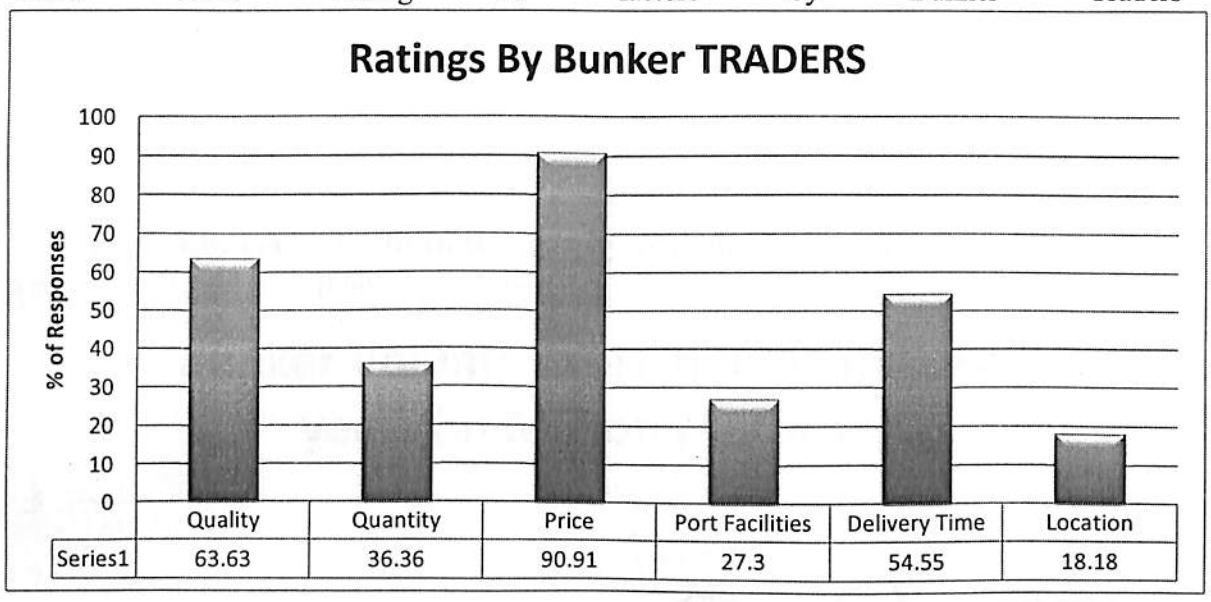
After having the responses from the respondents it was found that people are more concerned about the price of Bunker, the second ranked factor was quality and then quantity and so on.

Table 7.3.3: Rating of factors



The results of the responses by the Bunker traders after compilation showed the following results. The price of the bunker fuel is the most important factor for Bunker Traders.

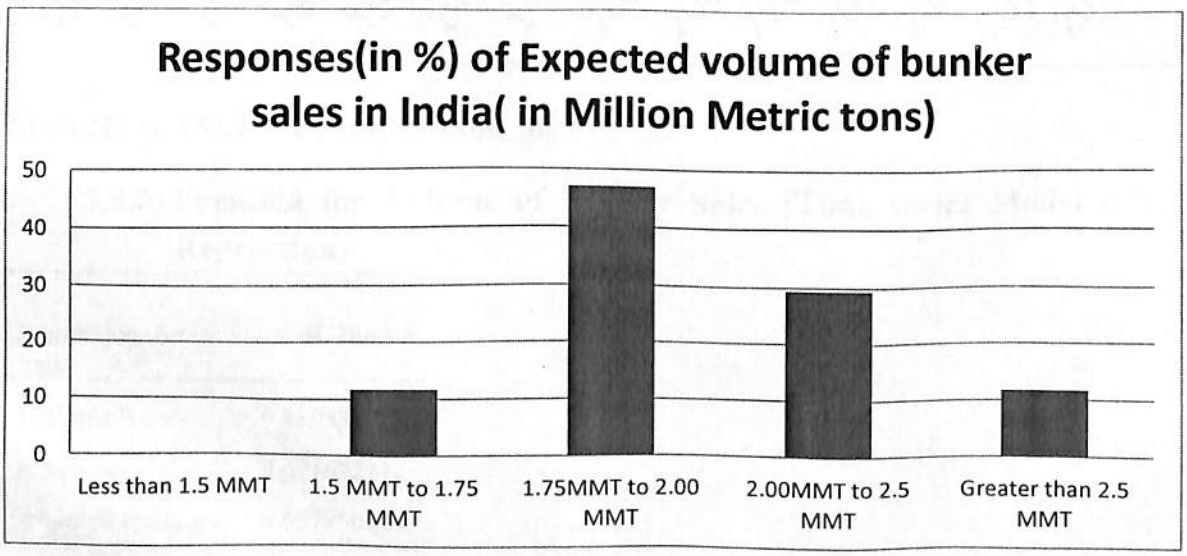
Table 7.3.4: Rating of factors by Bunker Traders



7.3.4) Bunker Sales in India as per the Primary Survey

As per the primary survey the sales of Bunker in India is calculated as the weighted average mean of the responses from the Bunker traders, Sip Owners and the Shipping agents.

