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THE FERTILIZER INDUSTRY IN INDIA

Background Paper

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THE FERTILISER INDUSTRY IN INDIA

by

Fertiliser (Planning and Development) India Ltd.

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PART - I Role of fertiliser in National economy.

1. The Indian fertiliser scene has been undergoing rapid changes since 1951 with regard to both consumption and production. The total consumption which was a mere 66,000 tonnes of fertiliser nutrients in 1951 increased to over 4.3 million tonnes in 1977-78 and is expected to cross 4.7 million tonnes during the current year.

2. Judging from the more recent trend of consumption, particularly since 1975-76 (the increase was about 18% in 1976 and 26% in 1977), it may be appropriate to say that India has reached the take off stage in fertiliser consumption with more and more farmers adopting improved agricultural technology. According to present expectations consumption may increase to nearly 7 million tonnes by 1981 and 10 million tonnes by 1985.

3. On the production front, the quantity of fertiliser nutrient produced in the country has increased from as low as 39 thousand tonnes in 1951 to over 2.6 million tonnes in 1977. With an

installed capacity of a little more than 5.5 million tonnes, the production during current year, it is anticipated, will be of the order of 3 million tonnes. The installed capacity is expected to increase to 6.8 million tonnes by 1980 and 9.1 million tonnes by 1983 and the likely production to 4.5 million tonnes and 6.6 million tonnes respectively. In Table 1 are given details with regard to changes in consumption and production over the years as also the likely future increases.

Level of use:

4. Inspite of recent increases in consumption, the level of fertiliser use in India is still much less than in many other countries including several ones in Asia. In the year 1975-76, for which comparable data are available for different countries, the level of consumption was only 16.5 Kgs. per hectare in India compared to 358 Kgs. in Republic of Korea, 319 Kgs. in Japan, 48 Kgs. in China and 28 Kgs. in Pakistan. The relative position among these countries may not have changed much since then as overall increase in fertiliser consumption has been taking place in most of the countries more or less in a similar manner since

1975-76. The present level of use is only about 25 Kgs. of nutrients per hectare, (17.2 of N, 5.1 of P_2O_5 and 3.0 K_2O). Compared to this even the average per hectare consumption for Asia as a whole is appreciably more (33.4 Kg. in 1975-76).

5. There are quite a few States in India where the level of consumption is far too low, 1.1 Kg. in Nagaland, 1.3 Kg. in Assam, 5.5 Kg. in Rajasthan and 6.4 Kg. in Madhya Pradesh. The highest level of consumption is in Punjab 61.6 Kg. which also is not appreciable compared to some of the countries mentioned above.

6. Another area of needing concern is the relatively low NPK ratio in India. The present NPK ratio is 5.8:1.7:1. This is against the general recommendation of 4:2:1 for most of the crops. There is therefore need for not only increase in the overall level of consumption but also in correcting the present imbalance which would mean proportionately more use of P_2O_5 and K_2O.

LAND AND AGRICULTURE:

7. Improvement of agriculture is vital to India's economy. In 1966, nearly 66 per cent of the population was dependent on agriculture for their

living and 40 per cent of the GNP came from this sector. India has a total geographical area of 328.8 million hectares. Of this a little over 140 million hectares is either under forests or not available for cultivation. There is very little scope for extending the cultivation. Only about 16 million hectares is under cultivatable waste, most of which is sub-marginal or is in inaccessible areas.

8. Land is one of the most exploited resources in India. Per person the cultivable area works out to only 0.25 hectares which is much less than for many other countries. A comparative picture of the per capita cultivable land in some of the developed and devloping countries is given in Table 2.

9. In large parts of the country there is no assured rainfall. Only on about 28% of area the rain-fall is more than 1,250 mm in a year. On 30 per cent of the area the rainfall is even less than 750 mm under conditions of which it is difficult to grow any crop. Besides, even in areas where rainfall is high, the distribution is not even. Most of the precipitation is concentrated in the monsoon season between May and August. Even during the monsoon there are spells of dry season

which affect the crop adversely.

10. Only about 28 per cent of the total cropped area is irrigated. Even of this, substantial proportion is seasonal and supplementary, as a result of which most of the agricultural area is cultivated once a year. In 1975-76 only 20 per cent of area cropped was sown more than once.

11. Another evil which afflict Indian agriculture is the very small size of holding. According to statistics as much as 99 per cent of the agricultural holdings covering over 94 per cent of the area are in sizes of less than 20 hectares. As many as 50.6 per cent of the holdings are in size of less than 1 hectare and 33 per cent of less than 0.5 hectare. This makes cultivation uneconomic on a substantial proportion of the area.

12. The land productivity in India is also low compared to other countries. For example, the average yield of rice in India is only 1.8 tonne per hectare compared to 3.3 in China, 2.3 in Pakistan and Viet Nam and 1.9 in Sri Lanka and Nepal. Similarly, the yield of wheat in India is only 1.4 tonne per hectare compared to 4.3 in the U. K., 2.1 in USA, 2.5 in Egypt, 3.9 in France and 2.7 in

Italy. The yield of other crops is also not substantial. In table 3 is given a comparative picture of the yield of important crops in India vis-a-vis some of the other Asian countries.

13. Since the land available for cultivation is limited, much of the development has to come through intensive cultivation. There are several measures taken towards this like irrigation high yielding Variety programme etc. According to the 6th Five Year Plan the irrigated area is to expand from the present level of 48.4 million hectare to 63.4 million hectare by 1982. Special developmental programmes have been taken up with regard to more important of the crops like wheat, rice, maize, jowar and bajra. Already 37 million hectares are under these crops and are having high yielding variety programmes. In the HYP areas particular attention is paid to practices involving the use of fertiliser, insecticides etc. The details of the HYV programmes and targets kept under the current Five Year Plan are as given in table 4.

FOOD GRAINS POSITION:

14. Traditionally, India has been deficit in foodgrains. Uptill 1935 most of its deficits were

being met from Burma which was then part of India and had surplus food production. However, with the separation of Burma, the situation became acute. Quite often, the land was afflicted with famine on account of drought or flood in various parts of the country. With improvement in drainage facilities and bunding of some of the rivers the floods are now not so frequent. However, due to dependence on monsoon the frequency of droughts continues unabated. Nevertheless, because of the various measures taken for improving agriculture since 1975 there has been appreciable increase in domestic foodgrains production, so much so, that the country has now a buffer stock of nearly 22 million tonnes which is nearly one-fifth of the annual requirements.

15. However, with a growth rate of nearly 2.5 per cent in India's population, it is necessary that the agriculture of the country should also keep pace.

16. There is also the backlog of consumption among India's present population, nearly, 20 per cent of which is living below the poverty line. Unless substantial increase takes place in agricultural production, it may be difficult for this

group to raise their consumption to the minimum nutritions level. Thus, both for meeting the increased population and also the backlog in consumption, it is necessary that India's agriculture production should increase substantially. It is in this context that the future fertiliser programme in the country has to be viewed.

SOILS AND FERTILISER RECOMMENDATIONS

17. The use of agricultural inputs like chemical fertilisers, seeds etc. depends upon the economics of their application. Quite often the economics of the use of fertilisers is a function of also other factors such as:

- soil fertility
- variety of seeds used
- management in agriculture particularly irrigation and water management.
- climatic conditions
- price of the input
- price of the output

18. The soils of India have been fairly well mapped. According to the Indian classification there are 26 different types of soils distributed

over the country. The predominant among these are alluvial soils, Medium Black soils, Red and Yellow, red sandy and red loam. In general the soils of India are low in organic matter. A detailed classification of soils showing the extent of their occurence in different States is given in table 5.

19. In India fertiliser recommendations are made by the concerned State Governments on the basis of soil tests undertaken. These recommendations are general and are not specific to any particular farmer's field. Some of the manufacturers help the farmers by analysing soils and giving specific recommendations. By and large, however, most of the farmers follow the State level recommendations for different crops. The summary of the recommendations for important crops in different States is presented in Table 6.

20. For high yielding variety of paddy the recommendations of Nitrogen vary from 40 Kg. per hectare in Assam to 136 Kg. in Andhra Pradesh, for high yielding variety of wheat the dose varies from 90 Kg. in the State of U.P. to 140 Kg. In Madhya Pradesh. Similar variations also are found in the case of Bajra, Jowar and Maize. For sugarcane

the recommended level of application is much higher than that for other crops. It varies from 150 Kg. of N in Madhya Pradesh to as high as 400 Kg in Maharashtra.

21. There is also variation in the case of P&K recommendations. For paddy the recommendations of P_2O_5 vary from 20 Kg. per hectare in Assam to 80 Kg. in Madhya Pradesh. For high yielding variety of wheat the variation is from 45 Kg. in U.P to 62 Kg. in Punjab. Most of the soils in India are relatively rich in Potash. Maximum recommended dose in the case of Potash is 175 Kg. on Sugarcane in Maharashtra followed by 112 Kg. per hectare in Karnataka. Among the other relatively high potash consuming crops are Cotton in Andhra Pradesh and wheat in Puhjab and Haryana.

CROP RESPONSE TO FERTILISER USE

22. Extensive laboratory and field research has been done over the year to assess the responses to various levels of fertilisers use and fix yardsticks for additional production. The research work covers all the important crops and agricultural belts of the country. The Indian Council of Agricultural Research (ICAR) has conducted fertiliser

trials on cultivators field in a large number of districts of the country. The varieties of different crops covered include high yielding paddy (like IR-8 and TN-1 wheat (S-227 - Kalyansona and S-308 Sonalika of maize (Ganga), Jowar CHS-1 and Bajra (HB-1, HB-3).

