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UNITED NATIONS INDUSTRIAL
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IDENTIFICATION OF FACILITIES NEEDED TO EXPAND FERTILIZER PRODUCTION AND SUPPLIES IN 23 LEAST DEVELOPED COUNTRIES*

(RP/GLO/78/008)

by

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INTRODUCTION

1. This paper summarises the results of a survey of investment opportunities for the establishment of facilities for bulk-blending/bagging fertilizers or manufacturing fertilizer in 23 of the least-developed countries (LDCs) in Africa, the Middle East and Asia. The survey was made by UNIDO in co-operation with FAO. 1/

2. The survey was prepared in response to a recommendation of the Expert Group Meeting on Regional Co-operation among Developing Countries in the Fertilizer Industry held in Vienna from 8 - 10 February 1978 (a) that special attention should be given to ways of ensuring adequate supplies of fertilizers for least-developed countries and other developing countries with a small population, and (b) that UNIDO should identify projects and propose specific measures to aid these countries which could be considered by the Second Consultation Meeting on the Fertilizer Industry.

3. For each country covered, the survey gives a brief account of (a) the fertilizer market and trends in fertilizer use; (b) problems encountered with the transport of fertilizers from the port to their final destination; (c) the availability of energy resources and raw materials suitable for local fertilizer manufacture; and (d) the investment required to establish a local plant to manufacture, bulk blend or bag fertilizers.

4. During the period May to September 1978, UNIDO consultants visited Guinea, Somalia, People's Democratic Republic of Yemen, Yemen Arab Republic, Burundi, Malawi, Rwanda, Sudan, the Central African Empire and Nepal. 2/

1/ The survey was financed by UNDP under the Regular Programme.

5. In addition, information needed for the survey was collected from reports of previous missions conducted by UNIDO in Ethiopia (1975), Mali (1975), Upper Volta (1972), the Sudano-Sahelian Zone (1976/1977), Benin (1977), Bangladesh and Afghanistan (1975); and by FAO in Ethiopia (1975), Tanzania (1976 and 1977), Afghanistan (1978) and Nepal (1978).

CONCLUSIONS AND RECOMMENDATIONS

African Countries

6. Fertilizer is used on only 6 percent of the cultivated land in the 18 African countries surveyed mainly on estates and small holdings that produce cash crops for export or grow cereals for the local market. The present average consumption of 13 kg of fertilizer material per hectare of cultivated land illustrates the potential for market expansion.

7. The survey forecasts that consumption of fertilizers in the 18 African countries surveyed will exceed 800,000 tons by 1980 compared to 500,000 tons in 1976. Consumption of compound fertilizers should exceed 300,000 tons in 1980 compared to 150,000 tons in 1976. (For details see Table 1).

8. The major constraint curbing growth in the use of fertilizers is the high cost of transport, the resulting high cost of fertilizers to the farmer, and also the inability of Governments to finance imports and/or provide the subsidies needed to make the use of fertilizers remunerative to farmers. In land-locked countries the price of fertilizers to the African farmer is two to three times the ex-factory price in Europe as shown in Table 2. In many countries, congestion in their ports, an inadequate railway system and a lack of paved roads add to the transport costs and leave little immediate scope for substantial savings in the cost of bringing imported fertilizers to the farmers.

9. All of the 18 African countries are dependent at present on supplies from abroad, except Tanzania. The only definite new project for fertilizer production is in the Sudan. The survey identifies new opportunities for investment in half of the 18 countries surveyed.

10. At present, fertilizers are imported in bags. For African countries that have port facilities to receive large shipments and a market to absorb annually at least 8,000 to 10,000 tons of straight or compound fertilizer such as Benin, Ethiopia, Somalia and Guinea, there may be an opportunity to invest in port handling equipment for the receipt of bulk cargoes, in bulk blending, storage and bagging facilities. The survey suggests that viable projects can be established in these countries. Guinea is considering to establish a double stream blending plant of 2 x 50,000 tons annual capacity which later may be integrated into a fertilizer manufacturing complex. The viability of the project is yet to be assessed.

11. For land-locked countries, local manufacture of fertilizers on a small scale is recommended. Chad, Rwanda and Malawi have the energy and/or raw material resources to produce nitrogenous fertilizer; Malawi, Burundi, the Central African Empire, Mali and Upper Volta each have all or some of the raw materials needed to produce phosphatic fertilizer. Although the cost of production in small scale units will be high, it will in most cases, compare favourably with the very high cost of imported fertilizer. More important, local manufacture could provide a reliable source of supply and all the benefits of self-reliance.

12. Afghanistan and Bangladesh produce nitrogenous fertilizers (urea), from natural gas and are in the process of establishing new capacities to supply growing domestic demand. Bangladesh produces phosphate fertilizers (TSP) to cover part of the domestic demand, from imported phosphate rock and sulphur. Afghanistan has plans to establish such facilities based on sulphur (recovered from natural gas) and phosphate rock from local deposits.

13. The fertilizer market in Yemen Arab Republic and the Democratic Republic of Yemen is too small at present to justify the establishment of either nitrogenous or phosphate fertilizer production facilities. Furthermore, these countries have no known deposits of raw materials.

14. A similar bulk-blending/bagging plant is being considered by Nepal, where the viability of a small-scale plant to manufacture ammonia and ammonium nitrate based on electrolytic hydrogen is also being studied.

Granulation

15. Bulk-blending followed by compounding and granulation is not feasible fo the small scale operations considered in this report. The very small market demand for a particular product mix would render compounding economically not viable. Granulation plants are more sophisticated than bulk-blending units and are recommended only when the market demand for a limited number of NPK compounds exceeds 100,000 tons per year.

Recommendations

16. The survey recommends:

(a) that detailed feasibility studies be made of the opportunities identified for the local manufacture of fertilizers based on local raw materials. Before a national project is implemented the opportunity for that plant to serve the regional market should be examined.

(b) that due consideration should be given to all aspects which have bearing on the delivered cost of fertilizer to the farmer. Local bulk-blending may offer a cost advantage of 10 to 20 percent in comparison with the cost of imported multi-nutrient fertilizer in bags or in bulk. However, the advantage may appear slight when technical difficulties in bulk handling and transportation under adverse climatic conditions are taken into account.

(c) that steps be taken to ensure that the viable projects are implemented,

(d) that engineering firms re-examine the designs and blueprints of small scale plants to adapt them to the specific requirements of the least-developed countries. Furthermore, efforts will have to be made to solve technical problems encountered in bulk handling of fertilizer materials in the hot and humid climatic zones.

(e) that the Governments of the least-developed countries continue or introduce subsidies and adopt other measures to promote a further sustained increase in the use of fertilizers.

17. The Consultation Meeting may wish to endorse these recommendations and consider whether the Governments of developed countries, international agencies and/or international financial institutions can finance:

(i) the feasibility studies recommended in the survey

(ii) the establishment of projects found to be viable by least-developed country concerned

(iii) supplies of fertilizer on concessional terms, pending completion of such plants

(iv) the cost of inland transportation in the case of land-locked countries.

SUMMARY OF THE SURVEY

I. The present situation in 18 least-developed countries

A. Trends in Fertilizer Use

18. The use of fertilizers in the 18 least-developed countries of Africa covered by the survey has increased steadily over the past ten years. In 1976, their consumption of fertilizers totalled about 500,000 tons and by 1980 it may exceed 800,000 tons (see Table 1).

19. Average consumption of fertilizer material used per hectare of cultivated land is only 13 kg - well below the level achieved in most other developing countries. Consumption of fertilizers per hectare ranges at present from less than 1 kg in Guinea to 35 kg in Malawi and the Sudan. The intensity of fertilizer use in different countries depends on the extent to which farming is commercialized and producing for export. Fertilizers are used on export crops like coffee, tea, cotton, tobacco, groundnuts and sugar cane, and accounted for 70 percent of fertilizer consumption in 1976. The balance was used for commercialized farming of rice, maize and wheat production.

20. The use of multi-nutrient fertilizers has increased in the period 1970 to 1976 and it now accounts for 50 percent of fertilizer consumption in most of the African countries surveyed. One country covered by the survey, the Sudan, is a large consumer of straight fertilizer. Compound fertilizers are mainly used for commercialized crops like cotton, coffee, tea and tobacco (and sometimes rice), brought under intensive cultivation by either estate farms or state organizations entrusted with agricultural development programmes. Compound fertilizers have become popular because they facilitate distribution and handling operations, fertilizer extension and promotion work, shaping and implementing price policies, and application by farmers.

B. Sources of supply of fertilizers

21. The 18 African countries surveyed imported 80 percent of their fertilizer supplies in 1976. Most of the imports came from Europe and the Middle East, but some came from Japan and North America. All fertilizers were supplied in bags except for small quantities to Malawi. None of the countries imported fertilizer in bulk.

22. In 1976, about 18 percent of the 18 countries' fertilizer requirements were produced in Africa. Tanzania's plant supplied 75 percent of national requirements.

C. The high cost of fertilizers delivered to farmers

23. Fertilizer use in many countries in Africa is discouraged by the very high cost to the farmers. The price farmers pay in such land-locked countries as Rwanda, Burundi, the Sahelian region and Central Africa is two or three times the price of the port of dispatch in, say, Europe. For seaboard countries, the situation is distinctly better, but nevertheless, delivered prices are high particularly in East Africa (see Table 2).

24. One reason prices are high is the lack of facilities in African ports to handle shipments in bulk. The cost of shipping fertilizer in cargoes of 5,000 to 10,000 tons from European and Japanese ports would normally be about US $ 30 per ton, gi ing a landed price of about US $ 175 per ton for bagged urea that sells in the home market of US $ 145 per ton. Yet the survey found that deliveries of large lots of fertilizer on a 'CIF Free Out' basis and those of small lots (less than 500 tons) shipped on 'liner term discharge' are currently costing US $ 200 to US $ 245 per ton. These costs reflect the substantial delays being encountered in the off-loading and inland forwarding of fertilizer materials due to severe congestion in most of the ports and deficiencies in the railway system.

25. The second reason why delivered fertilizer prices are high is the high cost of inland forwarding. This adds between 40 percent and 100 percent to the landed price, depending on the distance to be covered by rail and/or road. These costs bear particularly heavily on the land-locked countries which have no means to introduce improvements in port and transport operations in other countries.

26. As a result of the high cost of sea and inland transportation, fertilizers have to be subsidized heavily to achieve a favourable cost/benefit relation; this is often the case, even for high value export crops. Many countries covered by the survey lack sufficient means to finance such subsidies; they therefore rely on foreign assistance to finance fertilizer imports. This is a short term measure.

27. In the long term, these countries need to manufacture fertilizers themselves from locally available energy or raw material sources. The cost of producing fertilizers on such a small scale from local raw materials will be high; but the survey shows that local manufacture could be competitive with the very high cost of imported fertilizer products.

II. Investment Opportunities in the Least-Developed Countries

A. Bulk-blending/bagging of fertilizers imported in bulk

28. Bulk-blending offers a potential cost-saving to those countries with a suitable climate where a captive market for compound multi-nutrient fertilizers exists and where the facilities to receive and transport imports of fertilizers in bulk are available. The economics of bulk-blending need to be determined for each individual country situation to see whether local blending and bagging would be cheaper than imports of finished NPK products. Generally, there should be a captive market of at least 10,000 tons of compound fertilizers a year to justify the installation of bulk-blending facilities in any country.

29. It is technically feasible to install bulk-blending facilities of any capacity. In practice, the size of the mixing unit will be determined by the high degree of standardization in plant capacities and design, as practised in this field of engineering and contracting business.

30. Thus a plant producing 10,000 tons of multi-nutrient fertilizers a year is the minimum size of a blending unit that can be recommended; it should have a rated capacity of 10 tons/hour (effective operational output 5 tons/hour, giving an annual output of some 10,000 tons, on the basis of one shift of 8 hours per day and 250 on-stream days).

31. Investment costs are about US $ 10,000 per ton of installed capacity for a unit with 10 tons/hour of rated capacity. Investment costs for a 40 tons/hour unit amount to some US $ 7,000 per ton of installed capacity. Common standard-size units range in rated capacity from 10 to 40 tons per hour (operational output from 5 to 20 tons/hour).

Savings obtainable from transporting fertilizers in bulk shipments

32. Transport of fertilizers in bulk is cheaper than shipping fertilizers in bags, in particular for shipments that require to be forwarded inland after their sea journey. For shipment in bags, ocean freights between Europe and the African continent are US $ 25 - 30 per ton for large lots (8,000 - 10,000 tons) and US $ 45 - 70 per ton for small lots (300 - 3,500 tons) shipped on liner term discharge. The cost of shipping large lots could be reduced by US $ 10 - 15 per ton if the fertilizers are transported in bulk and loading/discharge rates of 2,000 tons per day can be achieved. Most African ports could and do receive shiploads of up to 10,000 tons, but many do not have the equipment to handle and to store such tonnage of

fertilizers if they were to be supplied in bulk. In addition, railways in general are not well equipped to move such large shipments inland.

33. Countries with deep-water ports can take advantage of favourable ocean freight for bulk shipments if they install the appropriate handling and storage facilities. Most of the existing (and planned) fertilizer plants in West and East Africa are located near ocean ports and have facilities to handle shipments of fertilizers in bulk.

34. On the other hand, the economic advantage of shipping fertilizer in bulk are less attractive and cannot be applied when the establishment of bulk-blending facilities in land-locked countries is considered. Transport of materials in bulk over long distances inland by truck can only be recommended for countries where there are suitable roads and transportation infrastructure. A connecting railway system equipped with special wagons to transport bulk materials to the port and fertilizers up-country is needed. A capacity to transport fertilizers inland at rates exceeding 1,000 tons a day, for example, will become available in Upper Volta in the early 1980s to ship ore to the coast. Similar railway projects may facilitate bulk shipments of fertilizer in other African countries.

Opportunities for bagging fertilizers in least-developed countries

35. Closely related to the transport of fertilizers in bulk, is the possibility of local bagging of imported bulk fertilizer materials. A gross reduction of US $ 20 - 21 per ton may be achieved in the cost of fertilizer supplied. Against this must be charged the local cost of bags and labour to fill them. Where bags can be filled manually or semi-automatically, a net saving in foreign currency of about US $ 17 - 18 per ton and an overall cost reduction of about US $ 10 - 12 can be achieved.