Table 7.3.5: Bunker sales in India as per Primary Survey



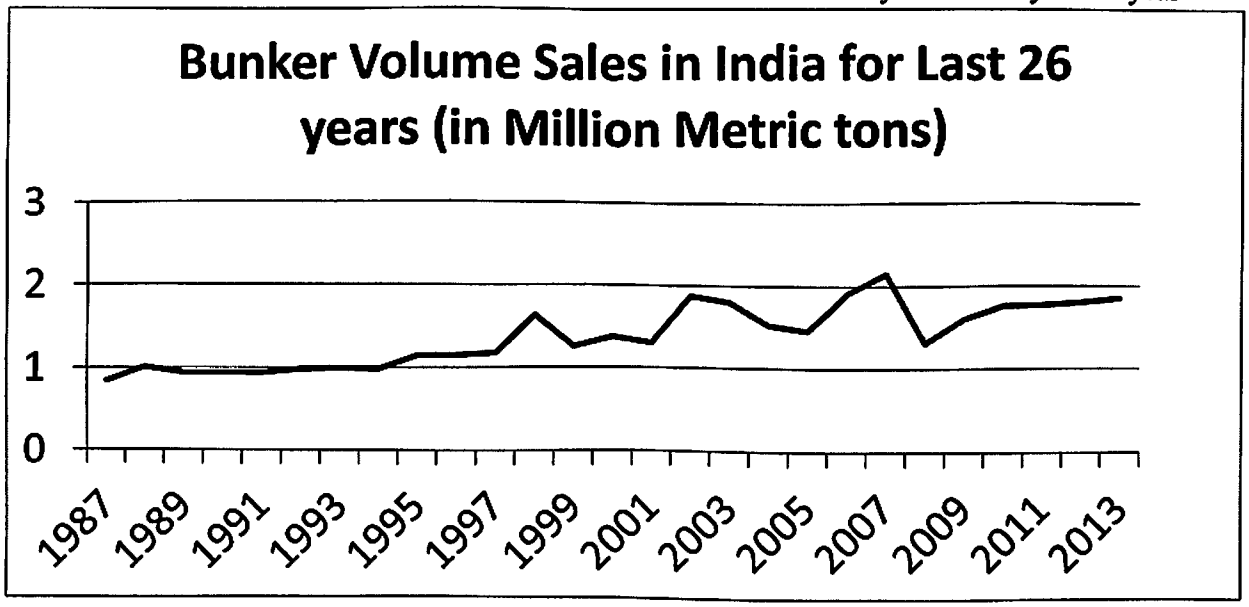
Weighted average Sum of Volume Sales in India:

Volume = (1.625*6 +1.875*24+2.25*14 + 2.5*6)/50 = 2.02 MMT

The weighted average is calculated by taking the average of the range of volume sales selected by the respondent multiplied by the number of responses. Then adding all the responses and dividing by the total number of responses we get the weighted average of the Total volume sales in India

7.3.5) Bunker Sales in India year by year (by Volume):

Table 7.3.6: Bunker sales in India year by year



Source: www.Indexmundi.com and IOCL

7.3.6) Formula for Volume of Bunker Sales (Time series Model using Regression)

Regression for volume of Bunker Sales	
Multiple R	0.819531723
R Square	0.671632244
Adjusted R Square	0.657950255
Standard Error	0.216064793
Observations	26

ANOVA

	D.F	SS	MS	F	Significance F
Regression	1	2.291660531	2.291661	49.08878	3.03551E-07
Residual	24	1.12041587	0.046684		
Total	25	3.412076402			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%
Intercept (α)	0.843210715	0.087252978	9.663976	9.54E-10	0.663129419
X Variable 1	0.039584686	0.005649839	7.006339	3.04E-07	0.027923992

Findings on Regression:

- **R square** in following model is 67.16%, showing that about 67.16% of total variation in Volume consumption in India can be explained by Independent variable "Year".
- **F Value**: Since calculated F value is greater than Critical value of F value hence this model is accepted. It can be concluded that ratio of explained variance by this model to the unexplained variance is very high. Thus the regression variable is significant in explaining the dependent variable.
- The dependent variable is "Volume of Bunker consumed" and the independent variable is "Year".
- Use the following Formula to calculate future volume consumption:

$$V.C = \alpha + (\beta \times Year)$$

- Here $\alpha = 0.843210715$

  $\beta = 0.039584686$

  V.C= Expected Volume of Bunker Consumption

*year is taken till 26 to calculate Regression (here 26=2013), so we can take 27 as value of year to predict the next year's (2014) Volume consumption and so on.

