A. The Problem:

The importance of agriculture in the overall economic structure of a country like India, can never be over emphasized. Villages form the backbone of the national economy, and in this context integrated rural development in general, and agricultural development in particular, assumes paramount importance. On the strength of agriculture depends the ability of the nation to feed its large and growing population. In addition, it is agriculture that provides the base for the growth of the other sectors of the economy. Agriculture is the largest single sector of the country's economy. It contributes 40 per cent of the net national product of India. In most of the developed countries agriculture ceased to be the major sector of the national economy when industrialization took place at a rapid pace, but in India, agriculture has continued to maintain its pre-eminent place in the national economy even after the country went through a good measure of industrialisation. Most of the experts on Indian economy strongly endorse the
view that agriculture constitutes the foundation of the growth process in India, and that the country's overall prosperity is bound up with the prosperity of the agricultural sector. To quote Dr. Manmohan Singh -

"By now there is a consensus in the country that a rapidly expanding and dynamic agriculture must constitute a basic foundation of a progressive, equitable and a self-reliant economy in India. It does not require much analysis to show that, without continued self-sufficiency in food and other basic agricultural commodities at steadily rising levels of per capita consumption, the development process in India will experience great strains. Agriculture is of critical importance in sustaining the growth process." ¹

Although agriculture continued to get high priority in the various five year plans, it was the year 1966-67 which was epoch-making in the history of Indian agriculture. It marked the launching of a new strategy for development, based on scientific advances in farm technology - what is popularly known as the "Green Revolution". The pace of progress can be gauged from the production figures for foodgrains. The foodgrain output, which was just 50.8 million tonnes in 1950-51, rose to 82 million tonnes in 1960-61, and went further upto 108.4 million tonnes in 1970-71. ² The Green

² Fertiliser Statistics, Fertiliser Association of India (FAI), New Delhi, 1987-88.
Revolution has been basically the outcome of the nation's total commitment to agricultural production, especially food production. No single factor can however, take the total credit for the revolution. To quote Dr. Sankaram -

"Green revolution has been essentially a process of modernisation based on science and technology and five different revolutions in five different sciences have made their contribution to the green revolution. The genetic revolution brought the high yielding crop varieties, the chemical revolution brought the fertilisers and plant protection chemicals, the engineering revolution enhanced the efficiency of cropping and removed the drudgery of farmers in multiple and intensive cropping, the communication revolution through press, radio, television, farm visits, training etc. enabled the dissemination of the new farm technology and finally the management revolution enabled the intelligent manipulation of the inputs for the highest output."¹

Other analysts of India's green revolution feel that three factors deserve to be recognised as the main pillars of the revolution.² These factors are:
- High yielding crop varieties

2. See for example:
   (a) Randhawa, M.S., "Green Revolution in Punjab", Punjab Agricultural University, Ludhiana, 1975.
With the introduction of short duration and disease resistant high yielding varieties it became possible to increase the per hectare yields of crops through increased use of fertilisers, particularly in irrigated and assured rainfall areas. Fertiliser, being the most important agricultural input, plays a key role in increasing agricultural yields. When a land is continuously used for arable farming, its organic matter gets reduced, as some of the plant nutrients are taken away by the crops, which results in lower yields. So it becomes essential that some extra nutrients be provided to the soil to maintain the fertility status of the soil, and to get higher yields. These essential nutrients are given to the soil by the use of organic as well as chemical fertilisers. The organic manures being limited by nature the chemical fertilisers have been given more weightage in modern agriculture practice.

Green revolution brought home the need for increasing fertiliser production domestically, and make the availability of the same easily to the farmers to meet its rising demand. As a result of this India is now the fourth largest consumer of chemical fertilisers in the world. The seventh five year plan of the nation proposed to step up the consumption of fertiliser in the country to 14.0 million tonnes by the terminal year of the plan i.e. 1989-90, from a level of 8.21 million tonnes consumed during the
terminal year of sixth plan i.e. 1984-85. ¹

As the nation adopted the use of fertilisers as a surest means for achieving quick and substantial break-through in agriculture, the task of fertiliser production as well as marketing has grown manifold in the country.