36. In summary, bulk-blending is most likely to be a viable operation in countries which have a local market for compound fertilizers of at least 10,000 tons a year and which have the infrastructural facilities to import the required fertilizers in bulk. In this case, savings of up to US $ 20 - 25 per ton achieved by importing fertilizers in bulk can be expected to cover the fixed and operating costs associated with the local bulk-blending and bagging operations.

37. Among the 18 African countries covered by the survey, Malawi and Lesotho already have bulk-blending/granulation facilities. In Somalia, Benin, Ethiopia and Guinea, and perhaps later on in Upper Volta, there appears to be an opportunity to invest in such facilities.

Opportunities for the Local Manufacture of Fertilizers

38. Tanzania is the only country among the 18 least-developed countries in Africa that manufactures fertilizers. Production costs are high because the raw materials such as ammonia, phosphate rock, sulphur (and also potash) have to be imported from overseas.

39. Sudan has firm plans to establish an ammonia/urea complex based on naphtha to be supplied by the local refinery which is scheduled for operation by 1982. The plant's capacity is expected to be sufficient to meet most of the country's needs for urea up to the mid 1980s. By locating near the centre of consumption, the delivered cost of fertilizer is expected to match the cost of imported urea which faces a long and expensive inland journey.

40. For the other African countries, and in particular the land-locked ones where fertilizer supplies are expensive and unreliable because of long transport routes, manufacture of fertilizer from local energy and raw material resources should be considered. Malawi, Rwanda and Chad have the resources to produce nitrogenous fertilizers, Malawi, Burundi, the Central African Empire, Mali, Upper Volta, Benin and Niger have all or most of the raw materials to produce phosphate fertilizers.

41. In most of these countries, the initial scale of production would have to be small and consequently the cost of production would be high relative to international standards. Nevertheless production costs, even for the smallest manufacturing units could turn out to be lower than the delivered cost of imported fertilizers which fall in the range of US $ 300 - 700 per ton of the nutrients N and P_2O_5.

42. Feasibility studies should be undertaken to demonstrate the viability of the projects identified about in paragraphs 37 and 40, with international co-operation.

III. Investment Costs of Fertilizer Plants that might be Established

A. Bulk-blending/bagging plants

43. The installation of bulk-blending cum bagging facilities with a rated capacity of 10 to 40 tons per hour (effective output 5 to 20 tons/hour) will involve a capital investment between US $ 500,000 and 1,000,000. The cost of equipment and machinery, delivered and erected at the site will amount to between US $ 200,000 and US $ 400,000; this constitutes the main foreign exchange component of the total cost. The cost of site preparation,

civil engineering and off-site facilities include facilities to store 3-months' supply of intermediate materials and finished products, make up the balance of the investment required.

44. Corresponding capital requirements for each of the countries qualifying for investment in bulk-blending operations work out as follows:

Country	Proposed rated capacity tons/hour	Investment required
Benin	10	US $ 500,000
Somalia	10	US $ 450,000
Ethiopia	50	US $ 2,600,000
Upper Volta	20	US $ 650,000
Mali	20	US $ 600,000

In Ethiopia, investment in port handling facilities and facilities to transport fertilizer to the plant site are included.

B. Local manufacture of phosphate fertilizers

45. Land-locked countries like Mali, Upper Volta, Malawi, Burundi have phosphate rock which can be used to establish a plant to manufacture phosphate fertilizers. The size of the local market in those countries would initially justify only a small scale operation to produce single superphosphate (18 - 20% P_2O_5).

46. Total investment costs for installing a unit producing SSP at a rate of 20,000 tons per year (70 metric tons/day) from local rock and imported sulphuric acid, would be in the range of US $ 1.6 million to US $ 4.5 million, if sulphuric acid is to be produced locally. These figures cover site preparation, civil engineering, cost of equipment and materials delivered and erected, as well as off-site facilities including rock grinding and storage buildings; they do not include installations for product granulation.

C. Local manufacture of nitrogenous fertilizer

47. The installation of a small ammonia unit with a design capacity of 100 metric tons/day would at present require an investment of US $ 30 - 35 million if it were to be based on natural gas feedstock as proposed for Chad and Rwanda, and perhaps between US $ 50 million and US $ 70 million, if electrolytic hydrogen or coal were used as the feedstock, as for example is being considered in Malawi.

D. Cost of feasibility studies

48. The viability of such local manufacturing projects can only be established by a detailed feasibility study in each country, costing approximately US $ 100,000 to US $ 150,000.

TABLE I

CONSUMPTION OF FERTILIZERS IN 24 LEAST-DEVELOPED COUNTRIES

(tons of fertilizer materials are reported)

Country	1975 Population	1976 Cultivated area	1976 Consumption per hectare	Actual 1976 Consumption total	Actual 1976 Consumption compounds	Forecast 1980 Consumption total	Forecast 1980 Consumption compounds
	MM	TH.Ha.	kgs.	m.tons	m.tons	m.tons	m.tons
AFRICA							
Benin	3.0	1200	7.1	8,500	5,500	15,000	10,000
Botswana	0.3	280	25.8	7,500	n. a.	10,000	n. a.
Burundi	3.7	2200	1.1	2,500	1,400	3,000	1,700
Cape Verde	0.3	58	5.1	300	n. a.	1,200	500
Central African Empire	2.0	2000	1.1	2,100	1,000	4,000	2,000
Chad	4.0	1447	10.8	15,500	12,000	26,000	21,000
Ethiopia	27.9	7900	5.0	52,000	40,000	195,000	130,000
Gambia	0.5	194	18.9	3,700	500	9,000	1,000
Guinea	4.4	4170	0.7	3,000	n. a.	5,000	n. a.
Lesotho	1.0	340	19.1	6,500	6,000	8,000	n. a.
Malawi	5.4	1908	35.8	68,000	28,000	100,000	40,000
Mali	5.6	1782	12.4	22,000	14,500	54,000	25,000
Niger	4.6	2604	1.2	3,000	-	9,000	2,500
Rwanda	4.1	1250	2.4	3,000	800	4,500	1,000
Somalia	3.1	675	28.4	19,000	9,000	29,000	15,000
Sudan	17.7	4800	35.0	168,500	-	202,500	-
Tanzania	15.3	2867	32.6	94,000	26,000	150,000	40,000
Upper Volta	6.0	2403	2.9	9,000	6,000	18,000	12,000
TOTAL 1/				490,000	150,000	845,000	300,000
ASIA ABD MIDDLE EAST							
Afghanistan	19.2	4800	47.6	70,000	n. a.	165,000	60,000
Bangladesh	76.8	12500	42.4	456,000	n. a.	650,000	n. a.
Nepal	12.5	3000	12.6	37,800	15,100	38,000	n. a.
Yemen Arab Republic	6.6	1520	6.0	9,000	3,000	27,000	9,000
Yemen Democratic	1.6	57	49.0	2,500	n. a.	6,000	n. a.

Total may not add due to rounding.

TABLE 2

Price Build-up of Fertilizer Supplies Delivered to Customer

(in US $ per ton of bagged urea)

Country	Year	FOB Europe	Landed C+FFO	Landed CIF Liner	Delivered central warehouse interior	Cost price customer
AFRICA						
Benin	1976	110-120	-	210	290	-
Burundi	1978	135-145	-	245	367	395
Central African Empire	1978	135-145	-	263	330	390
Chad	1976	110-120	144	-	280	290
Ethiopia	1976	220	-	-	275	327
Gambia	1976	110-120	140	-	164	-
Guinea	1978	135-145	-	-	-	-
Malawi	1978	135-145	200	-	230	-
Mali	1976	110-120	140	-	280	300
Niger	1976	110-120	140	-	288	-
Rwanda	1978	135-145	-	245	475	545
Somalia	1978	135-145	190	-	-	232
Sudan	1978	135-145	200	-	302	-
Tanzania	--	-	-	-	-	-
Upper Volta	1976	110-120	140	-	284	298
ASIA						
Afghanistan	1978	130(DAP)	160	-	-	-
Bangladesh	1978	125(TSP)	160	-	-	-
Yemen Arab Republic	1978	130	160(TSP)	-	-	244
Yemen Democratic	1978	-	185(urea)	-	-	270

Afghanistan

Fertilizer use development

A striking increase in fertilizer consumption took place over the past 10 years. Total tonnage rose from 6,600 tons in 1967/68 to 81,200 tons in 1976/77. The rate of application per hectare of irrigated land increased in the same period from only 6 to 50 kgs of fertilizer material. Yet, still fewer than 10 per cent of the farmers use fertilizer.

Urea accounts for almost 70 per cent of the total consumption and DAP for the balance.

Over 75 per cent of consumption goes for wheat. The balance is used for cotton, fruits, vegetables and vines. Wheat is grown on 2.3 million hectares of land of which 1.3 million are irrigated. Only 12% of the irrigated wheat area or some 150,000 hectares are fertilized at present. In 1978, urea and DAP were sold to farmers at $167 and $190 per ton respectively. The economics of fertilizer use on all major crops are favourable and do not put constraints to a sustained growth of consumption. It may, therefore, be anticipated that consumption by 1980 will have reached a total of 150,000 tons of which urea alone will account for some 100,000 tons.

Supplies, marketing and distribution

The urea plant, located at Mazar-i-Sharif has a capacity rated at 105,000 tons of urea per year. Output in 1974 was only 18,000 tons but improved to 85,000 tons in 1976/77. As a result, the country is no longer dependent on imports of urea to meet domestic demands. On the other hand, it may be expected that from 1980 onwards, additional supplies of urea have to be procured from abroad to supplment local production. In addition, all phosphatic fertilizers(DAP) have to be imported.

The AFC (Afghan Fertilizer Company) is in charge of procurements and distribution. Since fertilizer demand is seasonal and confined to a short period which peaks in July, logistics of supplies have been strained in recent years by lack of storage and transport. There are no railways and all transport is by road. Most of them are inaccessible during winter and spring time. With the financial assistance of the ADB (Asian Development Bank), the AFC is at present in the process of constructing 46 fertilizer warehouses in the country with a total capacity of some 100,000 tons.

Raw Materials

The feedstock for the ammonia-urea plant at Mazar-i-Sharif is supplied from the so-called Gogerdak field which will have exhausted its recoverable reserves of sweet gas within 5 to 7 years.

Sour gas from other reserves in the northern parts of the country will be developed to ensure feedstock and fuel supplies to the existing fertilizer plant and newly to establish industries. Sulphur recovered from this sour gas will become available in large quantities once the 4.5 billion m^3 gas-treating plant will come on stream. No potash salts have been located so far, but there are indications for phosphate rock occurrences.

Bulk Blending

Apart from DAP, the use of compound is insignificant in Afghanistan and the question of formulation of fertilizers locally does not arise.

Fertilizer Manufacturing

The construction of a second ammonia-urea plant based on natural gas is envisaged. It will have an annual capacity of 300,000 tons of urea, to make the country self-sufficient again towards the mid-80's. The production of sulphuric acid from gas-recovered sulphur and subsequently phosphoric acid will be undertaken pending the finding of phosphate rock in the country.

Country: **Afghanistan**

Table 1

Fertilizer Consumption Trends
(1000 tons)

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1977	1980
Urea	wheat, cotton vines, vegetables	3.0	6.0		27.4	26.0	30.7	42.9	50.9	54.3	107
TSP	" "	3.2	0.2		1.8	-					
DAP	" "		11.3		12.3	7.0	12.9	14.6	18.8	26.9	58
Total consumption:		6.2	17.5		41.5	33.0	43.6	57.5	69.7	81.2	165

Total cropped area: 4.8 – 5 million hectares
Total wheat area: 2.3 million
of which irrigated: 1.3 million hectares
Total cotton area: 0.06 million hectares
Total fruit/vegetables: 0.23 million hectares

Urea usaged per ha. irrigated wheat: 31.0 kg (1977)
DAP usage per ha. irrigated wheat: 16.6 kg (1977)

Bangladesh

Fertilizer use development

Between 1960 and 1972 consumption of fertilizers in Bangladesh has risen considerably from less than 42,000 to over 410,000 tons. At a compound annual rate of nearly 20 per cent. It dropped sharply in the following years but recovered to some 530,000 tons in 1976/77.

Nitrogenous fertilizer use is, with the exception of small quantities of sulphate of ammonia, almost entirely in the form of urea which accounts for 65 per cent in total consumption. Triple superphosphate (TSP) is the phosphate fertilizer commonly used whilst muriate of potash is the standard potassic fertilizer applied. The share of compound fertilizer in the consumption pattern is of little significance.

Fertilizer usage is mainly for paddy (80 - 85% of total consumption), whilst the balance is for jute, tea and sugarcane. Current rates are about 42.4 kg of fertilizer material per hectare of cultivated land.

Government targets aim at a consumption of some 0.65 million tons by 1980 and around 0.9 million tons of urea by 1985.

Supplies, marketing and distribution

Bangladesh has production facilities for both urea and TSP. The capacity of the plants at Ghorasal and Fenchuganj totals 460,000 tons of urea per year. The capacity of the two TSP units installed at Chittagong amounts to 160,000 tons of product per year.

In 1976, nearly 70 per cent of all urea fertilizer (230,000 tons) and 45 per cent of all TSP fertilizer (65,000 tons) were procured locally. The balance (120,000 tons of urea and 95,000 tons of TSP) had to be imported due to existing plants operating far below their design capacity.

The BADC (Bangladesh Agricultural Development Corporation) is responsible for the procurement, the transport, storage and sales of fertilizer down to the Thana (district) level. Retail distribution to the end-user is done by either private licenced dealers or the TCCAC (Thana Central Co-operative Association).

Fertilizers move by inland waterway (approximately 50%), by road and rail (each about 25%) from the points to supply to the warehourses at Thana level and from their by truck, bullock car; or headload to dealers, co-operatives and end-users.

