

Scenario of Production and Consumption of Petroleum Products Produced by Indian Oil in West Bengal

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Abstract

Indian Oil Corporation Limited is an Indian, state-owned oil and gas company with registered office at Mumbai. It is the largest commercial enterprise in the country. Indian Oil and its subsidiaries own and operate 11 of India's 23 refineries. It brings unrefined crude oil to its refineries and then refines it. During this refining process of crude oil, a variety of petroleum products are obtained. This study intends to find out the scenario of production and consumption of 4 such products obtained during crude oil refining in West Bengal. They are bitumen, naphtha, motor spirit and furnace oil. The present study is exploratory in nature. The data have been collected from various reports published by government of India and from different websites. It is found that over the last few years, Indian Oil is effectively catering to West Bengal's market demand for these petroleum products. It is also observed that the consumption of most of these petroleum products will increase in the near future in West Bengal.

Keywords: petroleum products, production, consumption, trend.

1. Introduction

Indian Oil Corporation Limited is the country's flagship national oil company, with business interests straddling the entire hydrocarbon value chain- exploration and production of crude oil and gas, refining, pipeline transportation and marketing of petroleum products, natural gas and petrochemicals. In the year 2013, it has been ranked at 88th position in the *Fortune* 'Global 500' listing. Indian Oil and its subsidiaries enjoy a dominant share of national refining capacity, pipeline capacity in the downstream sector and petroleum products' market. Indian Oil strategically structures its operations along the verticals like refineries, pipelines, marketing and R&D Centre. Indian Oil and its subsidiaries own and operate 11 of India's 23 refineries and its cross-country network of over 11,000 km of crude oil, product and gas pipelines is the largest in the country, meeting the vital energy needs of consumers in an efficient and environment- friendly manner.

There are 7 major business divisions in the organization- refineries, pipelines, marketing, research and development, petrochemicals, exploration & production (E&P) division and explosives and cryogenics division. To enhance upstream integration, Indian Oil has been pursuing exploration and production activities both within and outside the country in collaboration with consortium partners. The crude oil explored is then taken to the refineries division. Indian Oil controls a major portion of the refineries, with a group refining capacity of 80.7 million metric ton per annum- the largest share among refining companies in India. It accounts for 35% share of national refining capacity. After the refining process is completed the petroleum products are transported through the pipelines division.

Indian Oil operates a network of about 12,848 km long crude oil, petroleum product and gas pipelines with a throughout capacity of 93.7 million metric ton per annum of oil and 9.5 million metric standard cubic meter per day of gas. Finally, the final refined product is marketed through petrol and diesel stations, Indane (LPG) distributorships, Servo lubricants and greases outlets. Also, consumer pumps backed by bulk storage terminals and installations, inland depots, aviation fuel stations, LPG bottling plants and lube blending plants help the final consumers access the products in a hassle-free manner.

During the crude oil refining process a variety of byproducts are obtained which have specific applications in different fields. This report is based on the economic analysis of 4 such selected petroleum products manufactured by Indian Oil and they are bitumen, naphtha, motor spirit and furnace oil. Brief descriptions for each of these 4 petroleum products are given below:

1. Bitumen- Bitumen is a sticky, black, and highly viscous liquid or semi-solid form of petroleum. It may be found in natural deposits or may be a refined product. Natural bitumen deposits are found in different river beds. Before the 20th century, the term 'asphaltum' was also used. Its viscosity is similar to that of cold molasses while the material obtained from the fractional distillation of crude oil boiling at 525 °C (977 °F) is sometimes referred to as 'refined bitumen'. It has waterproofing and adhesive properties. The producer of bitumen often refines it several times to improve its grade.

2. Naphtha- Naphtha is a flammable liquid hydrocarbon mixture. It is an intermediate hydrocarbon liquid stream derived from the refining of crude oil. It is most usually desulfurised and then catalytically reformed, which re-arranges or re-structures the hydrocarbon molecules in the naphtha as well as breaking some of the molecules into smaller molecules to produce a high-octane component of gasoline (or petrol).

3. Motor Spirit- Motor spirit is a volatile liquid used as a fuel in internal-combustion engines. It consists mostly of organic compounds obtained by the fractional distillation of petroleum, enhanced with a variety of additives.