23. Large variations have been found in the response to fertiliser use on various crops. For example, in the case of high yielding variety paddy, the additional yield per tonne of nitrogen applied at the level of 60 Kg. per hectare varied from 7.5 tonnes in M.P. to 15.9 tonnes in West Bengal. The variations are quite large at the higher level of application (120 Kg. per hectare). The additional yield at this level varied from 7.9 tonnes per tonne in Karnataka to 12.8 tonnes in Tamil Nadu. Under unirrigated conditions, the additional yield varied from 4.5 tonnes per tonne in Maharashtra to 6.8 tonnes in Kerala. For locally improved tall varieties, the additional yield of paddy varied from 8.4 tonnes in M.P. to 15.9 tonnes in Haryana at 60 Kg. nitrogen per hectare level. In unirrigated areas of Maharashtra (for which the results are available), the additional yield is about 2-5 tonnes per tonne of nitrogen applied.

24. The response to phosphatic fertilisers varied even more. For IR-8 variety of paddy, under irrigated conditions at 30 Kg. P_2O_5 per hectare level of application, the additional yield was about 21 tonnes per tonne of P_2O_5 applied. For higher level of application (60 Kg. P_2O_5) the additional yield was 13-14 tonnes. These results refer to Karnataka and M.P. where the P_2O_5 status of the soil is low. However, the reason for the higher response cannot be ascribed to this fact alone. For instance in Andhra Pradesh, where P_2O_5 status of the soil was low the response to P_2O_5 was comparatively much less which may be due to possible limitations of other nutrients. Similarly, in Tamil Nadu, where the P_2O_5 status of the soil is medium, the additional yield was 21 tonnes for per tonne of P_2O_5 applied.

Under unirrigated conditions, the response to P_2O_5 was low varying from 3.7 tonnes in Maharashtra to to 7.2 tonnes in Kerala. For locally improved tall varieties the response to P_2O_5 varied from 21 tonnes in Karnataka and M.P to about 8.5 tonnes in other areas.

25. The yardsticks of additional production from K_2O varied from 1 to 7 tonnes per tonne of K_2O applied respectively in the case of Haryana and Bihar, the average being 4.8 tonnes under irrigated conditions. Under unirrigated conditions, it varied from 3.5 tonnes in Kerala to 5.3 tonnes in Maharashtra. The average over various states worked out to 4.4 tonnes. There was not much of variation in response between high yielding varieties and locally improved tall varieties. In the case of locally improved tall varieties, the additional production on an average was 4.8 tonnes.

26. The average responses for paddy and wheat worked out on the basis of these data are given in table 7.

PRICE CHANGES:

27. Between 1971-72 to 1974-75 there was a steady increase in the price per unit nutrient for all the three types of fertilisers namely Nitrogen, Phosphorous and Potash (table 8). The price increase in 1974 was quite substantial. For N (based on urea) the increase was almost 100% from 2.28 to Rs.4.35 per Kg. For P_2O_5 the increase

was (based on SSP) from Rs.3.02 to Rs.5.83 and ((based on complex) from Rs.4.7 to Rs.8.34 and for K_2O from Rs.1.12 tp Rs.2.03. Later from March, 1976 there was a reduction in the price of various nutrients.

28. During this period, however, the procurement prices of agricultural produces, both paddy and wheat did not show any substantial increase. In the case of paddy the increase was from 53 paise in 1971-72 to 77 paise in 1977 and for wheat from 76 paise to Rs.1.10 in 1977. As a result the farmers had to pay in terms of his produce more between 1971-72 and 1977. These details are given in table 8. The cost benefit ratio thus has not been favourable to farmers.

DISTRIBUTION AND MARKETING

29. In India distribution and marketing of fertilisers is the responsibility of manufacturers. This however, is coordinated to a certain extent by the Government of India. The role of the Government is necessitated on account of the fact that even now the entire requirement of fertilisers in the country is not met out of indigenous production. Naturally, each manufacturer would

prefer to sell his products in areas near to the centres of production. This may create a situation wherein there can be excess availability of fertiliser products in certain areas while in certain others there may be dearth. Another reason is that the imports of fertilisers is the responsibility of the Government of India. It may not always be possible to time the imports according to the seasonal requirements in different States. Therefore, the approach is that none of the States should be totally dependent on imports or on one single manufacturer. This takes care of possible failures either in imports or doemstic production. At the beginning of each season conferences of the representatives of the State Governments and of manufacturers are called by the Government of India, Ministry of Agriculture, one for each zone. At these Zonal Conferences the requirement and supply pattern in different States are finalised. Once these requirements are finalised orders are issued by the Government of India under Essential Commodities Act specifying the quantities each manufacturer has to supply to different states.

30. Each manufacturer has his own system of marketing. Fertilisers are manufactured in the public sector, private sector and in the cooperative sector. In the private sector while some of the manufacturers have a system of sole selling agencies some other distribute through wholesalers and retailers. In the public sector, the distribution is through both private and cooperative dealers. The only manufacturer in the cooperative sector is IFFCO which distributes fertilisers through apex level cooperative societies in different States who are all shareholders in their business.

SALE OUTLETS

31. According to the statistics, in 1977-78 there were over 50,000 sales points in the cooperative sector and nearly 58,000 sales points in the private sector. The number of sales points has been increasing over the years. For instance in 1969 the number was nearly 33,000 in cooperative sector and 35,000 in private sector. The increase has been more marked in the private sector compared to cooperative sector (table9). The total number of sales points is quite inadequate considering the number of agricultural holdings that we have now. According to agriculture census 1970-71, the

total number of agriculture holdings in the country was over 17.4 million. For these 17.4 million holdings we have only 96,000 sales points making the average of only one outlet per 733 holdings which is quite inadequate. This is one area which needs attention. Already some efforts are being made to increase the number of sales points in the country. Particular mention may be made of U.P. where there has been substantial increase in sales points during the last two years.

32. Fertiliser prices are fixed in respect of straight nitrogenous fertilisers at the farm level by the Government of India. Even in the case of complex and other phosphatic fertilisers the Government controls the prices indirectly in that the manufacturers will be entitled to the allowable subsidy on P_2O_5 content only if the price for the product is fixed in consultation with the Government.

33. Dealers are allowed margin over various products to cover their cost of distribution including such items as overheads, storage charges, interest on capital short distance haulages and handling charges.

34. Normally the dealership points are in

market towns and sometimes in rural areas. The cooperatives are more distributed into the interior, as these are village level societies manned by representatives of farmers from each of the villages.

35. Mostly private trade is concentrated in market towns or in areas near to railway stations. Concentration of dealership points in market towns is not very advantageous for increasing the use of fertilisers among farmers as market towns are generally few and far apart. Normally carrying cost from market towns to interior points of consumption is necessary and this is not met either by the manufacturer or the distributor. The distributor's margin does not provide for covering such costs. This is a serious hindrance in the development of fertiliser consumption in interior areas.

ORGANIC FERTILISERS/COMPOST OF FARM WASTE:

36. Main source of nitrogen in the soil is organic matter. The decomposition of the organic matter to a certain extent meets nitrogen needs of the plant but gradually the organic matter gets depleted. In India because of the mostly tropical

and sub-tropical climatic conditions the organic matter in the soil is very low and its decomposition does not contribute much towards meeting nitrogen needs of crops in most of the soils. The main source of organic matter in India is dung from the animal and the compost prepared from urban and rural waste. Farmyard manure had been used by Indian farmers for centuries. In fact in most relatively backward areas farmyard manure is the only cource of manure for plants. The availability of dung is dependent upon the number of livestock and the amount of dung voided by the animal. According to the livestock census of 1972 the total number of livestock in India was over 353 million as shown in table 10.

37. There are some statistics available relating to total availability of dung in the country. Dung production per animal (include youngstock) varied from 2.6 Kg. in Kerala and Karnataka to 7.0 Kg. per animal per day in Punjab. This does not include however, dung voided by the animal while grazing. According to another estimate the dung voided by an adult animal should be taken as 10 Kg. a day and young stock as 1/3 of the above. For sheep it is considered still smaller. It is

estimated that the total output of cow dung is of the order of 7,78 million tons worked out as shown in table 11. In addition the dropping of poultry birds is estimated around 5.4 million tonnes (for about 150 million birds) a year. About 20 per cent of the dung, it is estimated, is used by poor people as fuel. Thus the net availability of dung for agricultural purpose is 630 million tonnes a year. Urine of the animal is another form of manure. The estimate is that the availability of this would be around 100 million tonnes a year.

FARM WASTE:

38. Unlike many other countries of the world the straw of the agricultural crops is used in India as animal feed. The waste is not likely to be more than 1 Kg. per animal per day. On this basis the total waste available for composting will be about 85 million tonnes. The total potential of the nutrient from these different sources is estimated as around 4.8 million tonnes as shown in Table 12. All of these are not available. Available nutrients will be as shown in table 13.

GREEN MANURE:

39. Green manure has been used as a source of nitrogen in India for several decades. The studies conducted in various parts of Haryana and Punjab show that the amount of nitrogen added by green manure crops may be of the order of 100 Kg. per hectare for wheat and 80 Kg. per hectare for rice. There are however, difficulties in adopting green manures on large scale. Main constraints is the availability of adequate water.