Although the distribution system has proved to be flexible enough to handle the massive expansion in fertilizer use over the last decade, and to bring the fertilizer to within the reach of virtually every farmer, the system of movement predominated by waterway transport, is showing increasingly its inherent deficiencies. It is slow by lack of adequate capacity of craft. The existing fleet is heavily underutilized because of delays at unloading points in the absence of proper berth facilities and modern handling equipment. Movement by rail has also been impeded due to lack of rolling stock, the existence of two different gauges and priority given to haulage of foodgrains. Imported potash and locally produced TSP are subsidized by the state at a rate of 54 and 61% respectively. The price of locally produced and delivered urea is supported by a 43% subsidy rate.

Raw materials

Bangladesh enjoys major resources of natural gas. Reserves are estimated at 142 billion m^3. Those reserves are supplying the fuel and feedstock to the existing ammonia plants and will meet the requirements of those facilities under construction or scheduled for implementation in the near future.

There are no known deposits of potash, phosphate rock and sulphur and the country depends entirely on the import of those latter two materials to meet the requirements of the TSP plant at Chittagong.

Bulk blending

Since the market for compound fertilizer is virtually non-existent, the question of bulk blending does not arise.

Fertilizer manufacturing

To meet anticipated home demand and to create a source of foreign currency earnings, the country is expanding its production facilities of urea.

A third ammonia-urea complex with an annual capacity of 530,000 tons per year is at present under construction at Ashuganj. A fourth complex at Chittagong with an annual capacity of 560,000 tons of urea, is scheduled for completion towards the early 1980's. A fifth and much smaller plant of 100,000 tons of urea capacity per year will be constructed adjacent to the existing complex at Ghorasal.

These expansions will increase the country's urea capacity to well over 1.5 million tons per year, leaving a substantial surplus for export commencing in the early 1980's.

Country: **Bangladesh**

Table 2

Fertilizer Consumption Trends

(1000 tons)

Type of fertilizer	Crops	1960	1970	1971	1972	1973	1974	1975	1976	1977	1978
Urea (46%N)	rice, sugarcane, jute	32	200	212	185	291	278	182	320	350	400
AS (21%N)	tea	8	-	6	3	6	10	4	6	-	
TSP (46% P_2O_5)	rice, sugarcane jute	2	60	97	30	95	85	71	110	150	200
KCl (60% K_2O)	rice, sugarcane	-	15	18	14	18	32	7	20	30	50
Total consumption:		42	275	333	232	410	405	264	456	530	650

Net cropped area (million hectares)	9.0
Gross cropped area (" ")	12.5
Urea use per-hectare-cultivated	28.0
TSP use per-hectare-cultivated	12.0
KCl use per-hectare-cultivated	2.4
Total fertilizer use per ha. cultivated	42.4

Nepal

Fertilizer Use Development

Nepal is a land-locked country surrounded by China on the North and India on the South, East and West. Annex 1 is a map of Nepal which clearly shows the long distances to be covered while transporting fertilizer. There are three railway junctions on the southern boarder with India. The main port used by Nepal in India is Calcutta which is about 1000 kilometers from the border station of Raxaul/Birganj.

The country has a population of 10-12 million and the largest towns are Kathmandu, with the population of 400,000 and Biratnagar with the population of 200,000. Nepal is divided into 75 districts. The total area of the country 140,800 km^2 = 14,080,000 hectares, and cultivated area is 2,000,000 to 3,000,000 hectares. (18%) out of this 360,000 hectares are assured of water supply. The land can also be divided into three major topographical areas namely lower terrai, the middle area and the hill tracks. The main crops grown are wheat, maize and paddy and the total foodgrain output is around 1.4 to 1.7 million ton per year. (FCI-KRONBERG estimate 2.4 million tons of paddy per year).

Agriculture generates 66.5% of the country's GDP while manufacturing sector accounts only for 9%. Per Capita income in the Hill area is around 58 NRS while in Kathmandu valley it is 1.160.

Supply, Marketing and Distribution

There is an Agricultural Input Corporation (AIC) which is responsible for procuring fertilizer and other inputs from bilateral and international sources as free grant as well as buying in international market by international tenders. Due to difficulties in getting fertilizer as grants in time the AIC has to buy and stock large amounts ahead of time to assure supplies to farmers. This requires large blocking up of capital funds as well as storage space.

In 1978-79 AIC bought 14,500 tons of Urea from Japan and 4,000 tons of compound fertilizer of analysis 20:20:0 are expected. Federal Republic of Germany has agreed to provide 5,000 tons of 15:15:15 and 2,000 tons of 20:20:20. Although the Director General of FAO signed the protocal to supply 4,000 tons of supplies from the FAO Fertilizer supply scheme before May 1978 this has still not arrived. It was stated that FAO is trying to use the British contribution which has to be chanelled through the Crown Agents which is delaying supplies. Tenders for 4,000 tons of 20:20:0 is being issued. Another 28,000 tons are to be procured in 1978 either as bilateral grants or by tender.

Tenders are paid through the National Rastra Bank refinanced by Agricultural Development Bank (ADB). ADB's interest rate is 12% whereas Rastra Bank charges AIC 14%. The Japanese Government Bilateral Aid arrangement is that 2/3 of FOB price of fertilizer should be deposited. Out of the 900 million Yen credit when buying from Japan. This arrangement applies to Federal Republic of Germany also.

The minimum price fixed by Government for wheat is N. Rs. 150 per quintal whereas amonium sulphate to the farmer is NC Rs. 187 per quintal and Urea N.Rs. 344 per quintal. AIC is trying to get from Romania 5,000 tons in poly propylene bags CIF Calcutta for US $160 per ton for compound fertilizer 20:20:0 Urea from Jugoslavia is stated to cost US $129.50 CIF Calcutta. For unloading, storage and transport to go down in Nepal from Calcutta by train it costs 200 I.R. (Indian Currency). The target for 1977-78 of AIC was to procure and supply 56,000 tons of fertilizer but only 45,000 tons may be achieved. For 1978-79 target is to procure 56,000 or more.

Due to uncertainty of getting supplies in time, 6 months stock has to be maintained. This locks up capital and storage space. For providing fertilizer for the wheat crop in March stocks has to be procured, well in advance. Nepal has storage godowns in 35 locations for total of 52,000 tons. The main sales are in Kathmandu which consumes about 36% of the total requirement and Eastern Terai 37% (nutrients). Birgunj handles 70% of the imported fertilizer.

The National level of consumption during 1976/77 was 6.25 Kg nutrient per net sown hectare which is less than 1/3 of the average consumption per hectare in the developing countries of the world in 1974/75. It is only about 1/4 of the average in India. But the regional differences in Nepal are wide, for example average use in Kathmandu valley for paddy/Rice is 62 Kg/hectare of nutrients, whereas it is 3 Kg/ha in Terai and 2 Kg/has in the hilly regions. Application for wheat is 26.8 Kg/ha in Kathmandu valley and 16 Kg/has in Terai. For all Nepal wheat crop uses an average 14 Kg/ha whereas paddy uses 5 Kg/ha.

Review of the Fertilizer Consumption and Sources of Supply as well as projected demand up to the year 1990

The Agriculture Inputs Corporation (AIC) of Nepal has given the consumption in the last 10 years as follows:

Table 1: Consumption of Fertilizers

Type of Fertilizer	1965/66	66/67	67/68	68/69	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79
Ammonium Sulphate A.S (20% N)	1,629	4,000	5,664	7,510	10,133	9,929	12,295	17,005	16,857	13,440	-	7,755	10,378	12,000
Complex 20:20:0	-	1,150	3,042	2,668	4,572	4,558	9,203	9,024	12,127	14,056	-	9,423	14,097	17,000
Complex 20:20:10	-	-	-	-	255	685	44	-	-	-	-	-	-	-
Compound 15:15:15	-	-	-	-	13	-	-	-	184	215	-	5,651	3,154	7,000
UREA (46% N)	-	-	-	461	547	2,125	2,346	5,080	6,541	7,165	-	13,661	16,115	19,000
Potash (60% K_2O)	17	137	257	187	214	242	703	1,176	983	1,323	-	935	922	1,600
Single Super Phosphate SSP (22% P_2O_5)	450	155	36	248	138	168	155	198	64	26	-	-	-	-
Triple Super Phosphate TSP (48% P_2O_5)	-	33	127	28	11	10	4	2	-	-	-	73	106	-
Sterameal	-	-	400	192	-	-	425	69	-	-	-	-	-	-
Others	-	-	433	318	11	11	259	21	23	136	-	338	101	200
TOTAL	2,096	5,475	9,959	11,612	15,894	17,728	25,434	32,575	36,779	36,361	-	37,836	44,873	56,800
IN TERMS OF NUTRIENT														
N										8,923	8,423	10,694		
P_2O_5										2,849	2,491	2,778		
K_2O TOTAL										886	1,352	1,422		

RATIO:

$N:P_2O_5:K_2O$

Table 2: Sources of Supply

Total Fertilizers received from different countries (1965/66-1974/75)

Country	Quantity (tons)	Percentage
1. U.S.S.R.	1,000	0.40
2. India	13,600	5.37
3. Japan	117,638	46.48
4. W. Germany	82,341	32.54
5. Italy	3,500	1.38
6. Kuwait	25,500	10.08
7. Poland	500	0.20
8. France	1,500	0.59
9. Britain	3,500	1.38
10. Canada	2,000	0.79
11. UNDP	2,000	0.79
TOTAL	253,079	100,00

Table 3: Projected Demand

(1980/81 - 1984/85)

(Agriculture Input Corporation - AIC)

May 1978 In M. Tons - Nutrients)

Nutrients	1980/81	1981/82	1982/83	1983/84	1984/85	%
N	17,700	19,600	21,700	24,000	25,500	65
P_2O_5	5,000	5,600	6,300	7,500	8,200	21
K_2O	3,500	3,800	4,000	4,800	5,300	14
TOTAL	26,200	29,000	32,000	36,300	39,000	100

Table 4: Projected Demand

(FAI-Kronberg, March 1975)

Nutrients	1979/80	1984/85	1989/90
N	21,000- 26,000	41,000- 44,800	63,000- 66,000
P_2O_5	5,000- 7,600	9,000- 12,800	14,000 19,000
K_2O	2,000	4,300- 6,400	7,000 10,000
TOTAL	28,000 -38,000	54,000 -64,000	84,000 90,000

2. Type and cost of raw materials and utilization for nitrogen and NPK fertilizers

Electric power

Bulk tariff for industrial users with more than 500 k.w. connected load has a basic charge of 10 NRs/KVA. The price of electricity is as follows: -

Up to an annual consumption of	100,000 Kwh	0.10 NRs/Kwh
Up to " " " "	300,000 Kwh	0.09 NRs/Kwh
Above " " " "	300,000 Kwh	0.08 NRs/Kwh

The National Electricity Corporation (NEC) would probably be able to fix a lower rate provided that electric power at higher tariffs are not required for other purposes.

Water

Cooling water, process water and boiler feed water as needed is available. Cooling water used once through or recycled from rivers or lakes, process water after suitable treatment as for drinking water. Treatment will consist of filtration, flocculation and again filtration. Boiler feed water has to be treated to give 0 ppm hardness with cation and anion resins.

Fuel oil

Heavy fuel oil for fuel purposes, imported from India is NRs 1,090 per ton ex Raxaul. The cost at Hetaura is NRs 1,140 per ton and at Kathmandu NRs 1,224 per ton. If fuel oil is used for oxygen gasification to produce synthesis gas for ammonia production, the fuel oil has to be low in sulphur for which a premium price will have to be paid.

Naphtha

After the oil crisis in 1974, India raised the naphtha prices to 1,000 IRs/ton ex refineries. The freight rate from Calcutta to Raxaul is about IRs 170 = 252 NRs per 1000 litres of naphtha. Transport from Raxaul and other ancillary costs will bring this up to NRs 320 per ton. The C.I.F. price for naphtha to a Napalese border location should be taken as about $170 per ton.

Packing materials

First quality jute bags or three-ply kraft paper bags are available. Imported kraft paper bags cost between NRs 2,500 and 3,000 per thousand and jute bags lined with polyethylene film about 1.5 times this cost.