7.3.7) Calculation of Bunker Potential

To calculate the Bunker Potential the traffic has been observed. The number of vessels visiting the ports and the vessels which can take Bunker depending on its route has been calculated.

The vessels which are called on the ports of India last year has been observed. The vessels which are called on the Indian ports and their next visit is such that the vessel which will touch the Fujairah port or Singapore is not a potential vessel for Bunkering. Similarly if the vessel called on the ports of India had their last visit to the Fujairah port or Singapore then it will not be a potential vessel for Bunkering in India.

Potential Vessels = Number of Vessels Called on the port – Number of Vessel having last/ next port Singapore or Fujairah.

Table 7.3.7: Number of potential vessels

Port	Vessels Called Last year	Number of Potential Vessels
Kandla	2768	2063
Mumbai	1486	1090
JNPT	2589	1823
Murmogao	400	276
Cochin	847	598
New Manglore	1072	767
Kolkata	1336	934
Haldia	2403	1804
Paradip	1587	1109
Vizag	2320	1390
Ennore	740	320
Chennai	2080	1590

Tuticorin	**1643**	**1209**

Number of Potential Vessels as per Dead Weight Tonnage (DWT)

- Here the vessels are characterized into two parts, one with the vessels having DWT larger than 50,000 and the other being the vessels with DWT lesser than 50,000
- The vessels with DWT more than 50,000 consumes 400 MT/delivery of Bunker
- The vessels with DWT lesser than 50,000 consumes 300 MT/delivery of Bunker

Port	DWT > 50000	DWT < 50000
Kandla	**497**	**1566**
Mumbai	**569**	**521**
JNPT	**908**	**923**
Murmogao	**172**	**104**
Cochin	**291**	**309**
New Manglore	**230**	**537**
Kolkata	**330**	**604**
Haldia	**989**	**815**
Paradip	**309**	**800**
Vizag	**460**	**930**
Ennore	**210**	**110**
Chennai	**740**	**850**
Tuticorin	**578**	**631**

The volume of potential Bunker comes out to be as follows:

Table 7.3.8: Volume of Bunker Potential

Port	Potential by Vessels > 50000 DWT(400 MT)	Potential by Vessels < 50000 DWT (300 MT)
Kandla	198800	469800
Mumbai	227600	156300
JNPT	363200	276900
Murmogao	68800	31200
Cochin	116400	92700
New Manglore	92000	161100
Kolkata	132000	181200
Haldia	395600	244500
Paradip	123600	24000

Vizag	**184000**	**279000**
Ennore	**84000**	**33000**
Chennai	**296000**	**255000**
Tuticorin	**231200**	**189300**
Total	**2513200**	**2394000**

Total Potential = Potential by Vessels > 50000 DWT (400 MT) + Potential by Vessels < 50000 DWT (300 MT)