4. Furnace Oil- Furnace oil is a fraction obtained from petroleum distillation, either as a distillate or a residue. In general terms, furnace oil is any liquid fuel that is burned in a furnace or boiler for the generation of heat or used in an engine for the generation of power, except oils having a flash point of approximately 42 °C (108 °F) and oils burned in cotton or wool-wick burners. Furnace oil is made of long hydrocarbon chains, particularly alkenes, cycloalkanes and aromatics.

The table given below presents the areas of usage of these 4 petroleum products.

Table 1. Various Uses of Petroleum Products

NAME OF THE PRODUCT	AREAS OF USAGE
Bitumen	Road construction, water proofing
Naphtha	Plastic manufacturing, fertilizer industry
Motor Spirit	As an Engine fuel
Furnace Oil	Metal and steel industry

Source: Official website of Indian Oil

Indian Oil has been producing these products for quite a long time. The work of this report is mainly focused to find the market conditions of these petroleum products in West Bengal.

2. Objectives

1. To compare the production and consumption of these 4 products in West Bengal for the last 5 years.
2. To predict the consumption pattern of these 4 products for the next 5 years in West Bengal.
3. To observe how production of goods in other sectors and industries affect the consumption of these 4 products in West Bengal.

3. Methodology

This study has been mainly focused on 4 particular petroleum products produced by Indian Oil. They are bitumen, naphtha, motor spirit and furnace oil. These 4 particular products have been chosen for the analysis, among various other similar products produced by Indian Oil because a wide range of data is easily available for these 4 products. The study is based entirely on secondary data. Even the data used for empirically testing the objectives has been collected from various reports published by government of India and from various websites. The method of fitting a trend line to the given data has been used to predict the future consumption pattern of these 4 petroleum products. In this study, different diagrammatic representations, tables and correlations have been used to showcase the facts. All the statistical analyses and mathematical calculations have been done using Microsoft Excel 2007 and the statistical software STATA (version 12).

4. Analysis

Initially, year wise consumption of these 4 petroleum products in West Bengal, for the last 7 years is represented by the following table:

Table 2. Petroleum Product Consumption in West Bengal

PRODUCT	YEAR WISE CONSUMPTION (in metric ton)						
	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Bitumen	133000	131000	173000	189000	204000	232000	208000
Naphtha	547000	368000	686000	1040000	454000	517000	450000
Motor Spirit	392000	406000	443000	484000	555000	655000	726000
Furnace Oil	467000	451000	379000	349000	355000	368000	394000

Source: Indian Petroleum & Natural Gas Statistics

It can be observed from the above given table that consumption of bitumen, naphtha and furnace oil fluctuates from year to year, but consumption of motor spirit has increased consistently over these 7 years.

After observing the general consumption pattern, this consumption has been compared against the production of these products in West Bengal. The only refinery of Indian Oil within the state of West Bengal is situated in Haldia. So a comparison has been made between the yearly production of these 4 products in the Haldia refinery and their

consumption in West Bengal, for the last 5 years and this is represented by the following 4 bar diagrams:

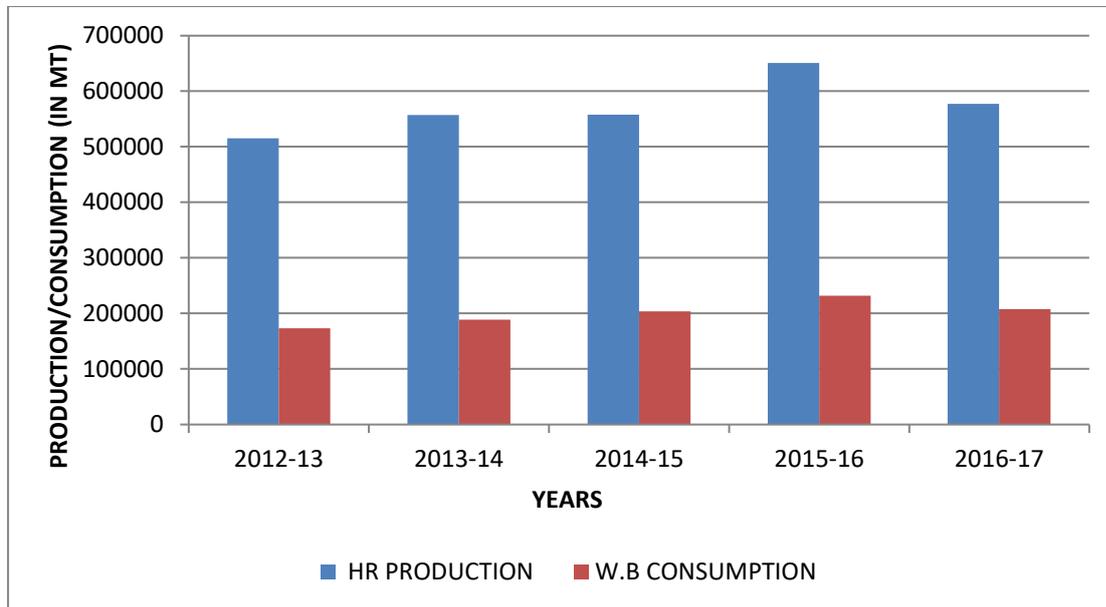


Figure 1. Production and Consumption of Bitumen in West Bengal

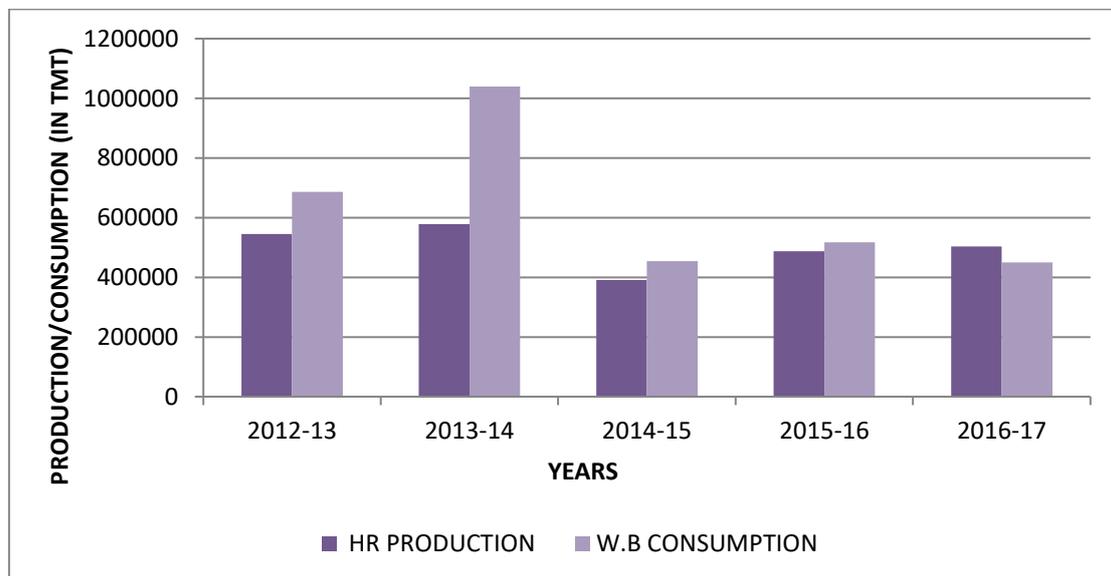


Figure 2. Production and Consumption of Naptha in West Bengal

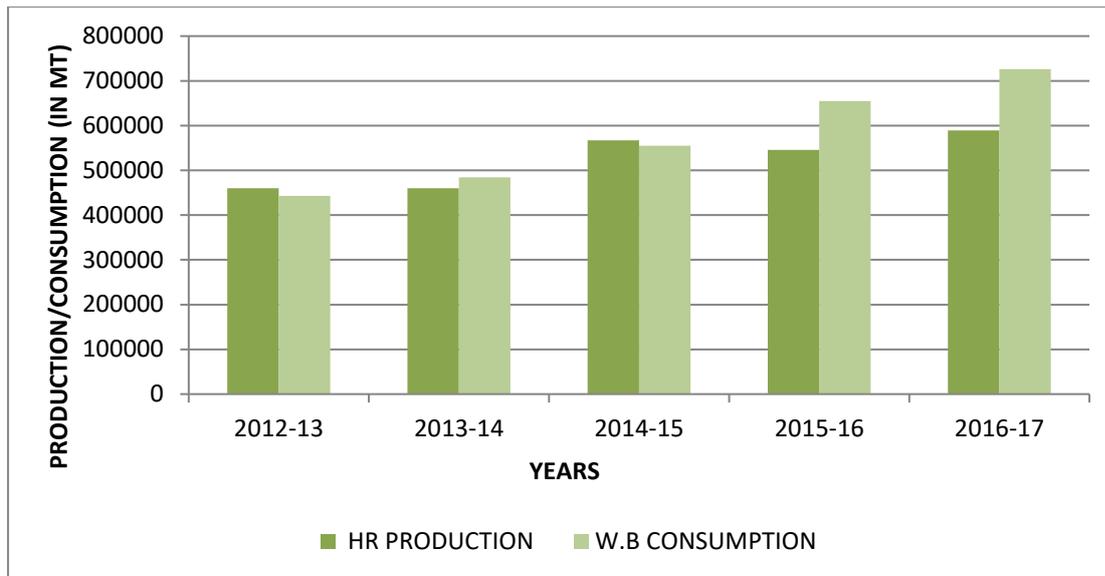


Figure 3. Production and Consumption of Motor Spirit in West Bengal

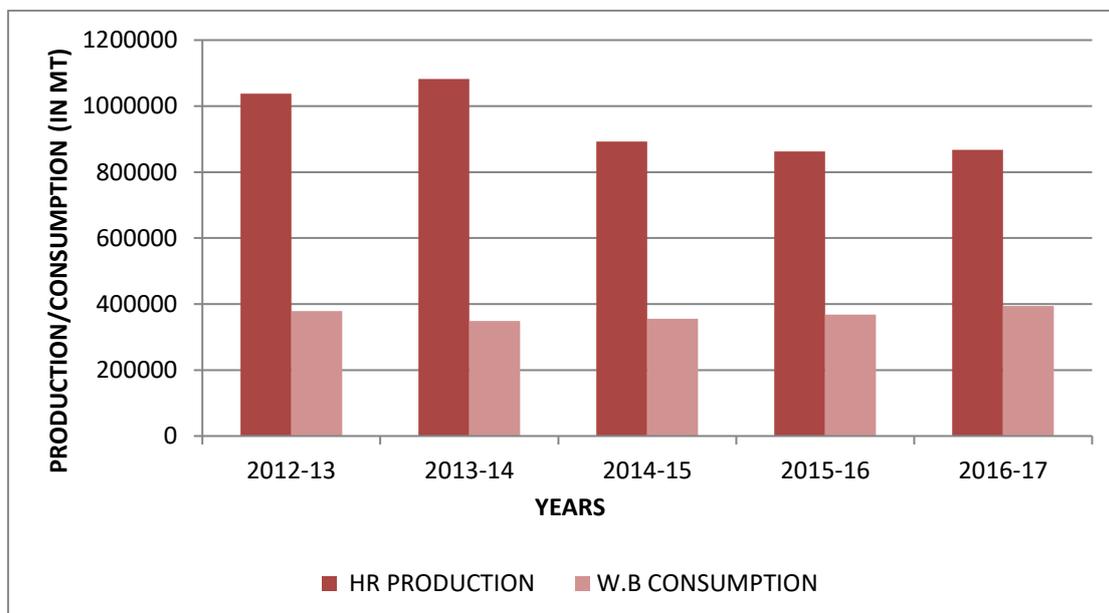


Figure 4. Production and Consumption of Furnace Oil in West Bengal

It is seen that Haldia refinery produces bitumen in adequate amount and that not only satisfies the consumption demand in West Bengal but also this bitumen is produced in such large quantity that it can be supplied even to other states. For naphtha, Haldia refinery’s production was not adequate to satisfy consumption demand in West Bengal till 2015-16 but after that it is found production of naphtha is more than the state’s consumption. The production-consumption scenario for motor spirit is highly fluctuating. In some years production exceeds consumption whereas in some years the picture is just the opposite. The scenario for furnace oil is very similar to that of bitumen. Much greater quantities of furnace oil, from that of required for satisfying the consumption demand in West Bengal has been produced consistently every year in Haldia.