Rock phosphate

Basic C.I.F. price into Calcutta $50 per ton

Transport costs (1975) from Calcutta to Hetaura

Table 5

Cost		Rate per ton IRs
Indian railway freight		149.50
Surcharge 22%		32.89
Siding charge		0.90
42% charge extra		0.39
Bridge tax		0.30
Calcutta port commission		3.50
CPE railway charge 50% extra		7.48
Trans-shipment charge		3.50
loading (by labour)		18.00
Trans-shipment by truck (or labour)		18.00
Calcutta to Raxaul		234.46 = US$29.50
Truck transport Raxaul-Hetaura	NRs	55.00 = US$ 5.24
Total transport costs Calcutta to Hetaura	US$	34.74/ton

The type and cost of fertilizers presently imported and those that could be manufactured

Selling prices of fertilizers

Table 6

Value: Rs/ton

Fiscal Year	A/S	Changed	Urea	% Changed	Complex	% Changed	Potash	% Changed	Average Price	Average Price Change in %
1967/68	[illegible]	-	1313.00	-	-	-	[illegible]	-	[illegible]	-
1968/69	[illegible]	+23.74	1400.00	[illegible]	-	-	[illegible]	-	[illegible]	[illegible]
1969/70	850.00	-	1400.00	-	[illegible]	-	[illegible]	-	3990.00	[illegible]
1970/71	850.00	- 0.93	[illegible]	[illegible]	1057.00	[illegible]	779.00	[illegible]	3049.00	- 5.53
1971/72	1000.00	+17.65	1535.00	+31.99	[illegible]	+47.27	895.00	+14.89	[illegible]	+29.56
1972/73	1000.00	-	1535.00	-	[illegible]	-	895.00	-	[illegible]	-
1973/74 I	1000.00	-	1535.00	-	[illegible]	-	[illegible]	-	[illegible]	-
1974Jan.II	1657.70	+65.77	2192.70	+42.85	2214.30	+42.25	1552.70	+73.49	7617.40	+52.73
1974/75	1657.70	-	2192.70	-	2214.30	-	1552.70	-	7617.40	-
1975/76 I	1657.70	-	2192.70	-	2214.30	-	1552.70	-	7617.40	-
II(Sept.19. 1975)	2200.00	+32.71	3050.00	+39.10	2670.00	[illegible]	[illegible]	[illegible]	9770.00	[illegible]
III(Dec.[illegible]. 1975)	1870.00	-15.00	2440.00	-20.00	2269.50	-15.00	1572.50	[illegible]	[illegible]	[illegible]
1976/77	1870.00	-	2440.00	-	2269.50	-	1572.50	-	[illegible]	-
1977/78	1870.00	-	2440.00	-	2269.50	-	1572.50	-	[illegible]	-

Agriculture Inputs Corporation

Cost - Sheet for

Inputs Price Computation

Table 7

S.No.	Particulars	Fertilizer	Seed	Insecticide	Small Tools (Sprayer,duster)
1.	Purchased price	actual	actual	actual	actual
2.	L.C.,Import license etc.	1%	1%	1%	1%
3.	Clearing + Forwarding	actual	-	-	-
4.	Insurance	actual	-	actual	actual
5.	Railway transportation	actual	-	actual	-
6.	Loading + unloading (on purchased price)	2%	actual	actual	actual
7.	Internal transportation (except for hills)	actual	actual	actual	actual
8.	Packing + Treating	-	actual	-	-
9.	Storage	actual	-	-	-
10.	Direct cost	-	-	-	-
11.	Loss + damage (on cost price)	3%	2%	2%	2%
12.	cost price	-	-	-	-
13.	Administrative cost (on cost price)	8%	-	-	-
14.	Interest (on cost price at prevailing rate)	for 8 months	-	-	-
15.	Total cost		-	-	-
16.	Dealers commission	6%	6%	6%	6%
17.	Selling price	-	-	-	-

Existing infrastructure and alternatively those required to distribute the fertilizers to farmers

The infrastructure in Nepal is in its first stage of development. Railway lines are non-existant. Road network is being expanded. Air services are satisfactory. Electricity supply is inadequate. Communications systems like telephone, telex and cable services are satisfactory but often disconnected or overloaded. There is no water transport possible now. Only Kathmandu has sufficient infrastructure and communication facilities although inadequate.

Road network (1975) was 1,468 km being all asphalt roads. There are three main routes: the road connecting north and south in Central Nepal from Kodari at the Chinese border to Kathmandu and Birganj, the most important town at the border to India and the roads connecting Pokhara with the Indian border and Kathmandu. More roads are being built with Chinese help.

The only locations which are served by roads and railway junctions and possible suitable sites for bulk blending, ammonia plant or fused magnesium phosphate (FMP) plants are as follows:

Bulk blending:	Bhairawa
	Birganj
	Biratnagar
Ammonia plant	Bhairawa
	Birganj
	Hitaura
FMP	Lamosangu

Storage capacity exists in Nepal for 35,850 tons of fertilizers under the AIC. The AIC has a central office in Kathmandu, regional offices, main branch offices, branch offices and sub-branch offices.

The storage facilities available for inputs storage in Nepal are given below.

Storage facilities available for Inputs

Storage in Nepal

Table 8

Capacity: M.Ton

Regions	Existing Storage Capacity		Storage under construction		Proposed		Total Capacity
	AIC	Coops.	AIC	Coops	AIC	Coops	
Eastern	8,350	10,510	900	1,700	500	900	23,460
Central	16,100	11,575	12,500	4,190	250	900	45,515
Western	8,150	3,680	2,050	1,920	-	2,100	17,900
F.Western	2,750	2,940	3,000	1,940	-	6,300	16,930
Total	35,850	28,705	18,450	9,750	750	10,200	103,705

Source: AIC Planning and Evaluation Division
ADB/N Planning and Research Division

<u>Study of a suitable location or locations where small fertilizer production plants could be established close to the consumers</u>

Taking into account the projections for demand of nitrogen made by different agencies in 1984/85, it is safe to assume that the demand will rise to the order of 35,000 tons of nitrogen. This is equivalent to an ammonia production of 45,000 tons per year or 150 tons of ammonia per day or 120 tons per day of nitrogen. Assuming 300 working days per year, an ammonia plant of daily capacity of 150 tons can be envisaged.

The raw materials on which such a production can be based are as follows:

a) Hydel power to produce electrolytically hydrogen and then either burn it with air and recover nitrogen or produce nitrogen by air-liquefaction. Electricity needed 10,500 Kwh/ton of ammonia (including air-liquefaction) 60 MW x 8,000 hours = 480,000,000 Kwh.

b) Gasification of coal using oxygen; coal needed per day: 450 tons.

c) Gasification of fuel oil using oxygen; fuel oil needed per day: 300 tons.

d) Steam reforming of naphtha; naphtha needed per day: 150 tons.

The electric power production and supply situation in Nepal is not satisfactory. However, the country has ambitious schemes to develop even small hydel resources as well as a very large one. In 1975, the installed capacity of Nepal's public power utilities was 45 MW and leaves no room for large industrial supplies. However, when the completions of the Deroighat and Kulikhani power stations with 14.1 MW and 60 MW are completed there may be possibilities to use hydel power for electrolytic hydrogen and from that ammonia production.

Nepal being a landlocked country and since there are no available resources of coal or oil, it is logical to consider electric power for fertilizer production. To import and transport coal, fuel oil or naphtha over large distances will not only be uneconomic but the country will have to depend on supplies and policies over which it has no control. The only drawback in the electrolysis route is that since there is no carbon dioxide available or produced, urea cannot be manufactured but only ammonium nitrate (A.N.). The suitability of A.N. for the crops and soils of Nepal has to be determined.

However, the electric power requirements for electrolytic hydrogen are high. All such plants built in the world like Nangal - India and Peru have changed over to other raw materials due to constant non-availability of power. The only plant operating is the Kima Fertilizers in Aswan Dam in Egypt.

A feasibility study in conjunction with hydro-power development in Nepal for a 150 tons/day ammonia project using about 60 MW power is warranted.

The import and use of coal for such a small unit is uneconomic. The other alternatives are to import fuel oil or naphtha from India - the Barauni refinery. This possibility should also be included in the feasibility study.

The capital costs of an ammonia plant using electricity and fuel oil and naphtha are indicated below (budgetary purposes only).

Table 9

Capital costs of ammonia plants using various raw materials - Capacity 150 tons/day; 45,000 tons ammonia or 35,000 tons nitrogen per year

Raw material	Capital cost million N.Rs.
1. Using electric power	360
2. fuel oil	-
3. naphtha	180

As regards production of phosphate fertilizers, Nepal has to import phosphate rock if it is desired to produce single super phosphate or triple super phosphate. In addition to the C.I.F. cost of phosphate rock imported into Calcutta - about $40 per ton - it is estimated that rail freight from Calcutta to Raxaul and then to Hetaura, a possible location of a plant, will cost US$ 35 per ton. Thus phosphate rock will cost about $ 75 per ton in any location in Nepal and is therefore uneconomic to be considered for phosphate production.

The magnesite deposit near Kharidunga in Nepal has been intensively surveyed and proposals made for beneficiation and sintering to produce high quality magnesite bricks for export and use the tailings for the production of fused magnesium silicate. No deposit is estimated to contain 14 million tons. So far it has not been decided whether the raw magnesite will be burnt without beneficiation or whether the more advantageous reduction of the SiO_2 content by flotation will be applied.

The test results of fusing large samples of Kharidunga magnesite is still not available which was initiated in 1974. Nor any final decision to collaborate with an Indian company - Orissa Refractories - for beneficiating and sintering the high grade magnesite ore seems taken. No exploitation, beneficiation, marketing etc. will confront problems.

In any case to fuse the low grade ore with phosphate rock to make FMP, phosphate rock will have to be imported as well as silica in the form of quartz or other materials as well as suitable electrodes.

There are proposals for making a revision of the feasibility study made in 1973 by Grundstofftechnik of FRG taking into account many new factors which have surfaced during the last five years on which the Nepal Bureau of Mines have been working.

The most advantageous, cheap and quick way to reduce the cost of fertilizers to farmers in Nepal seems to be to set up a bulk blending, granulating and bagging plant at a suitable location at a railway junction connecting Calcutta. Nitrogen, phosphate and potash fertilizers can be brought in bulk to suitable N:P:K mixtures made to bagged at this site. A cost reduction of at least 20% seems possible compared to importing bagged fertilizers. As and when primary fertilizers such as urea or ammonium nitrate are produced at a future date, those products can be used in the bulk blending plant.

A preliminary study report on a fertilizer formulation plant to be located at Bhairawa has recently been prepared by the Industrial Services Centre of Nepal for a private party.

They have estimated that for a 2.5 tons/hour plant running two shifts a day for 300 days a year to produce 9,600 tons of blended fertilizer will cost about N.Rs. 1,871,000 equivalent to about US$ 156,000.

Examination of the freight rate applicable to bulk and/or bagged fertilizers

Structure of prices - Imports and Distribution
Costs of Fertilizers bagged (1974/75)
Table 10

Cost Items	Ammonium Sulfate (A.S.) % cost	Complex % cost	Urea % cost	Potash % cost
C.I.F. price (Calcutta)	100.00	100.00	100.00	100.00
Rail-freight	6.10	7.48	4.20	7.11
Clearing and forwarding	5.20	5.20	5.20	5.20
International transport premium	6.83	4.08	4.08	3.29
Insurance	0.36	0.36	0.36	0.36
Misc. costs	1.48	0.92	0.92	1.58
L.C. charges	1.00	1.00	1.00	1.00
Procuring costs	120.97	119.04	115.16	122.54
Shrinkage	3.74	3.71	3.56	3.79
Interest for 3 months 7.5%	6.24	6.14	5.94	6.32
Admin. costs 5%	6.24	6.10	5.94	6.32
Profit 2	2.74	2.70	2.61	2.78
Dealer commission	5.19	3.10	2.72	5.54
Selling costs	145.12	140.79	135.93	147.29

Bulk freight rates same as phosphate rock

CONCLUSION

The progress in Nepal in the field of local production of fertilizer has been too slow. To break the vicious circle of low agricultural productivity and total yearly production of food grains, cheaper and more massive inputs of water and fertilizers are needed. Presently the ratio of prices between 1 Kg urea and 1 Kg of wheat is 2.5:1 whereas it should be about 1:1 as in Indonesia.

The country is rightly putting emphasis as electrical energy from hydro-electric schemes, road building and irrigation. Industries like cement, pulp and paper, sugar etc. are being put up. Fertilizer production and use must be given also high priority.

Feasibility studies either new or updating 5 years old ones are needed in the fields of fused magnesium phosphate production (FMP), and ammonia/urea/ammonium nitrate complex using electrical energy or liquid fuels and for a bulk blending fertilizer plant.

Bilateral or International aid must be requested to undertake these studies. UNIDO should contribute or undertake these studies. Estimated cost is $50,000.-

UNIDO's help must be sought and financial assistance provided for installing a bulk-blending and bagging plant of capacity 10,000/30,000 tons/year. The foreign exchange component for equipment, expertise and other services is estimated to be US $100,000. UNIDO should consider financing such a project under the LDC scheme of assistance. Most urgent assistance will be to survey various possible sites, study freight rates, raw material costs and other factors. Such a bulk-bledning plant is expected to reduce cost of fertilizers to farmers by about 20%.

Estimated investment cost

The following list summarizes the investment estimates (in thousands of dollars) for the plant. Note that land and off-site utilities are not included, nor are office buildings and equipment, labour and staff facilities, and maintenance equipment.

	Variant A (30,000 t/a)	Variant B (50,000 t/a)
Mechanical equipment	115	125
Electrical equipment	17	13
Laboratory equipment	4	4
Subtotal, equipment ex works	136	147

	Variant A (30,000 t/a)	Variant B (50,000 t/a)
Carry-over	136	147
Export crating, delivery, freights, 30% of above	41	44
Erection and installation		
Mechanical	11	11.5
Electrical	9	9.8
Subtotal, installed equipment	197.3	212.3
Civil engineering, foundations, concrete, floors etc.	28	42
Site preparation and roads	15	18
Bulk storage building	105	155
Blending tower and product storage building	90	130
Start-up supervision (four months)	8	8
Total	443.3	565.3

People's Democratic Republic of Yemen

(PDRY)

Fertilizer use development

Fertilizer use is developing in the country during last five years. Consumption of fertilizers has increased from a few hundred tons in 1974 to 3,800 tons in 1978. Annual consumption is expected to go up to 13,000 - 15,000 tons by 1983 as per the 5 year plan of PDRY.

Use of compound fertilizers in the country is practically non-existent. Major fertilizers used are urea, triple superphosphate and potassium sulphates. Of the total, urea usage forms more than 80%. Major consumption of fertilizers is by wheat which consumes about 900 tons of fertilizer (600 tons urea and 300 tons TSP), cotton (500 tons of urea), bananas (300 tons of urea), sorghum/millet (350 tons of urea), tomatoes (130 tons urea and 130 tons TSP), and maize (200 tons urea). Potatoes and vegetables are applied potash also in addition to urea. Other crops grown are sesame, fodder, vegetables, coffee, dates, tomatoes and other fruits.

Total land area of PDRY is 300,000 sq. km of which 300,000 hactares are the potential agricultural land. Agriculture is severely limited in this country by water availability and also the climate. Soils are sandy and have a poor soil texture. Crops have to be grown by means of irrigation. This effectively limits the extent of cultivated land. Thus it has become necessary to increase productivity by addition of fertilizer nutrients to the soil, by improvement of land and irrigation, by new crops production technology, use of modern farming practices and adopting intensive cultivation. The FAO project located at El Kod is making considerable progress in giving direction to farming techniques development in the country. Two key agricultural areas are Wadi Tuban and Wadi Abyan, the delta regions located near Aden.

Agriculture is of paramount importance to PDRY economy. About 100,000 hectares are estimated as normally cultivated. About 60,000 - 80,000 hectares are regularly farmed lands and rest irrigable land, but farmed in favourable years of water availability and climate. The country has an estimated population of 1.7 million and a large percentage of people is connected with agriculture. Cotton contributes to the foreign currency by expert as the largest single item of agricultural produce.