40. There are no data available with regard to area covered under green manure. Hence it is not possible to make a fair estimate on the likely contribution of this source towards manure requirements in India.

ROLE FERTILISERS IN AGRICULTURAL DEVELOPMENT

41. Though agriculture occupies an important place in the Indian economy, crucial factors like fertiliser which play an important role in the agricultural production did not get due importance till early sixties. The production of fertilisers in India started with the establishment of a small single super phosphate unit at Ranipet in Tamil Nadu by EID parry in 1906. The production of Nitrogenous fertilisers started as a by-product in the Tata Iron and Steel Company at Jamshedpur (Bihar) in 1933. Medium Scale production of ammonium sulphate started at Fertilisers and Chemicals Travancore, (FACT) Alwaye in 1947 using wood charcoal as a raw material for the production of ammonia.

42. The low importance attached to the fertiliser use in pre-independence India was responsible for the slow progress made by the industry during the initial years. Far more emphasis on agricultural production was given after the second world war when acute shortage of foodgrains was experienced. Measures to increase agricultural production were taken and setting up of the fertiliser plant at Sindri in 1951 to produce 320,000 tes of Ammonium Sulphate, 87,000 tes of ammonium sulphate nitrate and 18,000 tonnes Urea was a step towards this direction.

EARLY EXPANSION OF CAPACITY

43. The vital role which fertilisers could play in helping the country to achieve self-sufficiency in food was realised in the early sixties. This realisation was translated into action when number of projects were sanctioned. As many as 8 medium/ major fertiliser units were commissioned between 1966-70. The details regarding their location capacity, product pattern are given in Table 14.

TABLE 14

Name of Unit	Location	Product	Capacity (thousands of tonnes)	
			Nutrient	Material
1. Neyveli Lignite Corporation	Neyveli	Urea	70.0	150.0
2. FCI Gorakhpur	Gorakhpur	Urea	80.0	174.0
3. FCI Namrup	Namrup	Ammonium Sulphate	20.6	100.0
		Urea	25.3	55.0
4. IEL Kanpur	Kanpur	Urea	200.0	450.0
5. GSFC Baroda	Baroda	Urea	167.4	364.0
		DAP	73.4*	108.0
		AS	30.5	148.0
6. EID Parry	Ennore	AS	8.0	38.6
		APS	18.5*	51.5
7. Coromandel Fertiliser Ltd	Vishakha-patnam	Urea	7.3	16.5
		Complex Fertiliser (28:28:0)	146.0*	260.0
8. Sriram Chemical	Kota	Urea	111.0	240.0

* Includes N and P_2O_5.

44. In course of time, large capacities of two primary nutrients viz. N and P205 have been developed in the country. The present capacity of nitrogenous fertilisers including both from straight and complex materials is about 3.28 million tonnes. Of P205, the capacity so far developed is about 1.27 million tonnes. Table 15 gives growth of installed capacity of N and P205 during the past 3 decades.

TABLE 15

GROWTH IN INSTALLED CAPACITY OF N AND P205 IN INDIA

thousands tonnes of nutrients

Year	Nitrogen	P205
1951-52	85.0	63.5
1956-57	89.0	63.5
1961-62	242.0	116.5
1966-67	548.0	237.4
1971-72	1,464.0	500.0
1976-77	3,068.8	1,042.5
1977-78	3,276.0	1,273.6

FEED STOCK

45. Majority of nitrogenous fertiliser units now in operation utilise Naphtha for producing hydrogen. Natural gas is the next important feed stock. The units using natural gas as feed stock include some

of the large capacity plants like G.S.F.C. Baroda, F.C.I. Namrup, and IFFCO Kalol. About 70 per cent of the existing nitrogen capacity is Naphtha based and 17 per cent on natural gas. Break up of the existing capacity according to feed stock is given in Table 16.

TABLE 16

Capacity of Nitrogen according to feed stock as on 1.10.1977

Feed stock	capacity thousands of tonnes	Capacity as percentage of total
Naphtha	2140	69.8
Natural Gas	513	16.7
Coke/Coke Oven gas	194	6.3
Electric Power	80	2.6
Lignite	70	2.3
Imported Ammonia	72	2.3
Total	3069	100.0

46. The future product pattern is not likely to be so much naphtha dominated. The general shortage of naphtha all over the world and difficult power situation within the country has lead to the use of alternative feed stock like fuel oil and coal. The future product pattern according to feed stock after the projects under various stages of construction/

consideration are commissioned will be as in Table 17.

TABLE 17

CAPACITY OF NITROGEN PROJECTED ACCORDING TO FEED STOCK (1983-84)

Feed Stock	Capacity - thousands of tonnes	Capacity-as % age of total
Naphtha	2549	33.2
Natural Gas	2045	26.6
Electric power	80	1.0
Coke/Coke oven gas	194	2.6
Lignite	70	0.9
Imported Ammonia	152	2.0
Coal	684	8.9
Fuel Oil	1901	24.8
Total	7675	100.0

47. The existing and projected product pattern of N according to feed stock is diagramatically depicted at charts 1 and 2.

CAPACITY UTILISATION

48. A perusal of the production statistics of N and P2O5 (Table 18) in the context of corresponding capacities would indicate that the utilisation of capacity in India has been rather low. It is more so in the case of P2O5. The reasons for low utilisation of capacities are varied. Again, the problems in higher utilisation of capacity are different from product to

product. However, the single important factor responsible for over all low utilisation of capacity can be found in inadequate supply of power and power fluctuations.

49. Frequent power interruptions hampered the production greatly of products like CAN produced at FCI's Nangal unit where the hydrolysis of water provides hydrogen for manufacture of ammonia. Power dips also resulted in frequent shut down of the plants leading to loss of production for several hours in various factories.

50. Inadequacy of demand did not affect the production of fertilisers in India except in some sporadic cases for products like single super phosphate and triple super phosphate at certain points of time only when the farmers made a choice for other products like D.A.P. in preference to these. Other important factors which led to low utilisation of capacity in the past were :

i) Inadequacy of feed stock/raw material.

ii) Difficulties in procuring imported spare parts and their not being of up to the mark quality.

iii) Labour problems

iv) Pollution

51. Concerted efforts were made in the past and are even now continued to overcome these difficulties, Major steps taken in this direction are :

i) Installation of captive power plants in the factories.

ii) Systematic replacement and repairs of aging equipment.

iii) Debottlenecking of plants.

PROSPECTS

52. The Government and industry both are very keen that the production is stepped up so as to attain reasonable level of utilisation of the installed capacity. The problem of availability of suitable feedstock may not be as acute as it was envisaged in the recent past, consequent on the discovery of oil deposits in Bombay high and in the off-shore areas of Kutch. Some of the new units are expected to get natural gas or Naphtha from these reserves. The projects which are on hand and various stages of implementation are listed in Table 19.

TABLE 19

PROJECTS UNDER VARIOUS STAGES OF CONSTRUCTION/CONSIDERATION

Name of the Project	Capacity		Likely date of commissioning
	N	P_2O_5	
I. UNDER IMPLEMENTATION			
Haldia	152.0	75.0	January'79
Ramagundam	228.0	-	April'79
Sindri(Modern)	129.0	-	October'79
Talcher	228.0	-	April'79
Trombay V	130.0	-	July'80

GNVFC	273.0	-	April'80
IFFCO, Phulpur	228.0	-	June'79
NFL			
Bhatinda	235.0	-	October'78
Panipat	235.0	-	December'78
Hindustan Zinc, Debari(Phosphoric acid)	-	26.0	February'78
Sub-Total	1838.0	101.0	
APPROVED IN PRINCIPLE			
Korba	228.0	-	1983-84
Paradeep	345.0	300.0	1984-85
Namrup III	152.0	-	1982-83
Uran (2 plants)	345.0x2	-	1982-83
North of Bombay	345.0	-	1983-84
IFFCO, Ahmedabad	345.0	-	1982-83
MCFC, Tarapore	51.0	-	July'78
Nagarjun Fertilisers Ltd.Kahinda	228.0	82.0	1982-83
SCI, Kota (New Plant)	152.0	-	1983-84
Karnataka State Industrial Development Corporation	-	150.0	1980-81
Sub-Total	2536.0	532.0	
Total	4374.0	633.0	

53. Also adequate technological capabilities for putting up fertiliser plants have been generated within the country. Similarly some progress has been made in the case of equipment. It is, therefore, expected that in future the problems with regard to designing, erection and equipment will not be as acute as they have been in the past. On this basis it is expected that all the projects which have been approved and now under implementation will go in production by 1982-83.

PRODUCT PATTERN

54. As mentioned earlier, production of fertilisers in India started with low analysis products like Single super phosphate (16 per cent P205) and AS/CAN (20.6 to 20.5 percent N). By mid 1960s the farmers started appreciating the effectiveness of high analysis products like Urea and DAP which were available at relatively low cost on nutrient basis. The production of high analysis products assumed importance in the interest of national economy as well. The emphasis thus gradually started shifting to the production of high analysis and multi-nutrient fertilisers. The projects which were approved and commissioned from 1965 onwards included by and large such high analysis fertiliser materials. The products pattern so developed by the year 1977-78 is depicted in charts 3 and 4 and relevant details are given in Table 20.