As far as the fertiliser production is concerned the Indian fertiliser scene is continuously expanding. It has come a long way since the first superphosphate factory, with a capacity of 6,400 tonnes of phosphate (P₂O₅) per annum, was established at Ranipet, Tamil Nadu in 1906. The first synthetic ammonia production was set up at Belagule, Mysore in 1941. This was followed by "Fertiliser and Chemicals Travancore Limited (FACT)" at Alwaye in 1946. FACT was the first large scale nitrogenous fertiliser unit in India. The first public sector fertiliser plant to have been commissioned during the First Five Year Plan (1951-52 to 1955-56) was at Sindri (Bihar), in November, 1951 by the name "Sindri Fertilisers and Chemicals Limited". Following Sindri, a string of public sector fertiliser factories got established all over the country. The Nangal fertiliser plant, which was first in this series, went into production in 1961. In January 1961, the 'Fertiliser Corporation of India (FCI)' was established to take over the management of Sindri and Nangal factories. This

¹ Fertiliser Statistics, Fertiliser Association of India (FAI), New Delhi, 1987-88, pp. I-84 and I-207.
Corporation grew into a giant, managing a substantial proportion of the total fertiliser capacity in the country. It can be seen from Table-1.1 that fertiliser industry of India underwent a very fast expansion during the ten year period between 1961 and 1971 (decadal growth rate being 425.4 for 'Nitrogen' and 192.3 for 'Phosphate', which is the highest).

Many major units entered the scene and existing units also underwent rapid expansion. Neyveli Lignite Corporation Limited (NLC), Neyveli; Fertiliser Corporation of India (FCI), Trombay; Fertiliser Corporation of India (FCI), Gorakhpur; Fertiliser Corporation of India (FCI), Namrup; Hindustan Steel Limited (HSL), Rourkela; E.I.D. Parry Limited, Ennore; Gujarat State Fertilizers Co. Ltd. (GSFC), Baroda; Coromandel Fertilisers Ltd. (CFL), Vizag; Indian Explosives Limited (IEL), Kanpur; and Shriram Chemical Industries (SCI), Kota; went into production during this decade. Between 1971 and 1984 the fertiliser capacity further increased. Some existing units like SCI - Kota, FCI - Gorakhpur etc. expanded their capacity and few more units - Madras Fertilizers Limited (MFL) - Madras; Fertiliser Corporation of India (FCI) - Durgapur; Zuari Agro Chemicals Limited (ZACL) - Goa; Indian Farmers Fertilisers Cooperative Limited (IFFCO) - Kalol and Kandla; etc. went into production.

The industry produces a wide variety of fertiliser products. Today four straight nitrogenous fertilisers (A/S, Urea, CAN, A/CI)
Table No. 1.1

GROWTH OF FERTILISER CAPACITY

(Capacity in '000 Tonnes)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Capacity ('000 Tonnes)</th>
<th>Installed Capacity ('000 Tonnes)</th>
<th>Decadel Growth Rate (%)</th>
<th>Year</th>
<th>Total Capacity ('000 Tonnes)</th>
<th>Installed Capacity ('000 Tonnes)</th>
<th>Decadel Growth Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1933-34</td>
<td>5.0</td>
<td>31.0</td>
<td>31.0</td>
<td>1981-82</td>
<td>4719.0</td>
<td>217.3</td>
<td>1408.0</td>
</tr>
<tr>
<td>1947-48</td>
<td>92.0</td>
<td>31.0</td>
<td>129.0</td>
<td>1982-83</td>
<td>5174.0</td>
<td>1492.0</td>
<td>1614.3</td>
</tr>
<tr>
<td>1951-52</td>
<td>182.0</td>
<td>129.0</td>
<td>182.0</td>
<td>1983-84</td>
<td>5201.0</td>
<td>1767.6</td>
<td></td>
</tr>
<tr>
<td>1961-62</td>
<td>283.0</td>
<td>182.0</td>
<td>41.1</td>
<td>1984-85</td>
<td>5592.0</td>
<td>532.0</td>
<td></td>
</tr>
<tr>
<td>1971-72</td>
<td>1487.0</td>
<td>532.0</td>
<td>192.3</td>
<td>1985-86</td>
<td>6695.0</td>
<td>1952.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1986-87</td>
<td>6880.0</td>
<td>2214.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1987-88</td>
<td>7083.0</td>
<td>2453.3</td>
<td>74.2</td>
</tr>
</tbody>
</table>

Sources:
1. Ramaswamy, Dr. V.S.; 'A study of the Marketing of Fertilisers in India', Published by P. Madhawan, 101, Raghavachari Road, Mylapore, Madras, November 1985, P.29
2. Figures in respect of 1981-82 to 1987-88 have been taken from Fertiliser Statistics, FAI, New Delhi, 1987-88.