Several agricultural projects, like cotton seed oil production, dates, canned tomatoes, textiles, which have potential export earnings, are under execution or being planned.

Based on above, fertilizer consumption is planned for a target of 13,000 - 15,000 tons in year 1983. Most of it will be as urea, if present pattern of use is projected.

Fertilizer supply, marketing and distribution

PDRY has no local production of chemical fertilizers and has to import all the materials urea, triple superphosphate and potassium sulphate are all shipped from overseas. Kuwait and Egypt are said to be usual sources of supplies of fertilizers. Aid is also obtained from international agencies through UNDP.

Public corporations, set up for the purpose, are handling the import, storage and distribution of the fertilizers. All fertilizers are received as bagged, and order for procurement is placed 3-4 months in advance of the commencement of the two agricultural seasons. Adequate storage facilities are stated available both at receipt and distribution points. Major consumption of fertilizers (50% of total) is in the third governorate which is about 45 km from the port. The fifth governorate 1,000 km away, accounts for usage of 30% of the importation. The second governorate accounts for 20% of consumption and is located about 30 km away The CIF price of imported fertilizer is currently around $185/ton urea, $212/ton TSP and $160/ton of potash.

The transportation to the consumer and the agricultural development charges account for about $60-80/ton, to be added to CIF cost. The transportation is handled by Public Transport Corporation. Though the road network is reasonably adequate, there is pressure on availability of trucks. Further improcurement to the roads network is included in the current 5 year plan (1979-83).

There is no railway system in PDRY.

Port Information

All the cargo received at Aden has to be transshipped to the lighters and transported to the wharf forunloading (even bulk shipments of wheat are handled this way). However there is facility to directly unload a medium tonnage ship at wharf, provided the vessel has a maximum of 18 ft. draft and 350'- 400' length so as to be berthed at the wharf. Since the area available at the wharf is very limited, the cargo has to be moved away from wharf as quickly as possible. The port authorities are anxious to ensure that the vessels are unloaded as quickly as possible so that the shipping companies do not develop inhibitions to call at the Aden Port.

Raw materials and supply costs

The country does not have petroleum resources but has important petroleum refining facilities at little Aden. Other than reexport of refined petroleum products, the primary indigenous export commodity is from agricultural sector, viz. cotton.

The country does not have other fertilizer raw materials like phosphate rock, sulphur or potash. However, as the naphtha, gas from refinery and gas oil are the commonly used feedstocks for fertilizer manufacture, a study had been done on possibility of fertilizer manufacture about four years ago. Requirements of large quantities of water and high foreign exchange needs have possibly relegated the 0.5 mill tons/year urea project to the background.

Prospects for local manufacturing of compounds

1. In the absence of high consumption of fertilizer materials and also non-use of compound fertilizer, the question of putting up a bulk blending plant does not arise. However, purchase of fertilizers in bulk and locally bagging can result in cost savings and also foreign exchange savings as shown below:

	For UNIDO, long distance transportation to African continent(taken applicable for Middle East)	For PDRY, fertilizers from Kuwait and Egypt (assumed)
1. Savings in transportation (ocean freight) for bulk fertilizers (5,000 tons consignment) over bagged fertilizers	US$15-17/ton	US$ 4-8/ton
2. Savings in bags and bagging cost between suppliers point and local purchase of bags and bagging	US$10-12/ton	US$ 5/ton
3. Savings in net foreign expenditure	US$17-18/ton	US$ 10/ton

The above table indicates that there can be a savings of $4-8 + $5 = $9 - $13 or approximately $11/ton if local bagging is contemplated. The cost of bagging plant can be around $200,000. Hence annual savings that can result is of the order of $11 x 10,000 tons = $110,000 and payout time will be one year and ten months, which is satisfactory. The annual foreign exchange saving will be about $10 x 10,000 tons = $100,000.

An advantage of above step is that it will help develop necessary manpower infrastructure.

a) But the limitations of unloading at the Port and the shortage of wharf area for a bagging plant (as mentioned under Fertilizer supply, marketing and distribution) can be the potential difficulties which have to be resolved before deciding on the project.

b) Large capital funding: with the normal debt-equity ratios and allowing for foreign collaboration, immediately necessary finding will come down. The foreign collaboration will enable also to establish marketing of the product profitability and also be helpful to get loans from international agencies like IDA at tons rate of interest.

c) Foreign exchange earned by exporting fertilizers may perhaps be more than by exporting the feedstock.

d) Water requirement for modern fertilizer plants have been cut down greatly of late by improved designs of treatment and recycle systems.

2. Urea Usage

Biuret content of urea can vary from 0.4% to 1.5 - 2.0% depending on the process of manufacture. Most plants produce 0.5% and less of biuret, in urea. As biuret is harmful to crops, it is good practice to ensure that biuret is below 1.0% in all consignments of urea.

3. A composting plant for municipal wastes is being set up in Yemen under aid from UNDP, UNCDF and UNIDO. The project is in advanced stage and expected to be completed in next year.

Country: People's Democractic Republic of Yemen

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976/77	Cultivated Area (1000 ha) 1983	Fertilizer Recommendations Formula.	Kgs/ha	Total Consumption 1976(1)	Total Consumption %total	Area fertilized %total	Forecast 1983
Cotton: total	5.284	12.546	urea	124	500	17.8	80	
Wheat	6.313	12.140	urea	158	600	21.4	70	
			TSP	75	300	10.6		
Barley	0.069	809	TSP	124	8	3		
Bananas	.580	1.012	urea	620	300	10.6	100	
Potatoes	.278	.393	urea	248	60	2.1		
			K_2SO_4	124	30	1.0	90 – 100	
Tomatoes	1.561	2.023	urea	124	130	4.6		
			TSP	124	130	4.6	70	
Millet/sorghum	21.448	27.924	urea	124	350	12.4	15	
Maize	2.752	4.452	urea	248	200	7.1	30	
Sesame	3.116	13.355	urea	124	68	2.4	15	
Fodder	4.259	12.545	urea	124	60	2.1	10	
Vegetables	386	.607	"	124	80	2.8	30	
	1.100	2.428						
	1.133	2.934						
Tobacco	546	1.011						
Coffee	607	810						
Dates	7,329	7,285						
Fruits	633	2.266						
Total:	57.399	104.540	Total fertilizer consumption:	2,470	2,820			13,000–15,000
			Of which TSP + K_2SO_4 forms about 20%	494	564			2,600

Country: **People's Democratic Republic of Yemen,**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1972/73	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Urea Ammonium sulphate SSP	Cotton, wheat, sorghum, bananas, vegetables, potatoes, sesame, fodder.		520	750	1,972	2,258	3,086	3,389	4,502	6,096	7,679	10,355
TSP	wheats, barley, tomatoes		130	188	494	575	771	1,007	1,337	1,796	2,282	3,081
K_2SO_4												
Ammonium nitrate												
CAN												
KCl												
NPK												
NPK												
NPK												
K_2SO_4 (50% K_2O)												
Others												
Total consumption:			650	938	2,466	2,823	3,857	4,396	5,839	7,842	9,961	13,436
of which compounds:		650										

Yemen Arab Republic
(YAR)

Fertilizer use development

Usage of fertilizers has developed well during last 10 years. Consumption of fertilizers has increased from less than 2,000 tons per year before 1970 to nearly 20,000 tons in 1977/78.

Use of compound fertilizers is also playing an important role in the agricultural sector. Nitrophosphates (20-20-0) are being used. Other fertilizers commonly applied are ammonium sulphate nitrate, urea, triple superphosphate and potassium sulphate.

Major parts of Yemen soils lie in the high pH range. About 55% of soils are in 8.0-8.5 pH and 30% above 8.5 pH. These soils are classified as medium alkaline and high alkaline types. The effects of the high pH result in unfavourable environment for root growth, high fixation of phosphates from the applied fertilizers by the soil and some volatilization of applied nitrogen nutrient as NH_3. Fertilizer rate experiments carried out in the Southern uplands and lower plains indicate th availability of P_2O_5 from the fertilizers to the crops remains low at application level of 100 kg/ha. of P_2O_5. Application of split dosage of fertilizers is found somewhat superior to single basal dose but still not enough to result in significant increase in crop yield. Only by increasing the P_2O_5 application to 200 kg/ha. level, the availability of P_2O_5 in above soils remains sufficiently long to increase crop yield.

YAR extends over approximately 200,000 km^2. The population is currently estimated at 6.5 million, mostly concentrated in foothills, and central midlands. About 73% of total population is taken as connected with agriculture. The major cultivable lands in the country lies in the central uplands, middle heights and Tchama plans. The cultivable area of the country about 1.5 Mill. hectares and the classification is shown in annexure 1, indicating areas under flood, wells rainfed and perennial rivers irrigation.

However, about 2.0 million people out of total population is estimated to be working in outside countries, mainly in Saudi Arabia and remitting an estimated total of $1-2 billion a year. Consequently cost of local agricultural labour has gone up. This has affected the agricultural sector resulting in a shift in crop pattern, increasing acreage under cash crops. The fertilizer recommendations are being provided by FAO projects and by the Government agencies so that the agricultural production will increase to give a satisfactory cost-benefit ratio to the farmer.

Sorghum and millet:

These crops cover the maximum acreage under cultivation (about 50% of total). Fertilizer recommendations include administering a 50 - 150 kg N, 50 - 200 kg P_2O_5 and 20 - 100 kg K_2O per hectare, depending on the area under cultivation and the type. A good quantity of fertilizer is used for these crops though precise figures are not available.

Maize, barley and wheat:

Fertilizer recommendations are provided for these crops also based on the rate experiments conducted by Central Agricultural Research Organization in different areas of the country.

No information is available on the quantity of individual fertilizers imported and the type of fertilizers applied cropwise. However, as the intensity of cultivation increases, the consumption of fertilizers is expected to go up; use of compound fertilizers would accordingly increase which is estimated to reach a level of 30% of total usage.

Fertilizer supply, marketing and distribution

YAR has no local production of fertilizers and has to import all the materials. Urea |sulphate of ammonia, nitrophosphate, K_2SO_4 are all shipped from overseas. The major suppliers are Saudi Arabia, Kuwait, FRG, Chile, UK and Iraq. Ministry of Agriculture and Economy handles the import through the Central Bank of Yemen. However, a large percentage of material is obtained as aid, particularly from Saudi Arabia. As a result the total value of fertilizer imports mentioned in the various sources like Statistics Year Book, Foreign Trade Statistics of Central Bank of Yemen, Central Planning Organization's computerized data sheets is presumed to show a lower figure of import. Progressively, the computerized data sheets are including more of the aid material also in the tabulation so that the indicated quantities become realistic. The importation of the fertilizer is made mostly through the Hodeidha Port, though considerable quantities coming by road from Saudi Arabia are not ruled out. The imported fertilizer is distributed through the merchants to the farmers. Jihama coastal plan region is reported to consume 20% of total fertilizers while the bulk of consumption takes place in central highlands (70%), the foothills and middle heights using about 10%.

The agricultural projects run by the Government have facilities to store the fertilizers as also the merchants, before distribution to the farmers. The Agricultural Credit Bank gives a 4-month credit to the farmers. The major consumption period is April to June of each year and fertilizers are ordered 4 - 5 months prior to above period.

YAR has no rail system and the fertilizers are transported only by road. The network of major asphalted trunk road would appear satisfactory for handling the near future requirements of fertilizers.

The price of imported fertilizers varies from 55 Y.Rials ($12.00) per bag of 50 kg to 70 Y.Rials($15) depending on the fertilizer. Transportation to the farmer may cost about 20 Rials/bag. In mountain terrains, it can cost more.

Raw materials and supply costs

YAR does not possess any raw materials for fertilizer manufacture, like natural gas, oil, phosphate rock, sulphur or potash.

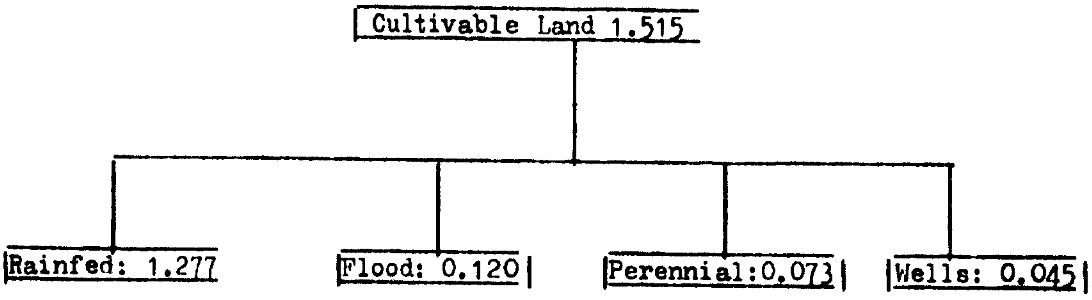
Prospects of local manufacturing of compounds

In the five year plan 1976/81, a fertilizer mixing plant of 55,000 tons/year capacity (300 stream days) is provided for. The project is scheduled to start in 1978 so that the plant becomes operating in 1981. The location is Salif, a port north of Hodeidah. The estimated cost is Y.Rials 29,000 Mill ($6.40 Mill), the project to be a joint venture of Government and private sectors.

YAR is stated to receive a good portion of fertilizer requirement as aid. No DAP or MAP is reported as being imported. In the circumstances, the technical as well as costwise feasibility of the mixing plant for urea, TSP and nitrophosphates gives rise to doubts. However, if the soils services recommendations shifts to ammonium phosphates and results in importation of DAP/MAP at world prices, then the possibilities of the bulk blending plant installation to the advantage of YAR is bright and real.

Annexure 1

Mill Ha.