TABLE 20

PRODUCT PATTERN OF NITROGENOUS FERTILISERS
(EXPRESSED AS PERCENTAGE OF TOTAL PRODUCTION OF N IN THE YEAR 1977-78)

Name of the Product	Production (%)
Straight Nitrogenous	
Ammonium Sulphate	5.7
Urea	70.7
CAN	6.4
Ammonium Chloride	0.2
Complex Fertilisers	
Urea Ammonium Phosphate	4.4
Nitro Phosphate	1.8
Di-Ammonium Phosphate	1.5
Ammonium Phosphate Sulphate	1.4
Others (NP/NPK)	7.9
Total	100.0

PRODUCT PATTERN OF PHOSPHATIC FERTILISERS

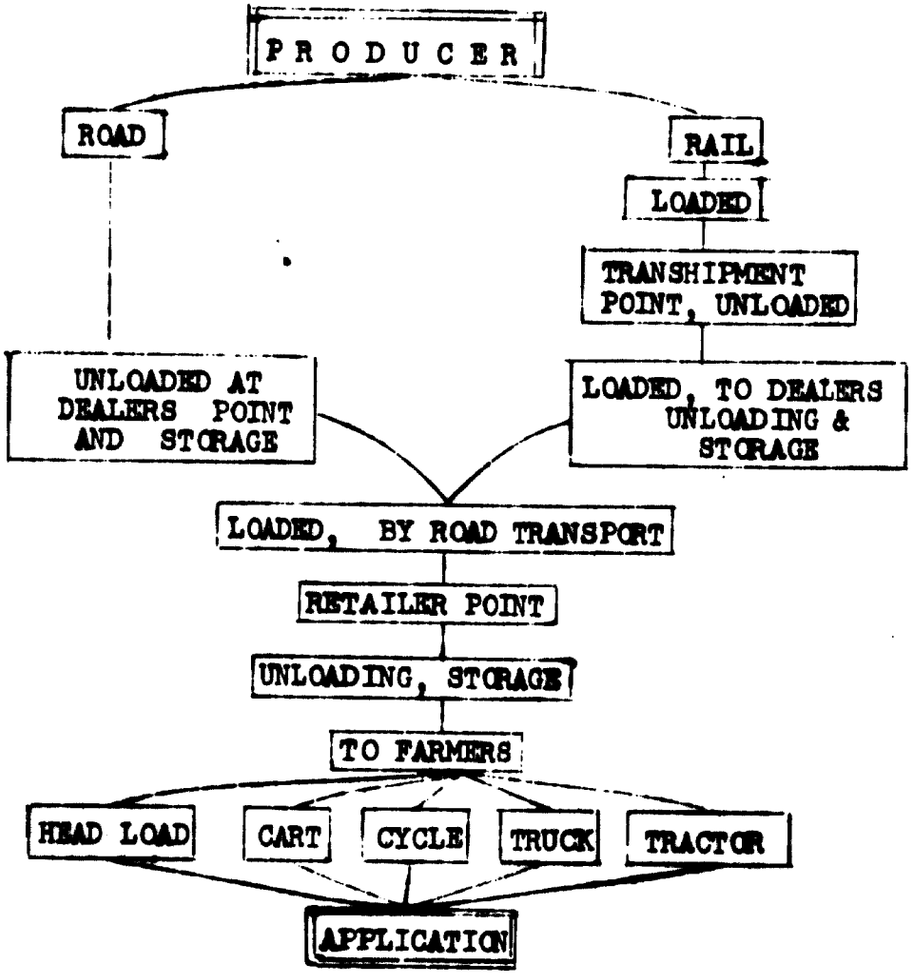
Name of the fertiliser	Production in 1977-78 (as percentage of total-P2O5)
Single Superphosphate	23.6
Triple super phosphate	0.5
COMPLEX	
Urea Ammonia Phosphate	14.0
Di-ammonium Phosphate	11.3

(17:17:17)	10.5
(12:32:16)	11.8
Nitro Phosphate	5.3
Ammonium Phosphate Sulphate	4.9
Others	18.1
Total	100.1

55. The above trend of production where emphasis is on the high analysis multi-nutrients products will continue in future as well. The major products in future will, therefore, be Urea as far as straight nitrogenous fertilisers are concerned, TSP for straight phosphatic fertilisers and high analysis complex fertilisers of different grades.

HANDLING AND DISTRIBUTION

56. Fertilisers are the kind of commodity which undergo multiple handlings before they are ultimately applied to the soil. An appreciation of the extent and the chain of handlings can be had from the following flow chart :



57. It may be seen from the above chart that the handling takes place at various stages and actual number varies from three to seven depending upon the mode of transport, extent of transhipment etc. In the case of primary movement by road which is generally a short haul (upto 300 Kms) the material is handled at the production centre, wholesale point, retail point and at the consumers level, sometimes the handling at the stage is avoided when the material is taken directly to retail centre on its way to wholesalers' godown without physical handling at the wholesale level.

58. On the other hand, when the material is transported by rail with one or two transhipment points the number of handlings increases.

59. Every handling leaves an adverse effect on the product. The handling particularly at transhipment points in movement of fertilisers by rail, where the porters make use of hooks contrary to the instructions, sometimes lead to significant losses. The holes left open by use of hooks allow moisture to enter into the bags and reduce the material to hard-lumps. It also results in loss due to leakage through these holes. So far the overall scarcity conditions in the marketing of fertilisers did not affect the sales but very soon when the country will be self-sufficient in fertilisers these problems will pose difficulties in marketing.

60. Almost entire handling of fertilisers in the country is in the bagged form. In the case of indigenous material the fertilisers are bagged in appropriate bagging (depending upon the contents). For nitrogenous and complex fertilisers mostly the bagging is in LDPE laminated jute bags with polythene lining. LDPE laminating materials are generally of 100 gauge and the bonding material is bitumen. The weight of these bags is about 450 gms. Straight phosphatic fertiliser (Single Super Phosphate) is bagged in HDPE woven bags which is acid resistant, high tensile, strong and light in weight. The imported material which sometimes comes in bulk form is suitably bagged at the port itself and the handling of the material as soon as it leaves the port is again in the bagged form. So the problems relating to bulk handling are non-existent as far as movement within the country is concerned.

PACKING SIZE

61. The usual size of packing is 50 kg. Certain low analysis fertilisers like ammonium sulphate and single super phosphate are packed also in 100 kg. bags. The 50 kg. size is considered to be most suitable both from the point of view of handling and marketing. Proposals with regard to smaller packaging were examined in the past but generally they were not

found to be feasible mainly because of the extra costs involved. For farmers with very small holdings, high analysis fertilisers like Urea and DAP bagged in smaller packings (25 - 30 Kg.) may be definitely advantageous but would be more costly. As such the existing practice of 50 kg. packing is considered to be an optimum one.

RE-BAGGING

62. The extent of re-bagging in overall fertiliser distribution is very insignificant. However, this has to be done to some extent in the case of imported fertilisers which are particularly slow moving type or whose consumption is highly seasonal. In such cases when the material remains un-sold for longer period, rebagging becomes necessary as these bags get corroded because of chemical reaction. Adequate provision is made by manufacturers/marketeers for necessary rebagging. Generally, in the case of rebagging the stitching of the bag is done by hand. Sometimes portable stitching machines are also used in the case of re-bagging of fertilisers.

TRANSPORTATION

63. In India all the three modes of transportation viz. rail, road and water are used for the movement of fertilisers. Bulk of the movement (about 76 per cent) is presently done by rail. The movement by water is limited

to coastal areas and there is hardly any inland water transport of fertilisers in the country. The rest of the movement is by road. Movement by rail is popular on account of its relatively low cost. Table 21 gives comparative freight for Urea by rail and road :

TABLE 21

FREIGHT FOR UREA

Distance (Km.)	Rs./tonne Road	Rail
50	24.50	12.20
100	32.40	18.10
150	36.40	22.30
200	41.60	26.50
300	45.50	34.70
500	-	49.90
700	-	69.60
1000	-	91.50
1500	-	124.80
2000	-	153.30
2500	-	172.20

64. Movement of fertiliser by road is practised in the case of short-haul where the higher cost is offset to some extent by way of reduced handling expenses.

65. Several measures have been undertaken over the past few years to optimise movement by rail with the existing rail transport capability. The two very important steps in this direction are rationalisation of rail movement and one Directional Block rake movement. At present the rail movement is coordinated and rationalised with the joint efforts of the Ministry of Railways, Ministry of Agriculture and the Ministry of Chemicals and Fertilisers. Efforts are made to avoid criss-cross movement of fertilisers and suitable movement plan is arrived at the high level meetings in which the officials of the above mentioned Ministries and representatives of the manufacturers participate. For this purpose quarterly meetings are convened by the Ministry of Agriculture in the month of March, June, September and December every year. The Fertiliser Association of India plays an active role as coordinating agency between industry and the Government Departments.

WAREHOUSING

66. The warehousing of fertilisers is warranted for two reasons :

i) Seasonality in the consumption of fertilisers.

ii) To make the material available at the right place and time up to remotest areas.

67. While the seasonality in demand can be taken care of by way of creating storage facilities at the factory site, the other objective is achieved only by storing the fertilisers in field godowns at appropriate locations. At present two organised agencies viz. Central Warehousing Corporation (CWC) and State Warehousing Corporations are playing a major role in providing field storage to the fertiliser manufacturers. In addition, the private godowns are also available which the manufacturers hire for storing their product. Sometimes manufacturers construct their own buffer godowns at strategic locations. These buffer godowns are of large capacity and feed the other smaller field godowns. Certain details about the capacity of C.W.C. warehouses are available. These are given in Table 22.

