CHAPTER - 1
INTRODUCTION

1.1 Background of the Study:

Assam has a unique historical distinction with regard to the process of industrial development like some other States of the country like Maharashtra and West Bengal. In fact, the base for industrial development of the State was started with the establishment of tea plantation and oil industry in the upper Assam area as were the cases of Maharashtra and West Bengal in regard to cotton textile and jute textile industries respectively. Although the rate of process of industrial development in Assam is slow compared to many emerging States like Gujarat, Haryana, etc. in spite of that the petroleum industry has made significant contribution to the process of industrial development in the State.

The petroleum crude oil in the country was first discovered in 1866 in and around Digboi and Naharkatia in upper Assam and consequent upon it, a refinery was established in Digboi under Assam
Oil Company in 1901, a then British Company responsible for exploration and production of petroleum product in Assam.


Petroleum Sector in Assam provides direct and indirect employment to about 10,000 people. It may be noted that the direct employment of BRPL was 1723 in 2005-06. But indirect employment generation in the State as well as in the rest of the country is several times more than the direct employment due to linkage effects. Moreover, backward and forward linkages of the petroleum refining sector as a whole on the aggregate economy of Assam is quite significant. (Govt of Assam, Report, 1990)

At present, there are four Refineries in the State - Digboi Refinery, Guwahati Refinery, Bongaigaon Refinery and Numaligarh Refinery.

The first commercial activity of the refinery started with the despatch of the first batch of Kerosene to the market in January 1902. Digboi Refinery was entirely rebuilt in 1923. Simultaneously, the oil
field production and refinery capacity increased. Ultimately Digboi emerged into a cost efficient commercially viable unit.

Establishment of another new refinery became necessary after discovery of new crude oil fields in the District of Sibsagar in upper Assam. The second refinery was commissioned at Noonmati area of Guwahati in 1961 and managed by Indian Oil Corporation (IOC) with the refining capacity of 1 MMTPA (million metric tonnes per annum).

Bongaigaon Refinery & Petrochemicals Limited (BRPL), the third refinery in Assam was set up as Public Sector Limited Company in January 1972 and was commissioned in 1974 with headquarter at Dhaligaon in the old Bongaigaon District of Assam, with the refining capacity of 2.35 MMTPA.

Again the Government of India set up the 4th Refinery in Assam at Numaligarh under Golaghat district of Assam. This new company, Numaligarh Refinery Limited (NRL) was set up in 1993 with the refining capacity of 3 MMTPA.

1.2 Statement of the Problem:

Bongaigaon Refinery and Petrochemicals Limited (BRPL) has unique distinction compared to other three oil refineries in Assam as
well as rest of the country. All the other three refineries, namely, Digboi, Guwahati and Numaligarh have only refining facilities of crude oil. But besides refining crude oil, BRPL has large petrochemical units. BRPL provides raw materials for growth of a large number of downstream industries based on its petrochemical units. This unique distinction of BRPL as refinery cum petrochemical complex among the Indian refineries has drawn our attention to make an in depth study of the production behaviour and also its economic impact and environmental issues related to the refinery.

Thus, BRPL has the unique distinction of being the first refinery in the country integrated with a petrochemical complex. Besides it is the only Public Sector Company which provides Polyster Staple Fibre starting from refinery crude oil down to paraxylene, Dimethyl Terephthalate (DMT) and Polyster Staple Fibre (PSF) Production in a single chain. Besides, BRPL did select the most modern technology from the world reputed process licensors for its petrochemicals as well as Polyster Staple Fibre (PSF) Plant.

Another factor which tempted to choose BRPL among the refineries of Assam for our study is that it is one of high profit
earning public sector undertaking refineries in the country. In 2005-06, profits before tax and profits after tax of BRPL are Rs. 267.27 crores and Rs. 174.26 crores respectively.

BRPL has forward linkages with other industries like textiles, paints, thinner, rubber and so on. Some industries using BRPL products are mentioned below:

(a) Cee Seven is a clean colourless liquid at normal temperature and pressure. This product is produced from Xylene plant. Cee Seven is excellent solvent and used by the industries like paint, thinner, rubber and other industrial solvents in admixture with other solvent.