* The growth rate is for a period of seven years from 1981-82 to 1987-88.
and twelve grades of NP/NPK complex fertilisers are manufactured, the former accounting for about 85 per cent total Nitrogen (N) production within the country. As the major thrust in new generation plants is on the production of 'urea', currently nitrogen (N) through urea alone accounts for about 80 per cent of total nitrogen (N) production. By 1990-91 the share of 'urea' in total nitrogen (N) would go up to 83-85 per cent.¹

Presently India's fertiliser industry is very large. The industry has an installed production capacity of 7.08 million tonnes of nitrogen (N) and 2.45 million tonnes of phosphate (P₂O₅) making a total of 9.53 million tonnes as on 31.3.88, and is still undergoing expansion. The seventh five year plan sought to expand the capacity to 12.24 million tonnes by the year 1989-90 envisaging an additional investment of Rs.7000 crores.²

The consumption of fertilisers played a pivotal role in augmenting agricultural production in the country during the last thirty years. In fact, consumption of fertilisers has all along been far in excess of the production, and the country has been importing large quantities of fertilisers to bridge the gap between consumption and domestic production.

In tune with the rapid growth of fertiliser production and

consumption in the country, the problems of marketing of fertilisers have also gained new heights.

The market for fertilisers is unique as it is constituted by over six lakh villages in India. This market is far different from the one constituted by the urban areas of the country, because in this market consumers are widely scattered. This market is further characterised by economic backwardness, cultural, religious and linguistic diversities and traditionalism. The fertiliser marketing also faces a unique consumer, in that he is a combination of economic, educational and social backwardness. All these problems give rise to a number of hurdles in marketing of fertilisers.

Physical Distribution of fertilisers has been the first among the special problem areas. Physical distribution comprises the tasks involved in planning and implementing the physical flows of materials and final goods from points of origin to points of use or consumption to meet the needs of customers at a profit. While several definitions of "physical distribution" have been offered by various authors and some authors have recently used the 1. For example:

(i) 'Physical distribution' is the broad range of activities concerned with efficient movement of finished products, from the end of the production line to the consumer, and in some cases includes the movement of raw materials from the source of supply to the beginning of the production line. These activities include freight transportation, warehousing, material handling, protective packaging, inventory control, plant and warehouse site selection, order processing, marketing, forecasting and customer service (The National Council of Physical Distribution Management, Chicago, Illinois.).

Contd....
term logistics\(^1\) for the total flow of materials, both raw material and finished goods, for the purpose of this study "physical distribution" is clearly the movement of finished goods from the production line to the customer. Physical distribution stands for an integrated system of many functions necessary to move a product from producer to customer. The main activity centres of the physical distribution system thus are:

- transportation
- inventory control
- warehousing
- packaging and material handling and
- communication.

Generally the total cost of physical distribution is anywhere between 15 and 30 per cent of sales\(^2\), but in the case of

Footnote continued from pre-page

(ii) 'Physical distribution' is the process of interpretation of an order to effect the movement of goods from the point of manufacture or storage to customer in accordance with company policy (Wilson, A., "The Marketing of Industrial Products", Hutchinson, 1965).

(iii) The process of 'physical distribution management' is concerned with movement of product to customers. In a 'physical distribution' sense, the customer is viewed as the final stop in the marketing channel (Bowersox, D.J., "Logistical Management", Macmillan Publishing Co., Inc., New York, 1978).

(iv) 'Physical distribution management' is concerned only with those flows which are from the end of the production line to the consumer (Christopher, Martin, "Total Distribution", Gower Press, 1971).

1. See for example:


fertilisers it is even more. Experts hold that substantial saving can usually be affected in the physical distribution area, which has been variously described as "the last frontier for cost economies"\(^1\) and "the economy's dark continent"\(^2\). Physical distribution decisions when uncoordinated result in profit suboptimization. Furthermore, physical distribution is a potent instrument in the demand stimulation process. Companies can gain by offering more in the way of service or by cutting prices through successfully reducing physical distribution costs.