TABLE 22

FREQUENCY DISTRIBUTION OF C.W.C. WAREHOUSES BY CAPACITY - SIZE AS ON 31.3.1978

Capacity (Tonnes)	Number of warehouses
Less than 500	4
500-1000	3
1000-2500	14
2500-5000	30
5000-10000	56
10000-20000	53
20000-30000	19
30000-40000	12
40000-50000	5
50000-& above	6

Source : Central Warehousing Corporation.

68. The exact location of buffer points is an exercise in logistics of fertiliser distribution and can only be determined after a serious consideration of both financial and operational factors. Individual manufacturers determine the locations after carrying out such exercise. The basic consideration in choosing a location for buffer godowns is the marketing strategy of the individual manufacturer. Generally, factors like lead time from the factory to areas of consumption availability of transport at short notice, availability of suitable godown space at reasonable rent, nearness to consuming areas, spread of dealership

net-work etc. are considered.

69. Routing of material through godowns adds two types of costs :

- Handling including godown rent
- Inventory.

70. An indication of the costs involved in sales through field godowns is given in Table 23.

TABLE 23

ADDITIONAL COST ON ACCOUNT OF SALES THROUGH GODOWNS

Rs./tonne

Particulars	Amount
Transportation charges from rail-head to warehouses	12
Handling charges	5
Storage charges for three months	9
Storage losses (approximately)	2
Inventory	22
Total	50

71. The efforts of the manufacturers are to match the cost with the desired benefits which accrue from the storage of fertilisers in field godowns. Sometimes part of the additional cost is charged from the distributors.

TABLE - 1

PRODUCTION AND CONSUMPTION OF FERTILISER NUTRIENTS, INDIA : 1951 TO 1983

Thousands of tonnes

Year	Production			Consumption			
	N	P_2O_5	Total	N	P_2O_5	K_2O	Total
1951	29	10	39	59	7	-	66
1956	79	18	97	123	16	15	154
1961	154	65	219	250	60	28	338
1965	238	119	357	575	132	77	784
1971	949	290	1239	1798	558	300	2656
1976	1909	478	2387	2457	635	319	3411
1977	2000	671	2671	2914	868	505	4287
1980	3577 (3595)	959 (970)	4536	4165	1277	758	6200
1982	4427 (4500)	1014 (1205)	5441	5177	1488	900	7565
1983	5538 (5280)	1014 (1500)	6552	5727	1599	975	8301

Note: Figures in brackets are projections by Govt. of India.

Source: Fertiliser Association of India & Ministry of C&F, New Delhi.

TABLE - 2

PER CAPITA ARABLE LAND : INDIA VIS-A-VIS SELECTED OTHER COUNTRIES

Country	Arable land and land under permanent crops thousands of hectares	Population in thousands	Per capita Arable land and land under permanent crops (Hectares)
USSR	232,704	255,038	0.91
Canada	43,100	22,801	1.89
Mexico	27,390	59,204	0.46
USA	206,921	213,925	0.97
Burma	10,373	31,240	0.33
Pakistan	19,450	70,560	0.28
Ethiopia	13,730	27,975	0.49
Algeria	7,000	16,792	0.42
India	154,291	597,868	0.26

Source: Production year Book 1975, FAO, Rome

Table - 3

Agricultural Productivity in India vis-a-vis selected other countries

(Kg./hectare)

Country	Rice	Wheat	Maize	Total Pulses	Potatoes	Sugarcane	Tea
Asia	**2,458**	**1,415**	**1,935**	**693**	**10,280**	**51,912**	**1,058**
Bangladesh	1,850			745	9,524		774
Burma	1,815			654			
China	3,294	1,387	2,994	1,027	10,364	69,950	936
India	1,826	1,409	1,048	531	11,628	51,154	1,401
Indonesia	2,608		974				673
Nepal	1,923	1,200			5,638		
Pakistan	2,321	1,413	1,183	531	10,345	36,504	
Philippines	1,808		831			48,571	
Sri Lanka	1,971						812
Thailand	1,817		2,250	1,262			
Vietnam	2,264						

Source : Production Year Book 1976
F.A.O., Rome.

TABLE - 4

HIGH YIELDING VARIETY PROGRAMMES: TARGET/ACHIEVEMENT

(thousands of hectares)

	1966		1970		1975		1977	1982
	Target	Achieve-ment	Target	Achieve-ment	Target	Achieve-ment	Target	Target
Paddy	1,317	888	4,588	5,588	12,974	12,742	15,000	20,560
Wheat	645	541	6,073	6,480	13,566	13,458	15,000	17,000
Jowar	375	191	1,215	803	2,170	1,958	2,000	NA
Bajra	152	59	1,417	2,051	4,153	2,897	2,700	NA
Maize	373	208	607	462	958	1,132	1,300	NA

Source : Ministry of Agriculture & Irrigation,
New Delhi.

Table 5

SOIL CLASSIFICATION

The extent, distribution of the different soil classes in 'Soil Map of India' and their equivalents according to the new USDA system.

S.No	Soil Classification	Extent in Km/Sq.	Distribution (States)	Equivalent according to the new USDA system of classification
1	2	3	4	5
1.	Red Loamy Soils	2,13,271	Andhra Pradesh, T.Nadu, Karnataka, Kerala, Madhya Pradesh, Orissa	Paleuslalfs, Rhodustalfs Haplustalfs
2.	Red Sandy soils	3,30,590	T.Nady, Karnataka, Andhra Pradesh,	Haplustalfs Rhodustalfs
3.	Laterite soils	1,30,066	Tamil Nadu, Kerala, Karnataka, Andhra Pradesh Orissa, Maharashtra, Goa, Assam	Pinthaquults Plinthustults Plinthustults Oxisols
4.	Red and yellow soils	4,03,651	Madhya Pradesh, Orissa	Haplustults, Ochraq-ults, Rhodustults
5.	Shallow black soils	31,532	Maharashtra	Ustorthents, Ustopepts
6.	Medium Black soils	4,30,383	Maharashtra, Madhya Pradesh, Gujarat	Pellusterts, Chromusterts
7.	Deep black soils	1,12,060	Maharashtra, Andhra Pradesh, Karnataka, Madhya Pradesh, Gujarat	Pellusterts, Chromusterts Pelluderts

1	2	3	4	5
8.	Mixed red and black soils	1,62,255	Karnataka, Tamil Nadu, Maharashtra, Madhya Pradesh	Association of Alfisols and Vertisols which cannot be separately mapped in the scale under reference
9.	Coastal alluvium soils	54,403	Tamil Nadu, Kerala, Andhra Pradesh, Maharashtra, Gujarat	Hapalaquents
10.	Coastal sands	4,534	Orissa	Ustipsamments
11.	Deltaic alluvium soils	87,045	Tamil Nadu, A.Pradesh, Orissa, West Bengal.	Quartzipsamments Tropaqualfs
12.	Alluvial soils Khadar (recent alluvium)	3,56,720	Uttar Pradesh, Punjab, Bihar, Assam, West Bengal.	Haplaquents, Ustifluvents Udifluvents
13.	Bhangar(old Alluvium)			Haplustalfs
14.	Alluvial soils	13,611	North-Eastern Uttar Pradesh, Bihar	Calciorthids
15.	Grey brown soils	1,01,572	Gujarat, Rajasthan	Calciorthids
16.	Calcareous Sierozemic soils	45,080	Punjab	
17.	Desert soil Rhegosolic	1,54,423	Rajasthan	Calciorthids, Psamments
18.	Desert soil Lithosolic			Lithic Entisols
19.	Terai soils	28,919	Uttar Pradesh, Bihar, West Bengal	Hapalaquolls

1	2	3	4	5
20.	Brown hill soils (over sandstones and shales)	81,242	Uttar Pradesh, Bhutan, Sikkim, Himachal Pradesh	Palehumults
21.	Sub-montane soils (Podsolic)	76,695	Uttar Pradesh, Jammu & Kashmir	Hapludalfs
22.	Mountain meadow soils	59,790	Kashmir including Ladakh	Cryoborolls Cryochrepts
23.	Saline and alkali soils	17,377	Uttar Pradesh, Punjab Maharashtra, Karnataka, Tamil Nadu	Salorthids, Salargids, Natrargids Some of the Entisols and Vertisols are also salic or natric
24.	Peaty and saline peaty soils	2,720	Kerala	Histosols
25.	Skeletal soils	79,151	Madhya Pradesh	Lithic Entisols
26.	Glaciers and eternal snow	29,335	Uttar Pradesh, Kashmir	

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Source : Studies on Soils of India by S.V. Govinda Rajan & H.G. Gopala Rao.