After this, the consumption data of Table 2 has been used to predict the consumption of these products in West Bengal for the next 5 years, i.e. from 2017 to 2021. Since a very small time range is being considered for prediction of future consumption, it can be assumed that there exists a high standard error the predictions and from this analysis only a very approximate prediction of trend is possible. But since, beyond this short time period, consumption data of these products in West Bengal is unavailable, so this short time period has been only considered for the future prediction. As Indian Oil is the main supplier of these petroleum products in West Bengal, this consumption prediction which has been done using consumption data for West Bengal as a whole, can be applied to determine consumption pattern of products produced by Indian Oil also. For this purpose, a trend line has been fitted to each of the scatter diagrams obtained from the given consumption data and what will be the consumption of these 4 products in the next 5 years is analyzed. The diagrams showing this analysis are given as follows:

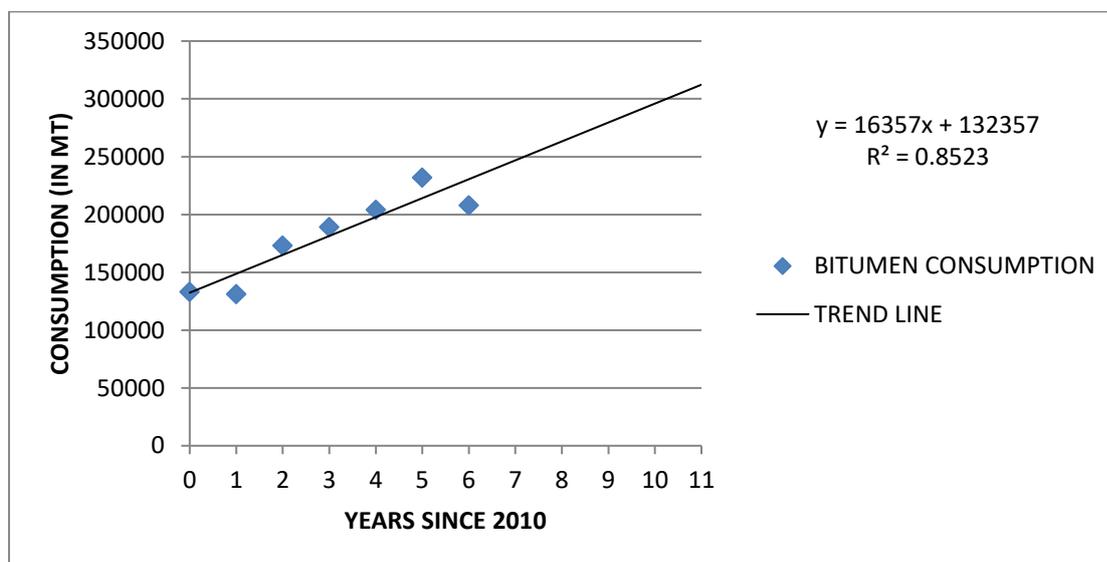


Figure 5. Prediction for Bitumen Consumption in West Bengal

Figure 5 shows the prediction for bitumen consumption in West Bengal. The trend line which can be best fitted to the scatter diagram for bitumen consumption in West Bengal is a linear trend line given by the equation, $y = 16357x + 13235$ for which the coefficient of determination (R^2) is 0.852. From this trend line it can be observed that bitumen consumption in West Bengal will increase gradually in the next 5 years.

Next presented below is the consumption prediction for naphtha. It is seen that no proper trend line can be fitted well into the given consumption data. This is because naphtha consumption over these 7 years is highly scattered and does not follow any specific trend. Thus, predicting the future consumption of naphtha in West Bengal is not possible by analyzing this data.

The same analysis is done for motor spirit and it is found that the trend line which can be best fitted to the scatter diagram for motor spirit consumption is a quadratic trend line given by the equation $y = 7857.x^2 + 10429x + 38957$ for which the coefficient of determination (R^2) is 0.995, which suggests that the trend line fits nearly perfectly to the data. From this trend line it can be observed that motor spirit consumption in West Bengal will increase consistently in the next 5 years.