Country: Yemen Arab Republic

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976/77	1980	Fertilizer Recommendations Formula.	Kgs/ha	Total Consumption 1975	1976	%total	Area fertilized %total	Forecast 1980
Cotton	15	25	Amm.nit. sulphate	300					
			TSP or Complex	100					
			K_2SO_4	30					
Date	5	5							
Barley	143	63							
Wheat	50	80	amm.sulph. (urea)	286 260					
			TSP, K_2SO_4	40					
Fodder	43	85							
Legumes	60	48							
Millet/sorghum	1,080	1,042	amm.sul/urea	240/130					
			TSP, $K_2SO_4(NO_3)$	170/40					
Maize, non-irrigated	50	50	am.sulp.nit. (urea)	230					
			TSP, K_2SO_4	170/40					
Sesame	8	12	$AmSO_4$	285					
			TSP	65					
Vegetables	15	47							
Tobacco	4	7							
Coffee	15	10							
Grapes	7	7							
Potatoes	5	20							
Fruits	10	14							
Total:	1,515	1,515	Total fertilizer consumption:		7,000	9,000	100%		27,000
			of which compounds:		2,000	3,000	30%		10,000

Country: Yemen Arab Republic

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1972	1973	1974	1975	1976	1977	1978	1979	1980
Urea	sorghum, millet, rice maize, wheat									
Amm.sulphate nitrate	sorgum, millet,									
SSP	groundnuts									
TSP	sorghum, millet, rice sugarcane, wheat, maize, sesame, tobacco									
MAP										
DAP	rice, sugarcane									
Amm.nitrate										
CAN										
KCl	vegetables									
K_2SO_4 (50% K_2O)	sorghum, millet, wheat maize									
Total consumption:		1,700	4,200	3,900	7,000	9,000	12,000			27,000
of which compounds*:						3,000	4,000			9,000

*estimated

Benin

Fertilizer use development

The use of fertilizers in Benin developped rapidly in the period 1965-70, from a mere 2,300 tons to about 12,000 tons, but has since remained stagnant.

As a matter of fact, overall consumption in 1976 declined again to levels already reached in 1968, i.e. 8,500 tons of which 5,500 or 64% consisted of compounded materials.

The so-called cotton mixture, i.e. 15-25-15 which also contains sulphur and borium, is the main compound in use. It is also recommended for rice and maize.

Straight fertilizers, like sulphate of ammonia and potassic materials are mainly used for oil-palm, TSP and urea for cotton as well as for cereals. Cotton consumes by far the largest amount of fertilizers, namely around 6,000 tons annually or 64% of total fertilizer consumption. It is followed in importance by oil-palm with a 31% share of the total.

For rice and maize, which at present hardly use any fertilizer in spite of the extent of the area under cultivation, well-defined productivity increase programmes have been launched,while a sugarcane industry is being set up.

Government targets aim at an overall consumption of about 36,000 tons of fertilizers to be reached in the '80's. Yet it seems that consumption will not surpass a 15,000 tons target by 1980 of which 10,000 tons or about 70% in the form of compounds.

Supplies, marketing and distribution

All of the country's fertilizer requirements have to be imported. SONAGRI (Société Nationale pour la Production Agricole) is responsible for the procurements from overseas as well as for their distribution to various state agencies in charge of crop production programme. It does not handle, however, the supplies for the oil-palm industry. Though fertilizers in Benin have to be transported over relatively short distances to reach the end-user, the charges for handling,storage transport as well as for taxes are high. In 1976 the cost of urea delivered to consumer amounted to $290 per ton of bagged material against a landed price of about $210 per ton (Liner term discharge per small lots).The difference in costs covers inland transport/storage/handling and various financial charges (15% on CIF value).

In order to make fertilizer use attractive to the farmer, the state heavily subsidizes (50%) those materials. Yet, with the exception of cotton, cost/benefit ratios seems to remain unattractive to growers of most of the other crops.

Raw Materials

Like Upper Volta and Niger, Benin disposes of phosphate rock at Mekeou near the border with the aforementioned countries. Although not fully prospected, the deposit appears to be vast (over 30 million tons) and of good quality, i.e. 28% P_2O_5. The bulk of the rock-bearing strata lies at depth between 100 and 200 meters. The exploitation would, therefore, be only economically justified if undertaken mechanically on a large scale.

Yet, sufficient material of acceptable quality seems to appear on or near the surface, which could be manually exploited with a minimum of investment to supply the feedstock for a small scale SSP plant if sulphuric acid could be made locally available or imported.

Prospects for Local Bulk Blending

Benin would consume by 1980 compound fertilizers in a sufficient large quantity to justify a minimum-sized bulk blending cum bagging unit (5 tons/hour, annual output 10,000 tons on the basis of one shift, operating 250 days a year). Since the port of Cotonou has the capacity to receive shipments of 4 to 5,000 tons of fertilizer materials in bulk and to discharge them, if simple bulk handling facilities are installed at a rate of 1,500 to 2,000 tons a day, bulk blending in a coastal country like Benin should operate very economically. Savings in costs for raw materials and freight would largely offset fixed and operational expenses, and induce price reductions, which would lessen the financial burden of subsidies for the state. The viability of operations could be further increased if the phosphate component in the blend could be supplied from a local manufacturing facility.

Investments

The estimated cost for installing a minimum sized blending unit would amount to approximately $500,000 dollars of which 220,000 for machinery and equipment erected near the port.

Country: Benin

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976/77	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1975	Total Consumption 1976	Total Consumption %total	Area fertilized %total	Consumption Forecast 1980
Rice: Total	10.2		15-25-15-5S-1B	200					830
Intensive		4.2	urea	137	314	33	2		570
Maize: Total	26.2								
Intensive		46.7	15-25-15-5S-1B	150	-	-			7,000
			urea	50	-	-			2,300
			TSP	40	490	131			-
			SA	80	137	42			-
			KCl	30	132	701	8.5		-
Cotton	50.0		15-25-15-5S-1B	200	6,000	5,435			10,000
			urea	50	480	756	66.8		2,500
Groundnuts	77		-	-	-	-			
Oil-Palm	320		SA	-	348	147			
			KCl	-	1,746	761			2,200
			K_2SO_4	-	964	292	22.5		1,250
			various	-	8	43	0.2		
Sugar cane	-	4.4	16-16-24	500	-	-			2,200
			urea	80-160	-	-			530
			Total consumption:		10,619	8,341			
			of which compounds		6,314	5,468			

Country: **Benin**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980 (target)	(forecast)
NPK: 15-25-15-59-1B	Cotton, rice maize							6,000	5,435	23,000	8,000
16-16-24	Sugar cane							-	-	2,200	2,200
NP: 18-46	- - -							314	33	-	-
Straights: Urea (46 N)	Cotton, rice							480	756	7,600	1,500
SA (21 N)	Tobacco, maize Oil-palm							485	189	-	-
TSP (46 P_2O_5)	Maize, groundnuts							490	131	-	-
K_2SO_4 (50 K_2O)	) Oil-palm, tobacco							1,096	317	1,250	1,250
KCl (60 K_2)								1,746	1,461	2,175	2,175
Miscellaneous								20	160	-	-
	Total consumption:	8,200	12,000	12,500	14,400	10,900	12,400	10,631	8,482	36,225	15,125
	of which compounds:							6,314	5,468	25,200	10,200

Burundi

Fertilizer use development

Fertilizers in Burundi are mainly used for coffee, tea, paddy and cotton. The area under tea cultivation is 100% fertilized. The practice of using chemical fertilizers for coffee has sharply decreased in recent years from some 80 per cent to less than 20% of the cultivated area.

Estate farms (Robusta coffee) continue to use fertilizers but small growers of (arabica) coffee are no longer applying them as before.

It is significant to note that overall consumption over the past 7 years has remained stagnant. It varies at present between 2,500 and 3,000 tons annually. The only compound, i.e. 25-5-5, is used for tea by both estates and small growers.

Although fertilizer are indispensable to increase the country's agricultural production potential, the prospects of expanding their use in the medium term, are very limited, mainly because of their very high cost and problems associated with the transport and transit of supplies from the Ocean ports to the interior over long and cumbersome distances.

Supplies, marketing and distribution

All fertilizers have to be imported and almost all supplies are provided under various technical assistance programmes. Fertilizers for tea are handled by the OTB (Office du Thé du Burundi) and are financed by the European Development Fund. They are distributed to farmers at marginal costs covering the expenses for local transport and distribution only. Fertilizers for coffee had been since 1970 financed by the World Bank under a credit scheme granted to the OCIBU (Office des Cultures Industrielles du Burundi) and distributed gratis to the small growers. This scheme lasted till 1975. In 1976 the OCIBU received some 500 tons of urea from the IFSS (International Fertilizer Supply Scheme). But at present it has to finance its own supplies entirely. In view of their high cost, the Government has suspended imports and is turning to organic waste as a substitute for maintaining soil fertility.

Fertilizer supplies to various rice projects and cotton growing schemes manged by the COGERCO (Comptoir de Gérance et de Réserve Cotonnière) have recently been undertaken under the technical and financial assistance programme of the Belgian Government.

The port of Dar-es-Salaam handles approximately 90% of the country's imports and exports, Mombasa only 10%. Fertilizers landed at the port are hauled by rail to Kigoma (1,250 km) at Lake Tanganyika from where they are shipped to Bujumbura (180 km). The cost of transport, various handling and storage charges amount at present to F.Bu. 11,000 ($122) per ton of fertilizer (about ¢8.50 per ton/kilometer). Because of the persisting congestion in the Port of Dar-es-Salaam and the inability of the Tanzanian Railways to ensure adequate and regular transport services, fertilizers like other goods usually stay 4 to 6 months in the warehouses or in the open at the port prior to being forwarded to Burundi, a voyage which normally would take nolonger than 2 to 3 weeks. Shipments through Mombasa, are hauled by road via Nairobi, Kampala and Kigali. The actual costs of covering the distance of about 2,200 km amounts to F.Bu. 24,000 or $270 per ton, or ¢14 per ton/kilometer. Thus, the actual cost at which urea is being delivered at the central warehouse Bujumbura amounts to F.Bu. 33,000 or $367 per ton against $245 per ton, liner term delivery Dar-es-Salaam.

Adding cost of local distribution, which amounts to an average of $28 per ton (mean distance of transport 100 km at a rate of F.Bu.25 per ton/kilometer), then the actual price of delivery to farmers increases to some $395 per ton of urea.

Raw materials

There are no known deposits of potash salts in Burundi. On the other hand, large reserves of phosphate containing clays (150 million tons with a P_2O_5 content varying between 3 and 22%) have been recently discovered some 100 km northeast of Bujumbura. The deposit, overlaying a carbonatitic crystalline rock formation of igneous origin, varies in depth between 60 to 90 meters and is suited to open-pit mining. The apatite is dispersed in the clay as small concretions of primary or secundary formation and may be partially soluble in water or weak acid, because of the extremely leached character of the deposit. This aspect is of importance as known deposits of pyrites are of a poor quality and most probably too expensive as raw material for sulphuric acid manufacturing. Laboratory test should confirm this quality aspect of the phosphate ore so as to assess its value as a phosphate material for direct application to the soil or alternatively as a raw material for further processing to phosphatic fertilizers by means of acidulation with strong acids. Equally the methods of beneficiation should be studied on a laboratory scale first to appraise the commercial value of the deposit.

Neither petroleum gas or coal have been found so far in Burundi, but the country possesses vast resources of peat (1.5 km^3) which could be used for ammonia production.

As a matter of fact, the feasibility study undertaken by a group of consulting firms, i.e. Ralph Parson, U.O.P. and Outokumpu Oy on behalf of UNDP for the industrial exploitation of the country's nickel reserves (300 million tons containing 1.4 - 1.5 % Ni) envisages the use of peat for this purpose. In making a choice between recovery technologies, the hydro-metallurgical process yielding electrolytic nickel has been given preference above the pyro-metallurgical method (yielding ferro-nickel: 35 - 40% Ni), mainly because of the country's poorly developed infrastructure, costly and cumbersome overland communications with the coast. As a matter of fact, the latter process involves much larger tonnages of exports and requires large quantities of fuel oil to be imported (2.4 tons per ton of product).

Nonetheless the hydro-metallurgical process will require ammonia at a rate of approximately one ton per ton of nickel for the extraction of the metal from roasted and reduced ore. (Nickel will be recovered from the ammonia solvent by electrolysis).

The study of the aforementioned consultants envisages the use of cokefied peat as fuel for power generation (11,300 KWH/ton Ni), and as source of gas for ore reducing purposes and for ammonia synthesis.

Bulk Blending

In the absence of a captive market for compound fertilizers the question of setting up bulk blending facilities of even bagging facilities for fertilizers imported in bulk, does not arise.

Prospects for the Manufacturing of Fertilizers

The project for the exploitation of the country's nickel reserves envisages an output of 90 tons of nickel a day. According to the chosen technology of extraction, some 30,000 to 33,000 tons of ammonia will be required annually. Imports and subsequent overland transport of those quantities is virtually excluded because of the infrastructural situation. The implementation of the project makes it, therefore, imperative to provide for local production of ammonia from peat, unless supplies would come available from a plant in Rwanda using the natural gas reserves of Lake Kivu as a feedstock. Anyhow, the realization of the nickel project has to provide the country with a source of ammonia supply that after conversion into fertilizers, could also be made available for agricultural purposes

The recently discovered phosphate reserves constitute a potential and immediate source of phosphate fertilizer supply for Burundi and neighbouring countries. Tests should be initiated to determine the most suitable method of beneficiation as well as the industrial and commercial value of the phosphate ore

Country: **Burundi**

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976/77	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1976/77	Total Consumption %total	Area fertilized %total	Forecast 1980
Tea	4	4.8	25-5-5	400	1,360	1	100	1,700
			KCl	100	150	67		300
			TSP	(new plantings only)	130			80
Coffee	40		Urea	50	380	16.0	20	500
Cotton	6.9		ASM (26N)	200	270			300
Paddy	3.5		TSP($45P_2O_5$)		70	17	20	120
			KCl($60 K_2O$)		80			100
Beans	530							
Cereals (maize)	300							
Total:	2,200	2,200	**Total consumption:**		2,440			3,100
			of which compounds:		1,360			1,700

Country: Burundi

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1977	1980
NPK: 25-5-5(-5S)	tea							1,300	1,280	1,360	1,700
Straight: urea (46N)	coffee							500	400	380	500
SAM (26N)	cereals, beans cotton, paddy							300	?	270	300
TSP	tea, beans							500	?	200	200
KCl/KSO_4	tea, cereals, cotton, beans							200	?	230	400
Total consumption:				1,368	1,309	1,412	1,679	2,800	1,680	2,440	3,100
of which compounds:									1,300	1,360	1,700

Central African Empire (CAE)

Fertilizer use development

Fertilizers in the CAE are mainly used for coffee and cotton growing. Consumption has shown an erratic pattern of growth in the past. Whereas demand by coffee estates, at present some 1,000 tons per year, is consistent, that by small growers of coffee and cotton has been subject to sharp fluctuations.