(b) Solvent Naptha is a clean liquid. Solvent Naptha is produced by blending two streams of refinery and petrochemicals unit. Solvent Naptha is very good solvent and broadly used in the industries like paint, varnish, thinner etc.

(c) Polyster Staple Fibre is used for the production of synthetic and blended fabrics. It can be used as 100% polyster fabrics blended with cotton, eri, muga and wool.
(d) Dimethyl Terephthalate is used as the feed stock for manufacture of Polyster Filament Yarn (PFY), Polyster Staple Fibre (PSF), Film etc.

Besides these, there are some other products like Para-xylene, Ortho-xylene, Cee-nine, Solvent Naptha, Mixed xylene used in different industries. BRPL’s Polyster Staple Fibre (PSF) is of high quality and marketed under the trade name ‘Bonpoly’.

The refinery consists of Crude Distillation Unit (CDU), Kerosene Treating Unit (KTU), Delayed Coker Unit (DCU), Coke Calcination Unit (CCU).

The Petro-Chemicals units are –

(i) Xylene Plant

(ii) Dimethyl Terephthalate (DMT)

(iii) Polyster Staple Fibre (PSF)
1.3 Review of Literature:

The existing literature on petroleum sector relating to our proposed study is very limited. The followings are some of the contributions on the literature related to our proposed study bringing out broad findings to justify our area of research:

1. A study on the "Nature of the Elasticity of Substitution: An econometric study based on the products of HFCL, Namrup and Oil, Duliajan using VES production function approach" was done by Dr. Jiten Hazarika and Hiranya Saikia (2001). This study reveals that the nature of elasticities of substitution for both the industries viz HFCL, Namrup and OIL, Duliajan are not constant. Hence they suggested that the two industries may use the proposed production function in their future production planning.

2. Another study on "Public Profitability of Oil Refining PSUs" was done by Pradipta Bhattacharya and Madhusudan Datta (2004). It is found that five Public Sector Oil Refining Companies like Indian Oil Corporation (IOC), Hindustan Petroleum Corporation Limited
(HPCL), Bharat Petroleum Corporation Limited (BPCL), Madras Refineries Limited (MRL) and Cochine Refineries Limited (CRL) have shown hefty profits during the period 1978 to 1998. Public profitability, the concept the authors have used here as a more appropriate indicator of operational efficiency, has declined for all these companies. This observation is supported by the upward trend in real unit cost of throughput of these companies.

3. In another study by Biswanath Goldar and Hiranya Mukhapadhyay on "India's Petroleum Imports - An Econometric Analysis" (1990) made an in-depth econometric analysis of India's Petroleum Imports. For this purpose, demand functions have been estimated for various petroleum products and an import function has been estimated for petroleum. The results of the analysis indicate that the gap between domestic demand for petroleum products and domestic production of crude oil is the main determinant of petroleum imports. International price of petroleum and foreign exchange availability also exert some influence on the government's decision to import petroleum. An important finding of the study is
that both domestic demand for petroleum products and import demand for petroleum are not much responsive to price changes. In this study, all equations have been estimated in log-linear specification applying the ordinary least square technique.

4. A study was done by Dipankar Dey on “Globalisation and the petroleum Industry” (2001). In this study Dey divided Indian Petroleum Industry in the Post-independent period into three phases. These are - Early phase, Development Phase and Economic Liberalisation phase. The liberalisation process which had been started in mid eighties was accelerated and extended to other sectors of the economy in the name of Structural Adjustment Process (SAP). The main features of SAP were (i) privatization (ii) opening up of economy to foreign companies. The study reveals that the declared policy of the Government of the post independent India was to develop this vital industry under the public sector. In actual practice, the industry from its inception was very much dependent on foreign technology, capital and even on expert personnel (manpower). Over the years, the foreign involvement and participation in different
critical stages like exploration, production, transportation and refining have increased.