TABLE : 6

STATEWISE RECOMMENDED DOSES OF FERTILISERS FOR PRINCIPAL CROPS

State (1)	Crops (2)	Dose N (3)	P (4)	K (5)	Number of applications (6)
Andhra Pradesh	Paddy HYV	136	67	25	Normal soil 2 Sandy soil 4
	Paddy Local	67	52	-	3
	Jowar and Bajra HYV	111	67	52	3
	Jowar and Bajra Local	44	44	-	2
	Maize HYV	136	67	35	3
	Groundnut	35	67	35	1
	Cotton	136	67	67	3
	Sugarcane	282	85	54	3
Assam	Paddy HYV	40	20	20	2
Bihar	Paddy HYV	100	60	40	3
	Wheat HYV	135	50	50	3
	Maize HYV	100	60	40	3
	Sugarcane	90	67	28	2
Gujarat	Paddy HYV	111	62	37	2
	Paddy Local	75	37	0	2
	Jowar HYV	125	62	37	2
	Bajra HYV	75	37	0	1

1	2	3	4	5	6
	Bajra Local	50	25	0	2
	Maize HYV	100	50	0	3
	Maize Local	50	12	0	2
	Groundnut	25	50	0	1
	Cotton	100	50	0	3
[illegible]	Paddy HYV	62	30	0	3
	Wheat HYV	124	62	62	[illegible]
	Wheat Local	62	30	[illegible]	2
	Bajra HYV	99	62	0	3
	Bajra Local	62	30	0	2
	Maize HYV	24	62	62	3
	Maize Local	62	30	30	2
Himachal Pradesh	Paddy HYV	120	60	60	3
	Maize HYV	120	40	60	3
Jammu & Kashmir	Paddy HYV	120	58	43	2
	Paddy Local	72	36	12	2
	Maize HYV	86	58	36	2
Karnataka	Paddy HYV	99	50	50	3
	Jowar HYV	124	74	37	2
	Bajra HYV	99	62	25	2
	Groundnut	25	74	37	1
	Cotton	25	74	37	2
	Sugarcane	309	99	112	4

1	2	3	4	5	6
Kerala	Paddy HYV	90	45	45	3
Madhya-Pradesh	Paddy HYV	100	80	50	3
	Wheat HYV	140	60	40	1
	Jowar HYV	100	60	40	2
	Jowar Local	40	25	15	2
	Maize HYV	150	62	37	2
	Maize Local	50	25	25	2
	Groundnut	20	80	20	1
	Sugarcane	150	85	62	3
Maharashtra	Paddy HYV	100	50	0	2
	Wheat HYV	75	50	0	1
	Jowar HYV	75	62	62	2
	Pajra HYV	50	37	25	2
	Groundnut	25	50	25	1
	Cotton	100	50	50	1
	Sugarcane	400	175	175	4
Orissa	Paddy HYV	125	60	60	3
	Cotton	60	30	30	1
Punjab	Paddy HYV	124	62	62	3
	Paddy Local	62	30	0	2
	Wheat HYV	124	62	62	2
	Wheat Local	62	40	25	2
	Maize HYV	124	62	62	3
	Maize Local	62	30	30	2

1	2	3	4	5	6
Rajasthan	Wheat HYV	130	60	50	
	Wheat Local	60	30	20	
	Jowar HYV	125	50	25	
	Bajra HYV	100	50	30	
	Maize HYV	120	60	40	
	Maize Local	90	55	25	
	Groundnut	20	60	0	
	Cotton	75	37	25	
	Sugarcane	100	60	40	
Tamil Nadu	Paddy HYV	124	62	62	2
	Sugarcane	227	69	69	2
Uttar Pradesh	Paddy HYV	124	62	62	
	Paddy Local	60	30	30	
	Wheat HYV	90	45	45	2
	Wheat Local	45	22	22	2
	Jowar HYV	80	40	40	
	Jowar Local	40	20	20	
	Bajra HYV	80	40	20	
	Bajra Local	40	20	20	2
	Maize HYV	136	68	45	3
	Maize Local	60	30	30	3
	Groundnut	12	40	6	2
West Bengal	Paddy HYV	89	45	45	3
	Paddy Local	40	30	30	2
	Jute	57	44	44	2

TABLE - 7

PRODUCTION RESPONSE TO DIFFERENT LEVELS OF FERTILISER APPLICATION

(tonnes/hectares)

Crop	Variety	No. of experiments	Yardsticks of additional production in tonnes				
			Per tonne of N		Per tonne of P_2O_5		Per tonne of K_2O
			At 60 Kg N/Hec	At 120 Kg N/hec	At 30 Kg P_2O_5/hec.	At 60 Kg P_2O_5/hec	At 60 Kg K_2O/hec.
Paddy	Kharif Irrigated						
	IR-8	975	12.0	10.3	13.5	10.0	4.8
	Locally improved	892	11.2	9.7	14.1	11.2	4.8
	Kharif Unirrigated						
	IR-8	274	6.4	5.3	5.4	4.7	4.4
	Locally improved	229	2.8	4.5	7.2	5.1	3.4
	Rabi Irrigated						
	IR-8	428	13.8	12.6	18.8	16.0	7.2
	Locally improved	337	9.8	8.6	10.8	8.8	4.1
	Rabi Unirrigated						
	IR-8	249	8.9	7.2	10.1	5.7	2.8
	Locally improved	178	4.6	3.8	6.7	5.2	4.0
Wheat	Irrigated						
	S-227	1,680	11.6	9.8	10.9	7.5	4.1
	S-308	555	12.2	9.7	8.4	7.9	2.7
	Locally improved	1,437	8.5	6.6	7.8	6.7	2.7

Source: Indian Council of Agricultural Research, New Delhi.

TABLE -- 8

ECONOMICS OF APPLICATION OF N, P2O5 AND K2O ON PADDY WHEAT

Particulars	1971-72	72-73	73-74	74-75	1975-76 Prior to December 75	1975-76 Effective	16.3.76	8.2.77	14.4.77	12.10.77
Nutrient Price(Rs./kg)										
1. N-Based on urea	2.01	2.09	2.28	4.35	4.02	4.02	3.80	3.59	3.59	3.37
2. P2O5 based on SSP	2.56	2.56	2.64	5.00	6.09	5.29	3.95	3.46	3.16	3.16
based on complex	2.71	3.02	3.02to 4.72	5.83to 8.34	7.33to 9.74	5.92to 7.43	5.15to 6.95	4.40to 6.81	4.40to 6.81	4.19to 7.15
3. K2O based on MOP	0.87	0.91	1.12	2.03	1.95	1.83	1.52	1.34	1.34	1.34
Output Prices(Rs/kg)										
4. Procurement Price of paddy	0.53	0.55	0.70	0.74	0.74	0.74	0.74	0.74	0.74	0.77
5. " price of wheat	0.76	0.76	0.76	1.05	1.05	1.05	1.05	1.05	1.10	1.10
			PHYSICAL RETURNS							
Paddy										
6. kg of paddy required to buy one kg of N	3.79	3.83	3.26	5.89	5.43	5.43	5.13	4.85	4.85	4.38
7. kg of paddy required to buy one kg of P2O5										
as SSP	4.81	4.71	4.77	6.71	8.23	7.15	5.34	4.27	4.27	4.10
as complex	5.08	5.54	4.30to 6.70	7.88to 11.30	9.90to 13.20	8.80to 10.72	6.96to 9.39	5.95to 9.20	5.95to 9.20	5.44to 9.29
8. kg of paddy required to buy one kg of K2O	1.64	1.66	1.59	2.75	2.64	2.47	2.05	1.81	1.81	1.74
Wheat										
9. kg of wheat required to buy one kg of N	2.64	2.74	3.00	4.14	3.83	3.83	3.62	3.42	3.26	3.06
10. kg of wheat required to buy one kg of P2O5										
as SSP	3.37	3.37	3.47	4.73	5.80	5.04	3.76	3.01	2.87	2.87
as complex	3.57	3.97	4.02to 6.20	5.60to 7.90	7.00to 9.30	5.64to 7.55	4.91to 6.62	4.91to 6.46	4.00to 6.19	3.81to 6.50
11. kg of wheat required to buy one kg of K2O	1.15	1.19	1.47	1.94	1.86	1.74	1.45	1.28	1.22	1.22

Source: Annual Review of Fertilizer consumption and Production 1976-77
Fertiliser Association of India, New Delhi.

TABLE - 9

NUMBER OF SALE POINTS

(figures in thousands)

Year	Cooperative & other Institutional Agencies	Private	Total
1969*	33.2	35.3	68.5
1971*	36.9	44.6	81.5
1973	39.3	47.1	86.4
1975	40.2	58.4	98.6
1977	38.4	57.8	96.2

* Excluding West Bengal and Union Territories for which data are not available.

Source: Fertiliser Statistics - various issues
Fertiliser Association of India, New Delhi.

TABLE - 10

TOTAL NUMBER OF LIVESTOCK IN INDIA

(Million)

	Adult over 3 years		Youngstock	Total
	Male	Female		
Cattle	74.46	56.40	47.48	178.34
Buffaloes	8.07	29.24	20.12	57.43
Sheep	-	-	-	39.99
Goats	-	-	-	67.52
Others	-	-	-	10.06
Total:	-	-	-	353.34

Source : Indian Agriculture in Brief,
Sixteen Edition,
Directorate of Economics & Statistics,
Ministry of Agriculture & Irrigation,
New Delhi.