An upward trend in consumption was noticeable in the period 1968-75, reaching a total of 7,300 tons in 1972. It dropped sharply after 1975 to around 2,000 tons, once the European Development Fund ceased to participate in the financing of imports.

The use of compound fertilizer is confined to estate farming (coffee) while the small grower uses mainly straight nitrogenous fertilizer, i.e. urea and sulphate of ammonia.

It is anticipated that consumption remains stagnant because of problems concerning the financing of imports and subsidies in view of the high prices at which fertilizers are landed, and those concerning the transport and handling of fertilizers over long distances including several transshipments.

Supplies, marketing and distribution

The coffee estates procure their supplies through the Agency of SCAEPC (Société Centrafricain des Engrais et des Produits Chimiques), a subsidiary of the Société Commercial de la Potasse et de l'Azôte. The CCSP (Caisse Centrafricaine de Stabilisation et de Péréquation) imports and supplies fertilizers to the small growers of coffee, cotton and other crops. Supplies originate from Europe mainly and are forwarded through the ocean port of Point Noire, from where they are subsequently railed (540 KM) to the river port of Brazzaville prior to arriving at Bangui by barge along the Congo and Bangui Rivers (1200 KM). The river voyage is normally completed in 10 to 14 days. Yet it takes usually $1\frac{1}{2}$ to 2 months for fertilizer arrivals at Point Noire to reach Bangui because of delays at the points of landing and transshipment.

Because of the poor navigability of the Bangui River in the period February-May and the need of having supplies at the spot well in advance of the cropping season, which starts in June, fertilizer orders have to be placed latest in October to ensure delivery at Point Noire in December/January. Whereas river transport facilities and storage capacity at Bangui (8,000 tons) and in the interior (18 units: total capacity 4-5,000 tons) are adequate to handle the country's present requirements, fertilizers often arrive too late in the season because of congestion and delays in the Port of Point Noire. As a result they have to be stored either at Point Noire or at Brazzaville until water levels in the Bangui River allow for inland forwarding.

The distribution of fertilizer from Bangui to the cotton growers in the interior takes place by truck and is handled by the Ministry of Agriculture. On the other hand, other purchasers of fertilizer have to procure their supplies from the stores of either the CCSP or the SPAEPC at Bangui. Fertilizer imports are usually delivered CIF Bangui and transported inland at an average cost of CFA 13,500/ton ($60.-) which amounts to an average of US cents 3.4 per ton/kilometer.

For 1977 the following prices per ton of bagged material were noted (1 US dollars = CFA 230).

Prices	Urea		Sulphate of ammonia		Compounds (20-10-10)	
	CFA	$	CFA	$	CFA	$
Delivered cultivator	89,646	390	73,390	319	-	-
Inland transport/ handling	13,500	60	13,500	60		
CIF Bangui	76,146	330	59,890	259	80,000	348
Transport/handling commission:Point Noire Bangui	15,340	67	15,340	67	15,340	67
CIF Point Noire 1/	60,806	263	44,550	193	64,660	281

1/ The small size of the individual lots ordered, i.e. 200 - 300 tons, a time and the shipment on liner terms, partly explains the high delivery price for fertilizers at Point Noire.

Fertilizer for the use on cotton are supplied to the farmers on credit for payment in kind after harvest at a value of CFA20,000/ton only. Sales prices for other supplies ex-CCSP-warehouse Bangui include a 10% rebate on landed prices.

Raw materials

Little prospecting and exploration work has been carried out in the Central African Empire. Information on the availability of raw materials suitable for fertilizer manufcturing is,therefore, scanty. There are indications for the occurence of petroleum in the extension of the same geological formation, where neighbouring Chad has found crude oil in sizable and commercially exploitable quantities. Yet, exploration work carried out over the past 5 years has not yielded tangible evidence.

In addition, and apart from lignite, no coal deposits have so far been traced, while the development of the country's hydro-power potential stagnates in the absence of electricity off-take by large scale consumers.

Potash-felspars occur in abundance but so far there are no indications for potash-salt formations.

The only asset of commercial significance, apart from diamonds, concerns the uranium-bearing phosphate deposit of Bakouma , some 500 KM north-east of the capital Bangui. It has been discovered some 15 years ago and has since been the subject of several studies and investigations. ALUSUISSE, which together with the State and French interests, participates in URCA (Société de l'Uranium Centrafricain), the company established for the exploitation of the deposit, has recently completed a comprehensive feasibility study.

The uranium occurs in phosphatic clays, either dispersed or in the form of a secondary mineral in association with calcium and phosphate (autunite) or with aluminium (chalcolite). Reserves are assessed at 6.6 million tons, containing at an average 0.25% UO_2 and 25% P_2O_5.

The process chosen for extraction is based on the dissociation of the uranium from the phosphate by acidulation of calcined mineral with sulphuric acid.

The uranium will be recovered from the acidulant by extraction with an organic solvent. Recovery is given as 94% effective. The proposed installations envisage a daily treatment of 80 tons of mineral, yielding some 1,500 tons of uranium worth 150 million dollars per year.

Resulting phosphoric acid will, according to the study, be disposed off as a waste, after neutralization with dolomitic limestone, the rock from which the deposit has been formed. The quantity involved amounts to some 150,000 tons of P_2O_5 per year, equivalent to over 300,000 tons of solid waste.

By using the phosphate-rich seams of the deposit as neutralizing agent, instead of dolomite, a valuable source of phosphatic fertilizer, i.e. TSP may be produced, of which the market value would substantially contribute to the financial and economic viability of the venture.

The project is stalled at present because of infrastrucural problems and the need of shipping in sulphur (100 - 130,000 tons/year) by air in the absence of supplies from domestic sources.

Bulk blending

In the absence of a captive market for compounds and fertilizers in general, the country has at present no need for a formulation plant, based on imported intermediates, or even bagging facilities for imports in bulk at the spot or at an ex-territorial location near the sea port of Point-Noire or the river-port at Brazzaville.

Prospects for the local manufacturing of fertilizers

The uranium project, if implemented, would provide the country with a potential source of phospharic acid, which with a minimal of additional investments, could be converted into TSP for local use and export purposes.

A critical evaluation of the ALUSUISSE study should be undertaken to assess flexibility of in-build capacities of the envisaged installations for meeting the additional requirements of electricity and heating gas (calcination of the mineral, concentration of the acid), to determine the kind and amount of investments in additional mining, mineral treatment, power generation and processing which are required to concentrate and convert the "waste" phosphoric acid into a granular TSP product, and to evaluate to what extent the exploitation of the phosphate as fertilizer, would improve the financial structure, as well as the viability of the entire project.

Simultaneously, a market study should be carried out to establish the off-take feasibility in both the domestic market and those in the surrounding countries, and to determine the investments required for the transport and storage of the anticipated production, as well as the measures to be adopted to promote the use of fertilizers.

Country: Central African Empire

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1974/77	1980	Fertilizer Recommendations Formula	Kgs/ha	Total Consumption 1977	%total	Area fertilized %total	Forecast 1980
Coffee	30.0		20-10-10 12-12-20	400	1,000	-	-	2,000
			urea	180	390	66	10	
			KCl	100	-			
			TSP	100	-			
Cotton	136.0		urea	50	370			1,000
			sulphate of	+		34	6	
			ammonia	50	360			1,000
Tobacco	1.6		14-14-16 SA TSP					
Roselle	3.6							
Groundnuts	80.0							
[illegible]	33.0							
Maize	40.0							
Rice	11.0							
			Total consumption:		2,120			4,000
			of which compounds:		1,000			2,000

Country: **Central African Empire**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980
NPK: 20-10-10 12-12-20	**Coffee**	-	-	3,600	4,000	1,000	1,000	2,000	1,000	1,000	1,300	1,600	2,000
Straight: sulphate of ammonia (21N)	**Cotton**	-	-	1,040	1,100	100	1,100	100	500	360	1,285	1,500	1,000
Urea	**cotton coffee**	-	-	1,340	1,400	700	1,900	400	450	760	1,115	700	1,000
TSP (45%)	**coffee**	-	-	400	400	400	400	-	-	-	-	-	-
Ammon.phosphate (22-25)	**cotton**	-	-	50	50	50	1,050	50	-	-	-	-	-
KCl/K_2SO_4	**coffee**	-	-	400	400	400	450	-	50	-	-	-	-
Total consumption:		1,175	2,700	6,830	7,300	2,650	5,900	2,550	2,000	2,120	3,700	3,800	4,000
of which compounds:													

Chad

Fertilizer Use Development

Fertilizer use in Chad amounted to only 6,000 tons in 1971 but increased in 5 years time to over 15,000 tons of which 12,000 tons compounded materials, accounting for 80% of total consumption.

The main formulation, i.e. 19-12-19 sulphur based and containing borium, was exclusively used for cotton. It has recently been replaced by a modified version, i.e. 22 - 12 - 18 somewhat higher in nutrient content.

The accelerating growth in consumption was mainly due to the expansion of the area under intensive cotton cultivation. Fertilizers were applied to over 60% of the land cultivated with cotton. Cotton also shares with 95% in the country's total consumption of fertilizers.

The use of straight fertilizers, i.e. urea and SSP, is less significant. They are mainly used for rice and groundnut respectively. In the context of the cotton growing expansion plans of the state, consumption of all fertilizers is anticipated to reach 26,600 tons by 1980 of which compounds will account for 80 per cent.

Supplies, Marketing and Distribution

Chad has no fertilizer production of its own and all annual requirements are imported, from overseas (Ivory Coast and Europe) and the established plant near Douala port in the Cameroons.

The state organization, OMRD (Organization Nationale de Developpement Rural) places the orders for fertilizer abroad and distributes the imported materials to the various state organizations in charge of agricultural production programmes of which Coton-Tchad is the most important one. Bagged fertilizer shipped in via Douala (Cameroon) move first to Ngaoundéré by rail (1,050 km) where they are loaded on trucks for further inland transport to Chad (distance 178 km). Those fertilizers which are shipped in via port Pointe Noire (Congo) move first by rail to Brazzaville (515 km) subsequently by river transport to Bangui (Central African Republique) (1,300 km) lastly by truck to Chad (650 km) covering a total distance of 2,465 km.

Another part of the annual imports is shipped in via Warri port (Nigeria), moves along the Benoué River up to Garoua (1,550 km) where they are loaded on trucks for onward transport to Chad (450 km) covering a total distance of 2,000 km.

In spite of its length the transequatorial route was the cheapest in 1976 ($176 per ton) followed by the trans-Cameroon route ($182 per ton) while transport along the trans-Nigerian route costed not less than $208 per ton. Because the maximum quantity that can be evacuated from the ports per rail amounts to 150 - 200 tons/day, the tonnage per shipment seldom exceeds 2,500 tons and it takes at an average 2 months from the time of arrival in port for the materials to reach the central warehouses in Chad along the river routes. For the trans-Cameroon route, the transport from port to Chad is usually completed within 4 weeks.

As a result fertilizers are ordered almost a year ahead of the season and are scheduled for arrival at the various sea ports from 4 to 6 months prior to the start of the new cropping season.

In 1976, the cost of delivery of fertilizers to a central warehouse in Chad amounted to US$280-300 per ton of product (compounds or urea). Because of these high costs, fertilizers have to be heavily subsidized by the state to make them remunerative to farmers (up to 60% for cotton). The fertilizer subsidies are compensated in the price the grower receives for its crop at the end of the season.

Raw materials

No deposits of rock phosphate have been located so far in Chad. On the other hand, crude oil and gas have been discovered recently and plans for a small refinery annex petrochemical industry have been drawn up. In the light here of it seems feasible that the country will sooner or later have its own nitrogenous fertilizer industry.

Prospects for Bulk Blending

The market for compound fertilizers in Chad is large enough to justify the implantation of bulk blending facilities.

Yet, the main cost saving factor, i.e. shipment of materials in bulk, is hardly feasible in the absence of a well-equipped railway system connecting ocean ports with the points of discharge within the country.

Bulk blending in the country could therefore only be contemplated seriously as soon as nitrogenous fertilizers would become available from a local plant.

For both technical reasons and economics of scale, such a plant should have a minimum capacity of at least a 100 tons of ammonia per day (26,000 tons of N per year) to operate viably.

In the meantime, the recently-established fertilizer factory at Douala may relieve much of the country's current supply problems.

Country: Chad

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha)		Fertilizer Recommendations		Total Consumption			Area fertilized	Consumption Forecast
	1976	1980	Formula	kgs/ha	1975	1976	%total	%total	
Cotton: total	290		22-12-18-6S-1.8B	100/150	-	12,090	95	40	
intensive	130	200	urea	50	-	400		(100)	21,000
Groundnut: total	38								
intensive		20	SSP	100		-	-	-	2,000
Rice: total	40								
water controlled	0.8	5.0	urea	100		50	5	2 (100)	600
Millet/sorghum	770					500			1,000
Total consumption:						13,040			26,600
of which compounds						12,090			2,000

Country: Chad

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980
NPK: 22-12-18-65-1.8B	Cotton								12,090	21,000
19-12-19-55-1.8B		-	-	6,000	5,660	4,150	8,600	10,000	-	-
Straight: Urea	Rice, cereals, cotton	-	-	-	-	487	982	915	3,465	3,600
SSP	Groundnuts	-	-	-	-	-	-	-	-	2,000
	Total consumption	-	-	6,000	5,660	4,637	9,582	10,915	15,555	26,600
	of which compounds	-	-	6,000	5,660	4,150	8,600	10,000	12,090	21,000

Ethiopia

Fertilizer use development

Apart from some large estates, the use of chemical fertilizers was virtually non-existent prior to 1967.