Irrespective of its paramount significance, very negligible attention has been paid to the physical distribution of fertilisers. Whatever little attention has been paid, it is restricted to the individual activity centres. In fact, there are very few studies on 'Physical distribution of fertilisers'. Even among these studies on fertiliser distribution the emphasis has been on individual activity centres. Some important and relevant studies on fertiliser distribution suggest that:


- Developing a transport optimisation model, using the concept of a rationalised and economic marketing zone for each fertiliser producing unit in the country within which only transport of fertilisers from the unit should take place.¹

(ii) In order to optimise the total transport cost, it is necessary to consider, both the primary and secondary transport components (i.e. primary transport by rail and secondary transport by road), and the market share of a manufacturer in a state should be directly proportional to the production capacity of the unit and inversely proportional to the distance of the unit from the market (i.e. the concept of inverse relationship between market share and distance from the point of production).²

(iii) Controlling inventory is a major aspect of fertiliser distribution system. The development of a realistic sales plan, quick and effective communication and documentation between warehouses and departments concerned with inventory control, and periodical review of the marketing situations, form the basic ingredients of an effective inventory management. Quantitative techniques like exponential smoothing, regression analysis, ABC analysis, transport

1. Rail India Technical and Economic Services Limited (RITES) "Fertiliser and Raw Materials transportation in India, (AN optimisation study)" (RITES REPORT), New Delhi, 1978.

2. The Ministry of Agriculture, Government of India sponsored this study. Fertiliser Planning and Development of India Ltd. (FPDIL) carried out the study and submitted the report to the Government in March, 1982.
technique etc. should be used as effective tools in inventory decisions. A periodical analysis of cost of carrying inventories against cost of offering incentives will help marketing men to decide on off-seasonal discounts, and lifting rebates, to motivate dealers and other agencies in the distribution channel to stock fertilisers in advance of the seasons.¹

(iv) A suitable transportation mix (keeping in mind the inherent economies, shortcomings and advantages of each of several alternative modes of transport) based on an effective strategy of depot planning would help in minimising the total cost of fertiliser distribution.²

Besides the above studies, there have been a number of articles on various aspects of physical distribution of fertilisers.³


3. Bee for example -


However, the above review of the literature on physical distribution suggests that there are very few empirical studies on physical distribution of fertilisers and whatever empirical studies are available, they only concentrate on individual activity centres. There has been no attempt to consider all the activity centres together, and to study the relationship between the activity centres. In fact, all the activities covered under physical distribution are related to one another. A decision in one area cannot be made in isolation, since any decision in one area leads to important changes in other areas. With the breakdown in or the inefficiency of, any of the activities, the total physical distribution system will be adversely affected. Therefore, this view of physical distribution leads to the important concept of the "total cost approach" to physical distribution. A distribution problem is a systems problem and it must be looked at as such.

The total cost approach aims to provide the best possible customer service at the least cost. It deals with the impact of distribution decisions on business costs wherever these costs may appear. The various steps involved are:

(i) Determination of all distribution related factors which contribute significantly to total business costs,

(ii) Development of data necessary to measure the impact that alternative distribution systems would have on total cost and customer service,
(iii) Determination of a combination of distribution decisions which will minimise the total cost at the desirable level of customer service.

Thus the aim of the total cost approach is to gain an optimum and best solution overall, even at the expense of sub-optimum performance in one of the activity centres. This approach is highly versatile in its application throughout the business system and it is not an instrument only for the distribution analyst or planner. Its prime importance in distribution is not only in helping to turn the spotlight on hidden costs of distribution, but it can also lead to reorientation in management thinking. It does this by producing estimates of cost savings through distribution decisions that can be evaluated in terms of return on capital investment.

Because of the complexity of the relationship between the various activities of physical distribution, the cost reduction potential which exists in the physical distribution area has remained relatively unexplored. Most of the companies place the responsibility for cost and service control at the functional level and the opportunity to look at the total cost is clouded by divided responsibility. The management always encourages the separate functional units to reduce and control their cost of operations. This cost reduction in the functional departments ultimately result in increased costs in some other departments. Thus to improve the efficiency and for reducing overall costs, attention should be paid
to the most important cost i.e. total cost of performing the physical distribution activity and not the separate costs of the individual activity centres.

There is hardly any study which has used "total cost approach" for physical distribution decisions. Hence the need for the present study with regards to physical distribution of fertilisers, which by using a total cost approach will help in:

- Finding out the loopholes in the physical distribution activities for fertilisers, which in a way will help in providing more efficient methods of distributing fertilisers and will be of direct use in increasing the agricultural output of the nation.

- Reducing the total cost of fertiliser distribution, which in turn will help in reducing the prices of fertilisers leading to a larger consumption of fertilisers and greater agricultural output.