TABLE - 11

POTENTIAL ANNUAL AVAILABILITY OF DUNG IN INDIA

Type of Livestock	No. of animals (million)	Dung voided per animal/annum (tonnes)	Total (Million tonnes)
Cattle (Over three years)	131.4	3.65	479.5
Buffaloes (Over three years)	37.8	3.65	138.0
Young Stock	68.3	1.25	85.4
Sheep and Goat	108.4	0.70	75.6
		Total:	778.5

TABLE - 2

TOTAL NUTRIENTS IN DUNG, URINE AND FARM WASTES

(Million tonnes)

Source	Quantity (Million tonnes)	N	P_2O_5	K_2O
Dung	630	1.86	0.63	0.94
Urine	100	0.60	0.10	0.50
Farm Wastes	85	0.34	0.09	0.34
	Total:	2.20	0.82	1.78

TABLE - 13

AVAILABLE NUTRIENTS IN DUNG/URINE & AGRICULTURAL WASTES

(Million tonnes)

Source	N	P_2O_5	K_2O
Dung	0.378	0.378	0.70
Urine	0.300	0.060	0.37
Farm Wastes	0.102	0.054	0.25
Total:	0.780	0.492	1.32

TABLE - 14

CAPACITY UTILISATION OF N AND P_2O_5

(from 1967-68 to 1977-78)

(thousands of tonnes)

Years	N			P_2O_5		
	Capacity	Production	Percentage capacity utilisation	Capacity	Production	Percentage capacity utilisation
1	2	3	4	5	6	7
1967-68	849	403	47.5	404	207	51.2
1968-69	1,024	563	55.0	415	213	51.3
1969-70	1,344	731	54.5	415	224	54.0
1970-71	1,464	833	56.9	505	228	45.1
1971-72	1,472	949	64.5	505	290	57.4
1972-73	1,940	1,055	54.4	571	330	57.8
1973-74	1,940	1,050	54.1	571	325	56.9
1974-75	2,204	1,187	53.9	706	331	46.9
1975-76	3,024	1,508	49.9	928	320	34.5
1976-77	3,069	1,909	62.2	1,042	478	45.9
1977-78 (current)	3,276	2,000	61.0	1,117	670	60.0

Source: 1. Fertiliser Statistics various issues
Fertiliser Assodation of India, New Delhi.