Finally the prediction of consumption for furnace oil is done. It is found that the trend line which can be best fitted to the scatter diagram for motor spirit consumption is a quadratic trend line. The equation for this quadratic trend line is given as, $y = 8416.x^2 - 65107x + 48061$, for which the coefficient of determination (R^2) is 0.915, which suggests that this trend line also fits nearly perfectly to the data. From this trend line it can be observed that furnace oil consumption in West Bengal will increase consistently in the next 5 years. The diagrams showing prediction for motor spirit and furnace oil consumption in West Bengal are shown by figure 6 and 7 respectively.

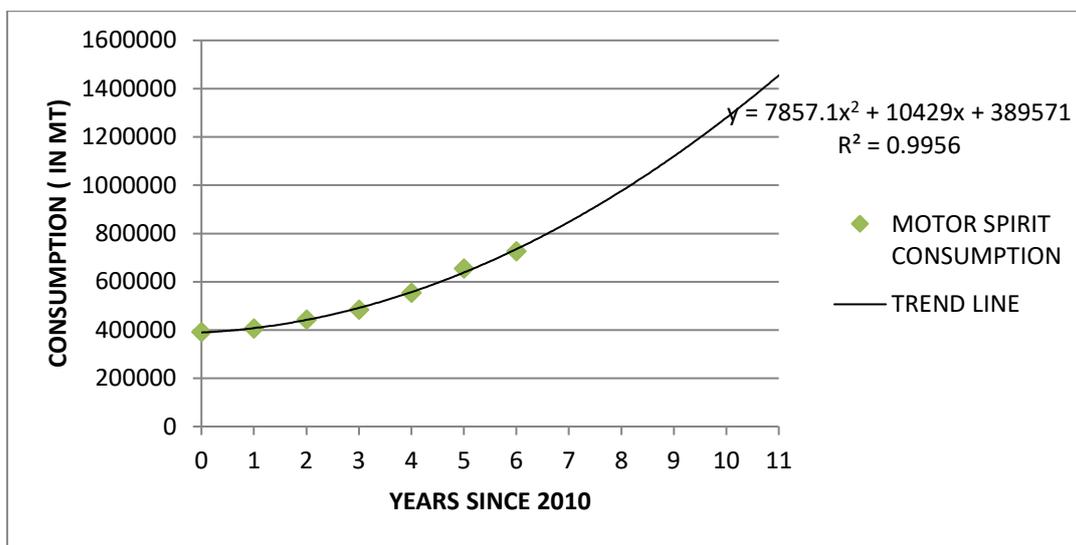


Figure 6. Prediction for Motor Spirit Consumption in West Bengal

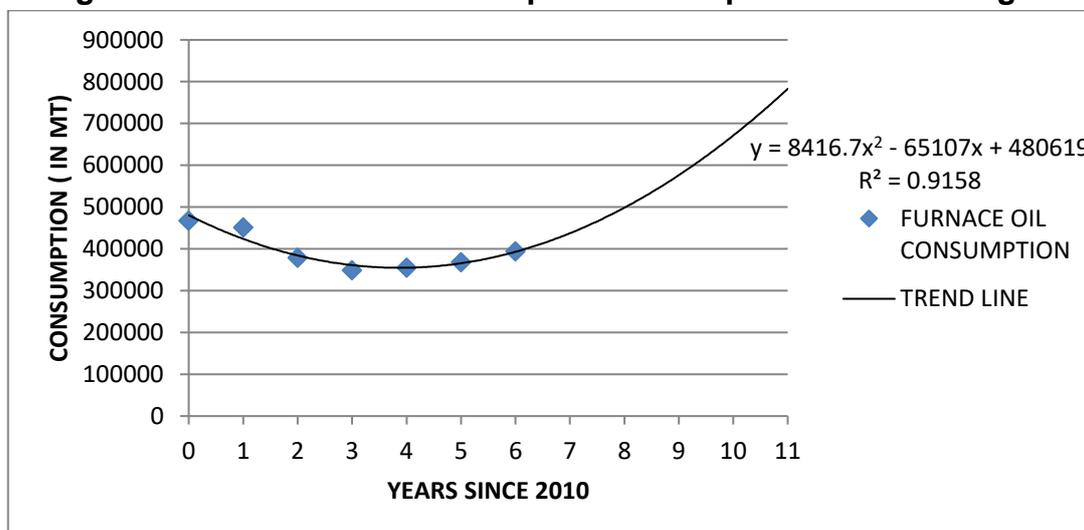


Figure 7. Prediction for Furnace Oil Consumption in West Bengal

After this, a correlative study is made with the objective of studying the inter-industry dependence, i.e. how the usage of these products in West Bengal affects the production of goods in other sectors and industries of West Bengal. For this, the correlation coefficients between the consumption of these 4 petroleum products and the development of those sectors or production of goods in those sectors which use these products as raw materials to produce finished goods, in West Bengal, are calculated. The correlation coefficients are represented by the following table:

Table 3. Correlation Coefficients

VARIABLE 1	VARIABLE 2	CORRELATION COEFFICIENT
Bitumen consumption in W.B	Total surface road length in W.B	0.38
Bitumen consumption in W.B	Length of NH in W.B	0.90*
Bitumen consumption in W.B	Length of urban roads in W.B	0.15
Naphtha consumption in W.B	Number of registered plastic manufacturing units	-0.61
Motor Spirit consumption in W.B	Total registered motor vehicles	0.93*
Furnace Oil consumption in W.B	Finished steel production in IISCO Plant	0.68

Source: Author's computation

The correlation coefficients denoted with * are statistically significant at 5% level of significance. The bitumen consumption in West Bengal and total surface road length in West Bengal are positively correlated but insignificant. Surface roads are roads which are accessible by people and are regularly used for commutation purposes. This suggests that, in West Bengal, more road construction involves more usage of bitumen but as the correlation value is insignificant it is inferred that bitumen is not the only material used for road construction. Roads are also constructed using brick paving, cement concrete, gravel or some of the surface roads are also made of natural soil. The bitumen consumption in West Bengal and length of National Highway built in West Bengal have a strong positive and significant correlation suggesting that for constructing national highway, bitumen is an indispensable material. Thus as more highways are constructed, the more bitumen will be consumed. The correlation between bitumen