B Objectives Of The Study:

The objectives of this study are:

(i) To study the activity centres viz., transportation, warehousing, inventory management, packaging and material handling and communication for the fertiliser industry, with particular reference to the three selected units, one each from the public, cooperative and private sector, namely National Fertilisers Limited (NFL),
Indian Farmer's Fertiliser Co-operative Limited (IFFCO) and Shriram Fertilisers and Chemicals (SFC).

(ii) To identify areas of cost reduction in the three selected units for various operational aspects of the activity centres.

(iii) To compare the costs of activity centres for the three selected units.

(iv) To assess the level of inter-relationship between different activity centres for the three selected units.

(v) To suggest a total cost approach for decision making regarding any physical distribution activity.

It may be mentioned that the study first considers the possibility of cost reduction in each activity centre. This relates to the operational aspects of physical distribution like inventory control, optimisation of transportation network, optimisation of warehouse locations, simplification and speed in order processing and choice of packaging and material handling systems etc. Costs will be compared for the three firms.

The second aspect of the study relates to 'total cost approach' whereby the inter-relationship between the activity centres is considered for major decisions like number, size and location of warehouses, mode of transportation, inventory size and customer service levels. The study would consider whether the total cost approach is adopted by the selected firms or not.
It would also identify the existing service levels for physical distribution in the selected firms. The study would attempt to suggest a framework for establishing a customer service level. For a given service level, different combinations of activity centres are possible. These would be identified and the least cost combination would be suggested. The organisation structure and its suitability for the total cost approach would also be discussed.

C Scope Of The Study:

There were about 132 fertiliser units in the year 1987-88 spread all over India. These units are manufacturing basically only two types of fertilisers namely, nitrogenous and phosphatic. The potassic fertilisers are being imported. The fertiliser units are both in the small scale sector as well as the medium and large scale sectors. It may be noted that only the medium and large units have the resources and the distribution network to distribute fertilisers on a wide-scale. The small scale units are only supplying to the local markets.

The fertiliser units can also be categorised according to the trade sectors i.e. public, cooperative and private sector. This study would thus make an interfirm comparison of three firms selected from each one of the sectors and having a well established distribution network.

Any study on physical distribution would require detailed cost data with regard to transportation, warehousing, material handling inventory and packaging. These costs of physical distribution would also vary according to the geographical distribution. It may also be added that these costs would generally be different for different types of fertilisers.

Keeping these factors in mind the study has been limited to the geographical area of Punjab and Haryana. These states have been selected because they constitute about 20 per cent of the total fertiliser consumption in India. Further, because of the nearness of the markets detailed cost data was easier to obtain.

National Fertilisers Limited (NFL), a public sector unit has Punjab and Haryana as its home markets. Its main product line is nitrogenous based fertilisers. Thus, two other units which have an established distribution network and producing nitrogenous fertilisers, as also distributing in Punjab and Haryana were identified. Indian Farmers Fertiliser Cooperative Limited (IFFCO) was selected from the cooperative sector while Shriram Fertilisers and Chemicals (SFC) from the private sector. Appendix I gives a profile of these units.

**Methodology:**

The data for the study was primarily collected through a structured questionnaire administered personally to different
officials concerned with physical distribution, as well as the field staff of the units concerned. A number of questions were added during the course of discussions with the personnel of the organizations. Secondary data was collected from the annual reports and other internal reports of the concerned organizations.

Another questionnaire was administered to experts in the area of transportation, warehousing and packaging. Suggestions were sought from them for improvement in the respective activity centres.

These questionnaires are attached in Appendix-II. It may be added here that data with regard to all the costs in each activity centre were not available, as the units hardly kept a record of all the costs.

Secondary data was also collected from a number of sources. These include The Fertiliser Association of India, Central and State Warehousing Corporations, National Cooperatives Development Corporation, The Railways and Road Transport Operators and State Cooperative Marketing Federations etc.

E. Plan Of Study:

The study is divided into ten chapters.

While the present chapter deals with the need, objectives and scope of the study and the research design, the second chapter
considers the production, consumption, imports and distribution of fertilisers in India as well as the selected units. The third chapter discusses the marketing channels for distribution of fertilisers in India and also specifically for the three selected units. The next five chapters discuss the five activity centres of physical distribution, namely, transportation, warehousing, inventory management, packaging and material handling and communication. The focus is on reduction of costs for each of the activity centres of the three selected firms. Suggestions for improvement are also indicated. Chapter 9 suggests a total cost approach for two major decisions in physical distribution: namely choice of a mode of transportation and decision on the number of warehouses. The final chapter gives the main conclusions of the study and suggestions for improvement of physical distribution activity for fertilisers.