= 49, 07,200 metric tons

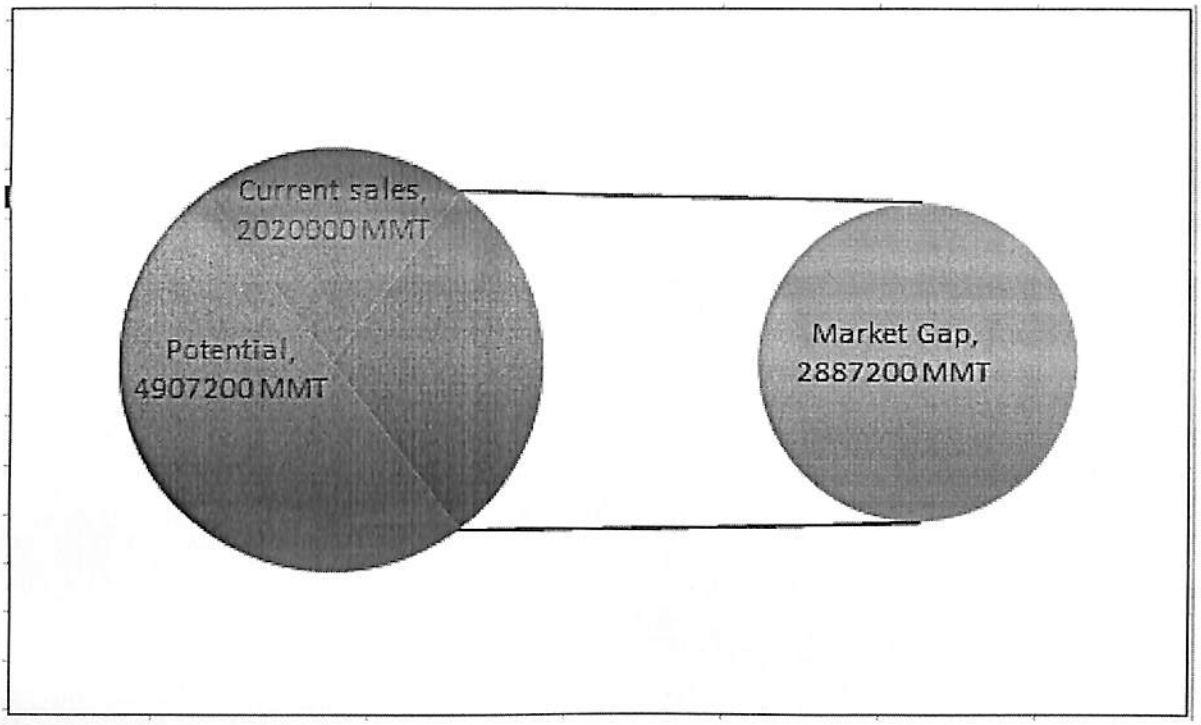
7.3.8) Market Gap in India

Market Gap= Total Bunker potential in India– Bunker Sales in India

= 4907200 MMT – 2020000 MMT

= 2887200 MMT

Figure 7.3.1: Market gap in India



- This shows that there is a huge market in India for Bunker and we are able to cover only approx. 41.16% of the market so far.
- There is a need to change the business strategies
- There is a need to look for the region wise trade and track the vessels.

Chapter 8: Tax Policy Comparison of India with Singapore

8.1) Singapore Tax policy

Singapore tax authority has made zero-rate for the supply of bunkers to the customer if the bunker is delivered directly to the vessel which is bound for a destination outside Singapore.

To receive the zero rate, the Inland Revenue Authority of Singapore (IRAS) said, a supplier must have a purchase order from the customer indicating the vessel name, date of departure, and next destination; written instructions from the customer to deliver the fuel to the vessel; a sales invoice to the customer; a bunker delivery note endorsed by the vessel's master or chief engineer; and evidence of payment from the customer.

Goods and Service Tax (GST) was introduced in Singapore on 1 Apr 1994. Currently, they are required to charge and account for GST at 7% on all local sales of goods and services unless the sale can be zero-rated or exempted under the GST law.

The Approved Marine Fuel Trader (AMFT) Scheme is designed to relieve approved persons from the payment of GST on local purchases of specified marine fuel oil from GST registered suppliers. The AMFT status is generally granted for 3 years from the date of approval. A shorter period may be granted at the discretion of the Comptroller.

1. **Under the scheme, an approved person can purchase MFO locally, without payment of GST.**

2. **GST registered suppliers (either approved or not approved under the scheme) sell MFO to a non-approved person, with payment of GST.**

Sales	**Trader1**	**Trader2**	**Trader3**	
	Approved under AMFT Scheme	Not approved under AMFT Scheme	Approved under AMFT Scheme	Not approved under AMFT Scheme
Import of MFO	7%	7%	-	-
Local Sales	-	-	0%	7%

Table1: Payment of GST

Note: In Table 1, Trader 1 or Trader 2 sells MFO to Trader 3.

If MFO is sold and delivered directly on board a ship / exported, such a supply of MFO can be zero-rated (i.e. provided proper export documents are maintained). Here Trader 3 exports MFO at zero-rated supply.

8.2) Tax Policies in India as compared to Singapore for bunker fuel

The bunker prices have a significant impact on the world freight level and the profitability as shipping companies, due to which the shipping companies are always on the lookout to find the optimum bunkering location for their vessel. Currently, the world market for the bunker is about 200 million tons in size approximately.

Despite of having a huge potential, Bunker market in India is not well established. The major portion of the bunker requirement in India is fulfilled by IOCL and imports. In India the bunker trading is mainly done over the counter bases, in which the prices are followed on the basis of MOPS, i.e Means of Platt's Singapore.