consumption and length of urban roads is also positive but insignificant. An urban road is a road within the limits of the area of Municipality, Military Cantonment, Port or Railway Authority. For construction of these roads also, bitumen is not the only indispensable material, thus the correlation value is insignificant, but the positivity suggests that more bitumen will be consumed as more of these type of roads are made. Next petroleum product is naphtha and it is used as an important raw material in plastic manufacturing industry. But the correlation coefficient between naphtha consumption and number of registered plastic manufacturing units in West Bengal is negative and insignificant. This is because nowadays most of the plastic manufacturing units are manufacturing plastic by recycling the old plastic products already available. So, fresh naphtha is not being consumed for plastic manufacturing. It is very evident as number of vehicles increases the consumption of motor spirit will obviously increase and that exactly happens in West Bengal also. So the correlation coefficient between motor spirit consumption and number of registered motor vehicle in West Bengal is strongly and positively correlated and it is significant too. The consumption of furnace oil and production of finished steel in IISCO, situated at Asansol in West Bengal, is positively but insignificantly correlated. This is because for steel production furnace oil is required but there are other various important inputs which determine the quantity of production in steel plants.

5. Concluding Remarks and Discussions

Indian Oil holds a prestigious position in the petroleum sector. In West Bengal, Indian Oil produces sufficient quantities of most of these products and satisfies the state's demand. It can also be seen that demand for most of the petroleum products produced by Indian Oil will increase in the near future and the reason can be that these products are being used as raw materials in various industries and other sectors. Various developmental activities which take

place in the state, like road construction, and the production in the heavy industries of West Bengal are instrumental in creating consumption demand for some of the petroleum products. It can be said that that proper storage of bitumen and other petroleum products can be arranged by the company so that these products are not wasted and they can be supplied at once to the market whenever the demand arises. As these petroleum products are used as important raw materials in other industries, it should be ensured that these are available to those industries very easily, whenever they are required. Indian Oil can also devise some strategies to stabilize the production of petroleum products over the years. That is, it should be taken care that random fluctuations in production do not take place and market supply remains more or less constant over the years.

6. Acknowledgements

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