5. "Environmental Impact Assessment of BRPL" (Vol-I) was done by a group of scholars from Roorkee University (1991). The study considered some factors influencing environment like temperature, humidity, rainfall etc. According to this study refinery activities do not exceed the pollution level as mentioned by Central Pollution Control Board.

6. Another comprehensive "Environmental Impact Assessment studies for Digboi Refinery" was prepared by Department of Chemistry in association with Dept. of Bio-Technology and Dept. of Zoology -G.U. (1997). According to this report, there is no major impact on the physico chemical nature of the soil of the study area. The industrial activities couples with urbanization have not adversely affected the soil of the area and no negative impact is discernible. Besides, the treated effluent discharge from the refinery is gradually decreasing due to increased recycling. Besides the present quality of
ambient air does not indicate any significant impact from the refinery operations. The agricultural environment in the area has remained undisturbed with normal yield of rice and tea.

7. Again another “Environmental impact assessment study of diesel Hydro-Treatment Project – Bongaigaon Refinery and Petrochemical Limited, Dhaligaon, Assam” was done by Engineers India Limited (2002) (A Govt. Undertaking). The environmental impact assessment consists air quality, water quality, land and biological environment, socio-economic status and environmental management. According to this study, water quality, air quality in the area do not reveal any significant pollution caused by the existing plant. Different measures have taken by the environmental management cell of BRPL.

8. Another study was done by Ritu Bisht, A.Kumar and K.C. Koshel on “Safety and Environment Management in Petroleum Industry” (1998). The study reveals that safety and environment management in petroleum industry is a vital issue and for which the
Planners, Engineers and Managers are forced to think about the exploitation of hydrocarbon reserves through safe and environmentally friendly means. In this study, various aspects of safety and environmental management for all disciplines associated with oil and gas exploration, production and transportation are presented to effectively avoid any disaster on environmental damage. Safety and environment management should be a part of overall management functions.

9. An important study on "Environmental aspects of Petroleum Production, Transportation, Refining and Marketing" was done by Teh Fu Yen (1999) of University of Southern California, School of Engineering, Los Angeles, USA.

A critical evaluation of different environmental problems caused by petroleum and petrochemical industry is discussed in this study. The study reveals that at present considerable progress has been made by the petroleum industry to combat, abate, eliminate and minimize pollution in our atmosphere but three types of pollution – air, water and land, still remain future challenges. Wide spectra of the
environmental concerns and degradations are discussed in four areas for petroleum production, transportation, refining and marketing. The study has emphasized on the scientific basis for solving environmental problems.

10. A study on “Strategic Inter-actions and Industry Dynamics: A case study of the effects of Advanced upstream Seismic Technologies on the Petroleum Industry” was done by Prof. Harry Block & MS Jo Voola, School of Economics and Finance Curtin Business School, Curtin University of Technology, Perth Western Australia (2002).

In this study, the particular focus is on the use of exploration technology by the major international companies in the pursuit of new reserves of crude oil. A secondary related issue is that of mergers among the firms as a response to profit pressure that has resulted from the aggressive adoption of a cost-reducing innovation in exploration technology. The study begins with extending the Cournot Duopoly Model to include the possibility of firms incurring a fixed cost of making the decision to adopt a new process technology that will reduce its per unit cost of production. The analysis also suggests
that each company may be expected to react to the expenditures of its rivals, although the direction and magnitude of response will vary across companies depending on company's chosen strategy.

The review of literature in the limited number of studies mentioned above indicates that the production behaviour and environmental issues of petroleum sector need to make more in depth studies. Assam being a pivotal State in the production of petroleum products and Bongaigaon Refinery Petrochemicals Limited (BRPL) being a major public sector petroleum concern, we have decided to carry out an in depth study of the production behaviour and consequent environmental issues arising out of the effluent.

1.4 Objectives of the Study:

The following are the main objectives of our research problem:

1. To study the overall role of petroleum sector on economic development of Assam. This will encompass the contribution of petroleum Sector to income generation, employment and industrialization.