The major reason for lack in set up of Bunker Industry is the Tax policy and Infrastructure in India as compared to the neighboring countries like Singapore and Fujairah which are considered to be the bunker trading hub. There is a market of around 2.2 million metric tons in India.

	Locations						
	Eastern Region			**Western Region**			**Southern Region**
	Kolkata	Haldia	Paradeep	Kandla	Mumbai	Mormugao	Chennai
Bonded	1.5%	1.5%	-	-	-	-	-
Duty paid	5%	5%	13.5%	5%	5%	12.5%	4%

Source: www.iocl.com

The CAGR (Compounded Annual Growth Rate) of the traffic at Indian Ports as a whole so far has been around 5 % for the last 10 years as per the Indian Port Authorities but the bunker consumption so far has been very less as compared to the growth in traffic.

The Approved Marine Fuel Trader (AMFT) Scheme is designed to relieve approved persons from the payment of GST on local purchases of specified marine fuel oil from GST registered suppliers. The AMFT status is generally granted for 3 years from the date of approval. A shorter period may be granted at the discretion of the Comptroller.

If India can have a policy such as Singapore which is AMFT, this can really help India to reduce the market gap of 2.8 million metric tons and this will further bring in more foreign reserves for India.

Chapter 9: Conclusions

9.1) S.W.O.T Analysis of India for Bunker Business on Major Ports of India

Figure 9.1 S.W.OT Analysis

Strengths (S)	Weaknesses (W)
✓ **Strategic location of most ports** ✓ **Relations with the Middle-East** ✓ **High refining capacity** ✓ **Global presence** ✓ **High growth** ✓ **High market share** ✓ **Financial means available**	✓ Supply chain management ✓ Old infrastructure ✓ Limited water depth ✓ Old and inefficient bunker handling systems ✓ Rigid institutional framework ✓ High port tariffs ✓ Non uniform and high tax structure ✓ Cumbersome and detailed documentation procedures
Opportunities (O)	**Threats (T)**
✓ **Gujarat is about to come up with its own Export policy** ✓ **Introduce competition** ✓ **Improve organization, training** ✓ **Port reform – more autonomy** ✓ **Invest in infrastructure, lower costs for port users**	✓ **Colombo port Development** ✓ **Only IOCL supply a big amount of Bunker.** ✓ **Future LNG Market** ✓ **Bureaucracy**

9.2) Findings

- The Bunker Sales in India for the next year comes out to be **1.912 million MT** as per regression and **2.02 million metric tons** as per the primary survey which shows that there are more expectations of sale of bunker in India.
- As per the Gujarat Government, Gujarat is going to be the first state to have its own export policy due to which the exports from Gujarat will increase from 25% to 30%.
- Port tariffs and tax rates are very high as compared to the neighboring ports of Singapore and Fujairah.
- The Vessels take bunker mainly at the time of Loading.
- **4.857 %** is the expected growth rate of the shipping Industry.
- The price of the bunker fuel is the most important factor for Bunker Business. **81.57%** of the respondents consider it as the most important factor for bunkering.
- The potential of Bunker in India came out to be **49, 07,200** metric tons.
- The **market gap** in India is **2887200** metric ton which India needs to tap. India is able to tap only 41.16% so far.

- Use the following Formula to calculate future volume consumption:

$$V.C = \alpha + (\beta \times Year)$$

Here $\alpha = 0.843210715$

$\beta = 0.039584686$

V.C= Expected Volume of Bunker Consumption

9.3) Recommendation

- Improve supply chain infrastructure
- Coal, Bulk Vessels, General Cargo, Containers and Edible Oil Vessels can be the prime target.
- Vessels which load on the Indian ports and are touching E.U, America, and Africa should be the prime target.
- Also Target the small agents as they forward the enquiries for bunker to the local bunker traders.
- The traffic is expected to grow in Gulf of Cambay because of the more Industrial growth in Gulf of Cambay.
- Pipavav will be the preferred port of future in Gulf of Cambay because of its deep drafts and facilities.

Port	**Target Vessels**
Kandla	Iron Ore, Coal, P.O.L
Mumbai	Liquid Vessels, Coal, Container
J.N.P.T	Break Bulk, Container
Murmogao	Coal, Container
Cochin	Container, P.O.L, Iron ore
Chennai	Container, Break bulk
Tuticorin	Container, coal
Haldia	Container, general Cargo
Kolkata	Coal vessels, General cargo, P.O.L
Vizag	P.O.L, Coal
Paradip	Coal, Iron ore vessels, P.O.L

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