2. Fertiliser Statistics 1974-75
Ministry of Petroleum & Chemicals,
New Delhi.

CHART I

PIE-CHART SHOWING THE CAPACITY OF NITROGEN ACCORDING TO FEED STOCK

AS ON 1.10.77

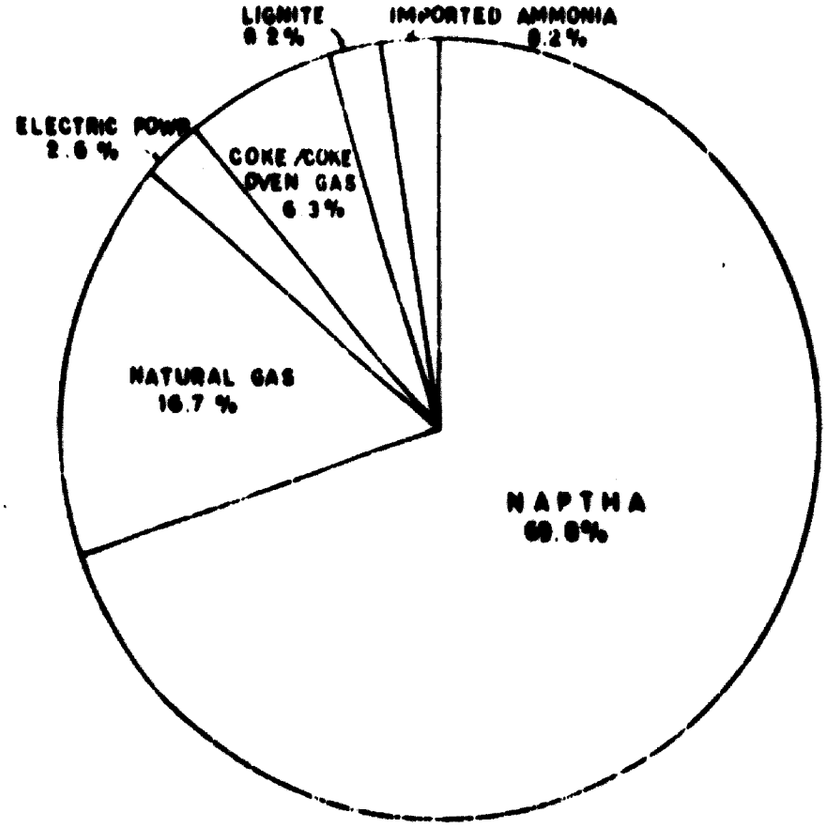


CHART II

PIE-CHART SHOWING THE CAPACITY OF NITROGEN ACCORDING TO FEED STOCK

1983-84

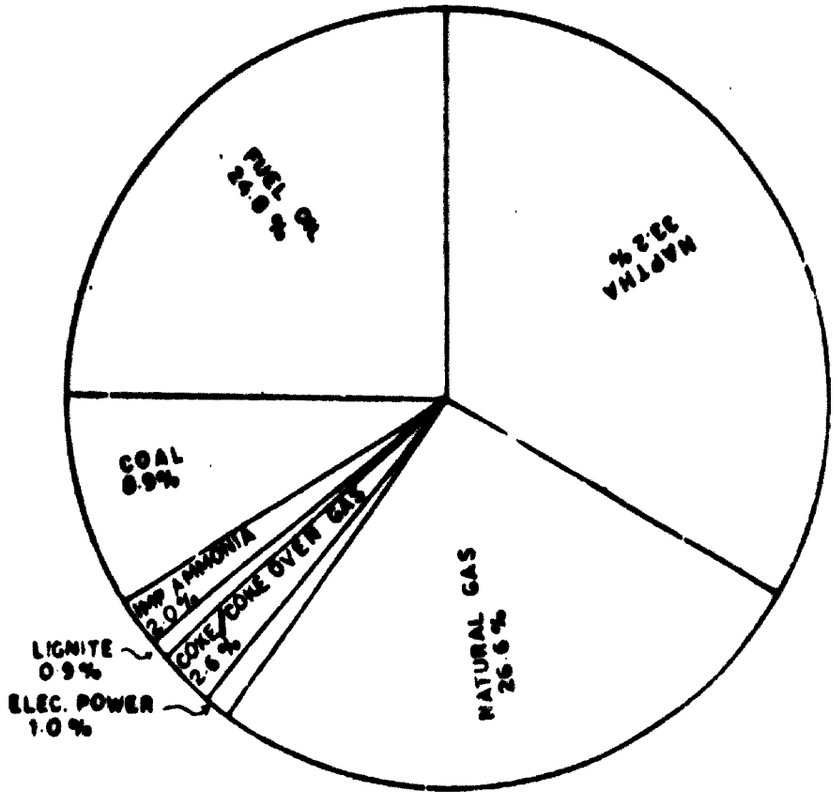


CHART III

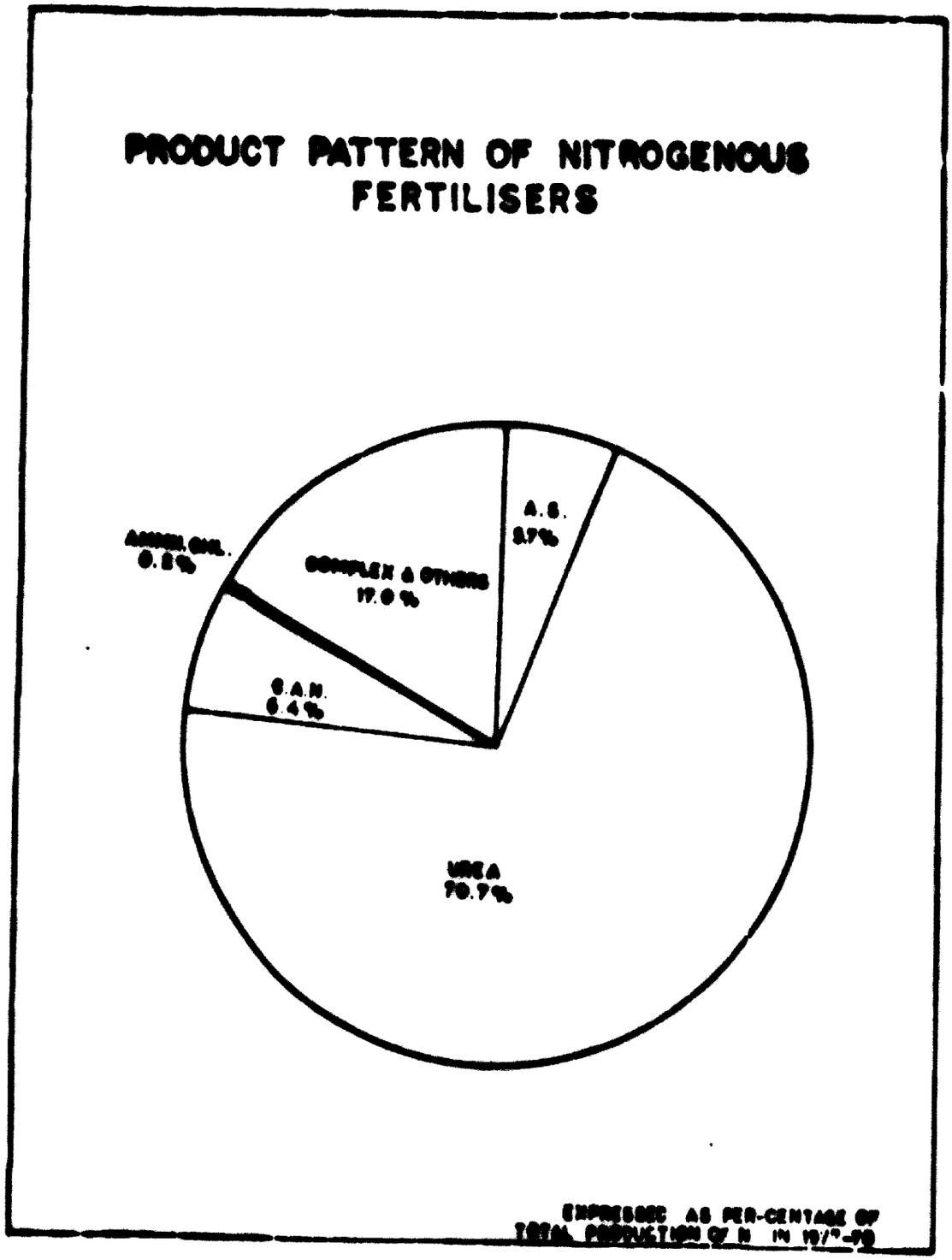
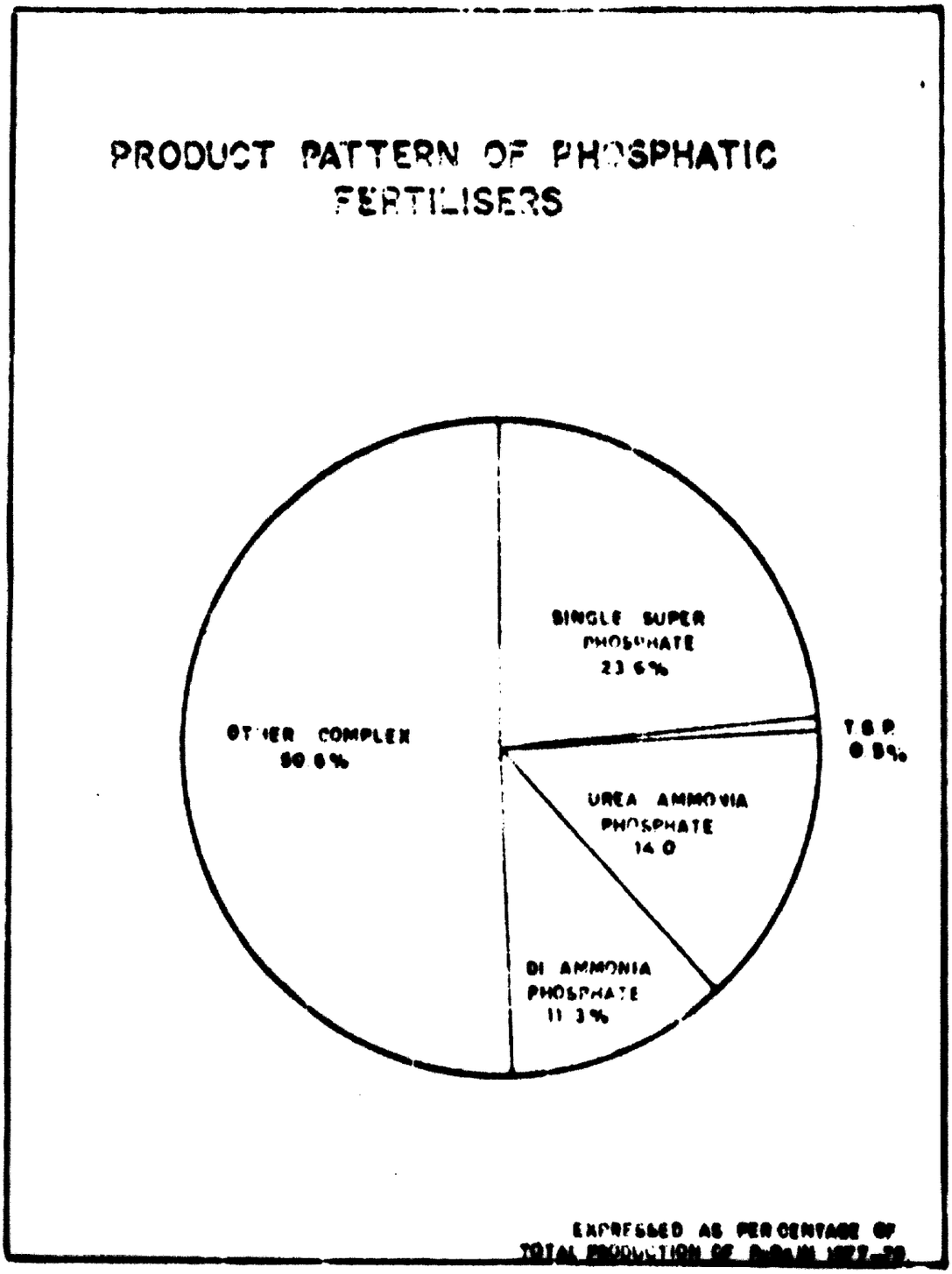
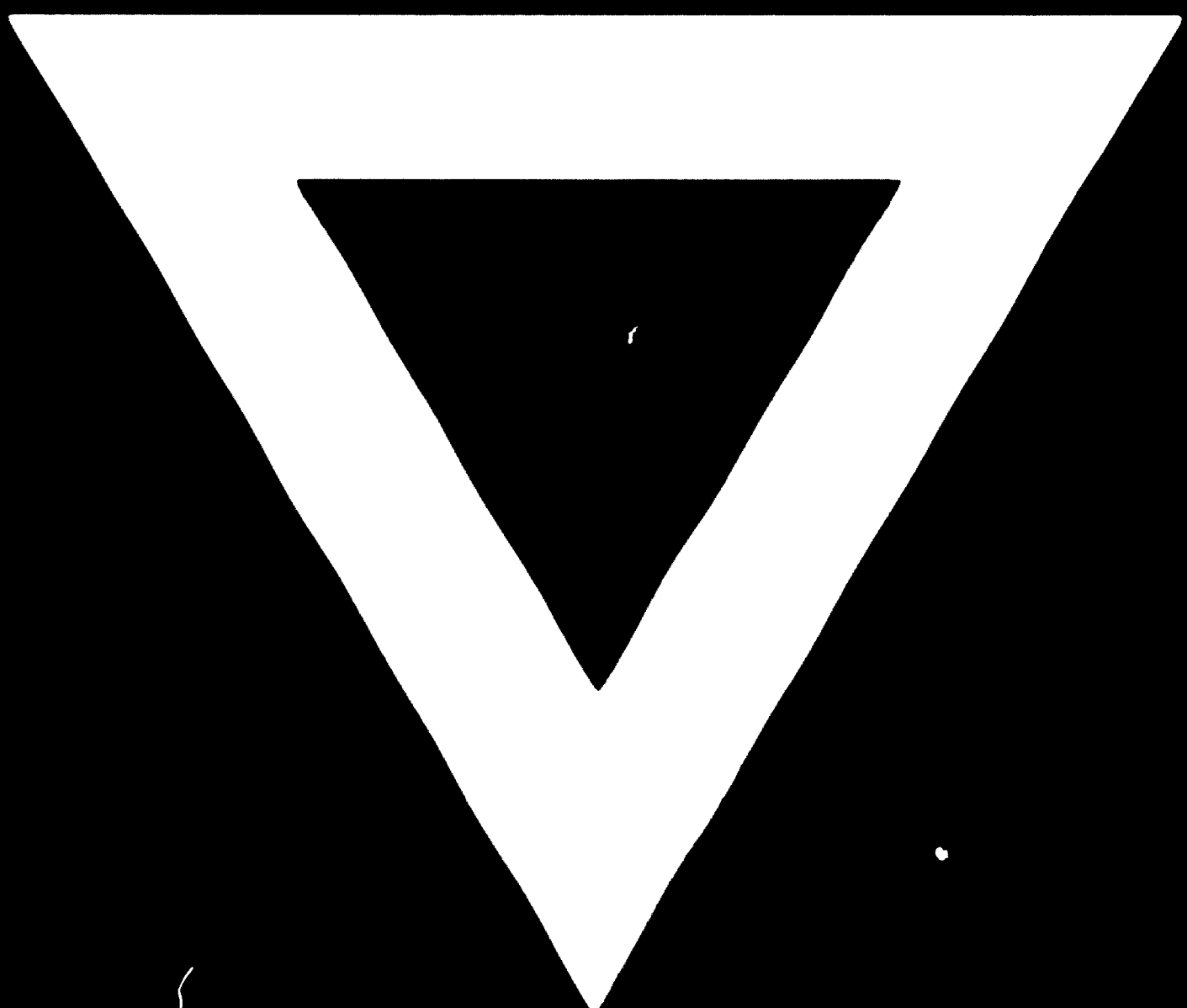

PRODUCT PATTERN OF NITROGENOUS FERTILISERS
A.S.
5.7%
AMMON. CHL.
0.8%
COMPLEX & OTHERS
17.0 %
C.A.N
6.4%
UREA
70.1%
EXPRESSED AS PER-CENTAGE OF

CHART IV


PRODUCT PATTERN OF PHOSPHATIC FERTILISERS
SINGLE SUPER PHOSPHATE 23.6%
T.S.P. 0.5%
UREA AMMONIA PHOSPHATE 14.0
DI AMMONIA PHOSPHATE 11.3%
OTHER COMPLEX 50.6%
EXPRESSED AS PERCENTAGE OF

C-11



79.11.14