2. Secondly, to estimate the backward and forward linkages of petroleum sector of Assam based on input output table in
order to ascertain the impact of petroleum sector on the economy of Assam.

3. Thirdly, to analyse the production behaviour of BRPL in terms of productivity, rate of return, economic efficiency etc. using three standard production functions like Cobb-Douglas (C-D) production function, Constant Elasticity of Substitution (CES) production function and Variable Elasticity of Substitution (VES) production function.

4. Fourthly, to trace out the economic impact of the establishment of BRPL and its subsequent expansion on income generation, direct and indirect employment generation and growth of trade and commerce.

5. Finally, although BRPL officially claims to have adequate precaution to avoid health problem of the population in and around the refinery complex through effluent treatment plant, it is attempted to ascertain whether the BRPL has any adverse impact on environment including health condition of population in and around the refinery complex based on a sample survey.
1.5 **Hypothesis of the Study:**

The present study is based on the following hypothesis –

(a) BRPL is running under increasing returns to scale with high economic efficiency.

(b) The environment protection programmes taken by BRPL has kept the pollution level within permissible limit.

1.6 **Data Source:**

The study is based on both primary and secondary data. The secondary data are thrown up by the various published and unpublished data of official and non-official sources like State Government, BRPL and Petroleum Ministry, Government of India.

Two sample survey of households have been conducted - one for studying economic impact of BRPL and the other for environmental impact of BRPL in an around of the refinery cum petrochemical complex. In the first survey to study the economic impact of BRPL, a total of 500 household samples were selected out of which 150 samples were collected from Bongaigaon town and remaining 350 samples were collected from the surrounds of the BRPL. In the second survey to study the environmental impact, a total
of 300 households were surveyed in the nearby areas of effluent treatment plant.

1.7 Methodology:

The production behaviour of BRPL is investigated with the help of production function. In this study different production functions, namely Cobb-Douglas (C-D) production function, Constant Elasticity of Substitution (CES) production function and Variable Elasticity of Substitution (VES) production function are applied in our empirical investigation.

The usual Cobb-Douglas production function in the form

\[ Q = AK^\alpha L^\beta e^u \]

where, \( Q, K \) and \( L \) denote output, capital and labour and \( A, \alpha \) and \( \beta \) are the parameters and \( u \) is random variable, is used in the estimation of the production behaviour of BRPL. Parameters are estimated using the Least Square Method after logarithmic transformation of the variables. (Cobb C.W. & Douglas P.H., 1928)
The generalized form of Constant Elasticity of Substitution production function developed by Arrow, Chenery, Minhas and Solow,

$$Q = A[\delta K^\rho + (1-\delta)L^\rho]^{-\theta/\rho} e^u$$

where $Q$, $K$ and $L$ have the same meaning as in the case of C-D production function, has been used in our empirical investigation.

The CES production function has been estimated adopting Kmenta's method. (Kmenta, 1986)

Finally, the following Variable Elasticity of Substitution (VES) production function or Translog production function (Christensen, 1973) has also been fitted into the same set of observations to investigate the production behaviour

$$\ln Q = \beta_0 + \beta_k \ln K + \beta_L \ln L + \beta_{kk} (\ln K)^2 + \beta_{LL} (\ln L)^2 + \beta_{LK} (\ln K \ln L) + u$$

where $Q$, $K$ and $L$ have the same meaning as in the case of CD and CES.

The appropriate econometric tools are used for estimation and analysis of the parameters of the production function.
1.8 **Chapterization:**

Besides this introductory chapter, (Chapter-I) we have outlined
the chapterisation as indicated below

Chapter II  Economic Background of Assam
Chapter III  Industrial Profile of Assam
Chapter IV  Development of Petroleum Industry in Assam
Chapter V  BRPL – analysis of status of production,
            employment, income generation, profitability and
            linkages.
Chapter VI  Production Behaviour of BRPL – A study of
            production function
Chapter VII  Economic Impact of BRPL
Chapter VIII Environmental Issues of BRPL
Chapter IX  Summary of findings and conclusion.

Bibliography