Under influence of various agricultural development projects, it started to develop rapidly, from only 4,465 tons in 1967 to about 48,000 tons in 1973, at rate of almost 50% per year. Then it fell back in the years 1974-75 to recover again to 52,000 tons in 1976. DAP, with an average of 75 to 80% in total consumption, predominates the pattern of fertilizer use. It is almost exclusively used on cereals and other foodcrops.

The practice of applying straight fertilizer, i.e. SA, urea and TSP is prevalent in the production of sugar cane, cotton, oil-seeds and pulses.

Teff, a millet, leads the list of crops on which fertilizer use is practised (30% of total consumption in 1975-76). It is followed in importance by oil seeds (13%) and subsequently by wheat, sugar cane, cotton and maize, each sharing with 7-9% in total consumption (1975-76).

Projections made in the years 1974-75 estimated total consumption to reach about 195,000 tons by 1980. This seems to be a far too optimistic picture and a quantity of around 70,000 tons of materials of which some 55,000 tons as DAP would appear to be more realistic.

Supplies, marketing and distribution

There is no local manufacture in Ethiopia and all fertilizers are imported.

Imports originate from Europe, North America, the Middle and Far East and are mainly channelled through the ports of Assab and Djibouti. From there, they are transported by truck and rail to the principal centres of distribution in the interior over distances varying between 800 (Addis Ababa) and 900 km (Harrar).

Transport by road from Assab costed in 1976 US$0.045 per ton-km inclusive clearing and handling, whilst railway transport from Djibouti to Addis Ababa was somewhat higher, i.e. US$0.06 per ton-km inclusive clearing and handling.

Fertilizer shipments usually arrive in port in the period December to April. Due to limited port facilities in Assab and insufficient means of transport to inland destinations, in addition to the railway capacity which is limited to maximum 500 tons per week, delays up to 2-3 months may be experienced before shipments have been evacuated from ports. As a result they often arrive too late in the season of peak demand, which occurs between May and August.

The spreading of arrivals of shipments more evenly over the year and the provision for more and better distributed storage facilities in the interior would certainly alleviate current constraints in distributing fertilizer supplies and pave the road for a more efficient transport system. The procurement, wholesale and retail distribution are at present a monopoly of the government who also fixes the prices to farmers.

In 1976, effective cost per metric ton of product (urea and DAP) delivered to central stores amounted to US$275 to 300 against US$210 - 230 CIF landed. Fertilizers were sold to farmers on credit at a subsidized rate corresponding up to 40% of the effective costs. Considerable amounts of fertilizer donations and aid on concessionary terms were given in the past to Ethiopia to alleviate the financial burden on foreign exchange position and budget.

Raw material supplies

Deposits of sulphur and phosphate rock occur in Ethiopia, but very little is known about them. The country also disposes of natural gas, the vital feedstock for ammonia and nitrogenous fertilizer production, but also here very little is known about it.

The country has, however, important deposits of potash, located in the Danakil Desert. Yet domestic demand for potassic fertilizer is not expected to grow to such extent that exploitation and processing of the deposit would be viable, unless substantial outlets for the product could be found on the world market.

Prospects for Bulk Blending

A comprehensive in-depth study conducted by UNIDO in 1974/75 clearly established the viability of substituting local formulation of bulk fertilizer ingredients for imports of bagged compound fertilizer. The proposal comprised the establishment of a blending cum bagging unit with corresponding transport and port facilities at Assab, having a capacity of 40-50 tons/hour, operating on a one-shift basis (8 hours/day, 300 days/year). The plant would have the capacity of turning out annually about 100,000 tons of blended materials at average cost of $12.7 per ton.

The output of the same installations could be doubled in accordance with market demand growth by introducing a second shift, thereby reducing operating costs to $7.60 per ton of product (figure covers handling, mixing, bagging but excludes cost of bags)

Savings in foreign currency were estimated at 13-15% while the price of fertilizer could be reduced by 9-10%. The internal rate of return on investments totalling $5.2 million was calculated at 24%.

In addition, the establishment of a bulk blending/bagging unit at the port of Assab would certainly contribute to a timely and more efficient distribution of fertilizers to the consumer.

Investments

Total cost of investment for the proposed mixing plant amounted in 1975 to US$2.6 million of which US$1.6 million were allocated for design, procurement and erection of blending and bagging equipment, cost of transport and handling equipment at the port site and in the plant; the balance for civil works, buildings, auxiliary services and pre-operational expenses. The figures quoted for machinery and equipment costs are still valid today.

Country: Ethiopia

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976/77	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1975 1976 Average	Total Consumption %total	Area fertilized %total	Forecast
Teff	2,200	2,400	DAP 16-48 urea	50 14	13,500	30.1	10	
Wheat	1,100	1,300	DAP urea	50 30	3,900	9.0	4.5	
Barley	1,800	1,900	DAP urea	50 14	2,600	6.0	2.3	
Maize	900	1,000	DAP urea	75 45	3,000	7.0	2.8	
Sorghum	1,200	1,300	DAP urea	50 14	2,000	4.5	2.6	
Dagussa	300	300	DAP	50	1,700	3.8	11.0	
Pulses	900	1,000	DAP	50	2,600	6.0	6.0	
Oilseeds	900	1,100	DAP urea	50 25	6,000	13.6	9.0	
Fruit/vegetables	-	-	DAP urea	50 50	700	1.6	-	
Peppers	250	275	DAP urea	75 25	600	1.4	-	
Sugar cane	9	9.7	urea SA	- -	1,300 2,600	9.0	-	
Tobacco	1.4	1.4	15-15-15 K_2BO_4	- -	50	-	-	
Cotton: total	300	700		-	-	-	-	
intensive	45.7	70	urea	75	3,500	8.6	100	
Total consumption: (average 1975/76)					44,000			195,000
of which compounds:					36,600			131,000

Country: Ethiopia

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980
NPK: 15-15-15; 20-20 23-23	tobacco	1,006	2,101	-	-	-	1,300	12,000	5,600	-
NP: 16-48	cereals pulses oil seeds	378	3,315	14,711	13,737	41,810	22,700	18,900	34,000	131,000
Straight: SA (21 N)	sugar cane tobacco)	517	4,720	2,331	3,141	2,881	2,260	2,300	2,600	3,000
urea (46 N)	cereals sugar cane)						2,600	5,200	4,400	61,000
TSP (46 P_2O_5)	oil seeds pulses	118	533	5,534	396	3,377	400	1,600	5,600	-
KCl/K_2SO_4	tobacco	48	106	51	100	-	90	180	-	-
Total consumption:		2,067	10,775	22,627	17,374	48,068	29,350	40,180	52,200	195,000
of which compounds		1,384	5,416	14,711	13,737	41,810	24,000	30,900	39,600	131,000

The Gambia

Fertilizer Use Development

Consumption of fertilizer in the Gambia reached a total of 3,700 tons in 1976 of which only 450 tons (12%) of compounds. They have mainly been used for groundnuts in the form of SSP (3,000 tons).

With the exception of the period 1970-72, the use of fertilizer has remained stable. It implies that about 20% of the cultivated area has been regularly fertilized.

Compound fertilizers in use for rice and cotton, i.e. 300 and 150 tons respectively, hardly play a role or importance in the consumption pattern.

It is anticipated that by 1980 consumption will reach anything between 9,000 and 12,000 tons with compounds between 1,000 and 2,000 tons.

Supplies, Marketing and Distribution

Fertilizers are imported into Gambia by the GPMB (Gambian Produce Marketing Board), a semi-autonomous organization in charge of the marketing of groundnuts and other exportable agricultural commodities.

Supplies mainly come from Europe or from the plant at Dakar in Senegal. Fertilizers, upon arrival from overseas, are stored and distributed by GPMB to individual growers and co-operatives on credit and at subsidized prices (up to 70% of the costs, which amounted to 160 - 170 dollars per ton in 1976). As a result fertilizer use in the Gambia is very remunerative to farmers. Yet, no more than 20% of the area under groundnuts regularly receives fertilizers.

Raw materials

The Gambia does not dispose of any raw materials for the manufacture of fertilizers.

Prospects for Bulk Blending

In the absence of any market of importance for compound fertilizers there is virtually no need for contemplating the installation of bulk blending facilities.

Country: **The Gambia**

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha)		Fertilizer Recommendations		Total Consumption			Area fertilized	Consumption Forecast
	1976/77	1980	Formula	Kgs/ha	1975	1976	%total	%total	1980
Groundnuts	115	130	SSP	125	-	3,000	82	20	8,000 - 10,000
Rice: total	25		20-20-0	200		300			
irrigated	1,9	5.0	urea			200	14	94	1,000-1,500
Cotton	1.3	2.4	16-20-0	125		150	4	100	300
			Total consumption:			3,650			9,000 - 12,000
			of which compounds:			450			1,000 - 2,000

Country **The Gambia**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980
NPK: 14-6-0	Rice	100								
20-20-0	Rice		250							
25-10-0	Rice			500	900	1,490	1,500			
20-10-0	Rice							2,000	300	1,000-1,500
12-12-18	Cotton					200				
12-12-17-25	Cotton						2,000	-	150	300
Straight: SSP(18-20 P_2O_5)	Groundnuts	2,200	1,200	300	850	2,500	2,456	2,700	3,000	8,000-10,000
urea (46 N)	Rice								220	-
Total consumption:		2,300	1,450	800	1,750	4,190	5,956	4,700	3,670	9,000-12,000
of which compounds:		100	250	500	900	1,690	3,500	2,000	450	1,000- 2,000

Guinea

Fertilizer use development

Guinea is one of the least developed countries where fertilizer consumption is marginal. There is no consistent use of fertilizer on a scale that could be taken as the basis for the assessment of likely future market developments and consumption trends. In spite of the fact that climatic conditions are favourable and hence the potential for consumption of large quantities of fertilizer seems obvious, farmers are not motivated to apply chemical fertilizer. The country lacks raw materials as hydrocarbon feedstocks and minerals for the production of any type of fertilizer. On the other hand lack of foreign exchange for importing fertilizer has hampered development of local demand and marketing facilities. In recent years some small quantities of fertilizer were made available through the International Fertilizer Supply Scheme of FAO.

Furthermore, there are no fully representative statistics which might seriously be considered and taken as guidance in connexion with the Government's intention to establish fertilizer manufacturing facilities in the country.

FAO has been requested by the Government to provide assistance in increasing agricultural production FAO project production. FAO projects will be designed to improve farming methods and will surely lead to increased demand for fertilizer. Ultimately the project outputs may be expected to develop a consistent pattern for application of fertilizer on certain crops and plantations. However, no work is underway to establish a long term agricultural input programme for the country in general. A satellite soil survey is being conducted by FAO and is expected to provide the basis for a countrywide cropping pattern in Guinea.

Agricultural development is of top priority within the Government's Plan of Development of the Country's Economy. It may be anticipated that in few years from now the importance of fertilizer use will appropriately be recognized in practical terms. But it will take some time to establish the prerequisite efficient infrastructure to handle agricultural inputs and produce, in parallel with development of the fertilizer industry.

Supplies, marketing and distribution

As delineated in the foregoing paragraph it is difficult to present a meaningful set of statistical background data. With reference to the annexed tables which were compiled from various sources it may be noted that fertilizer consumption is insignificant relative to the large area of agricultural land available.

Fertilizer import, marketing and distribution is handled by state enterprises on a case to case basis when foreign exchange is available for purchasing or when fertilizer material becomes available through foreign aid programmes providing technical assistance and inputs in kind. Consequently it might be considered premature for the Government to establish a fertilizer marketing and distribution organization.

Consumption tends

The scarcely available supplies of fertilizer were used on few large Government plantations. Individual farmers are so far not motivated to use fertilizer because of low official prices of food crops, and for other obvious reasons, as lack of continuity of supply which naturally impedes development of a seizable market demand. Furthermore, it is not known so far what types of fertilizer should have preference. The Government's plan to establish a fertilizer mixing plant is based on vague quantitative and qualitative assumptions giving preference to blended and granulated NPK fertilizer in order to introduce a wide range of NPK mix whatever the future market demand will be.

It may be anticipated that a clearer picture will develop in connexion with the forthcoming Norwegian fertilizer aid programme which is expected to combine delivery of fertilizer material and provision of agricultural extension services relating to fertilizer use, farmer's training and advice on marketing and distribution systems.

Raw materials supply

Guinea does not dispose of any of the fertilizer materials needed for the bulk blending/granulation plant. The country is not endowed with raw materials for manufacture of chemical fertilizer. The second phase of development of the fertilizer industry planned by the Government will also have to be based on imported raw materials and intermediates for at least 10 years from now until geological research is successfully concluded with discovery of crude oil, natural gas or phosphates in commercial quantities. In addition to ongoing exploration for bauxite and ore minerals the Government is seriously considering expansion of the research programme to include search for raw materials for the chemical industry and fossil fuels.

Because of the humid climate fertilizer the distribution system is bound to handle initially only bagged products. There is no PE/PP production in the country. Bags have to be imported and will thus increase the foreign exchange requirements for implementation of a consistent fertilizer programme.

Development of the fertilizer industry

The Government intends to establish fertilizer manufacturing facilities in Guinea and has allocated high priority to making the necessary preparations. The subject is presently being studied by a foreign company which is interested in contracting for construction of the fertilizer granulation plant on turn-key basis. In this connexion UNIDO has been requested to provide ad-hoc expertise and long term consultancy services. The following capacities are considered by the Government plan :

Phase I. Two units for blending and granulation and bagging of imported fertilizer material. Capacity 50 000 mtpy each.

Phase II. Fertilizer manufacturing plant of up to 350 000 mtpy total capacity to produce single nutrient components for the mixing plant and marketable straight fertilizer material (N, P, and/or NP) based on imported raw materials.

The Government intends to locate the fertilizer complex 32 km from Conakry. Implementation of Phase I and II is scheduled to take 2 and 3 years respectively.

Prospects for bulk blending and bagging

The Government decision concerning the establishment of a bulk blending granulating and bagging plant may be understood as a firm intention to develop a fertilizer industry in the country regardless the costs involved. The feasibility study being presently under preparation by a foreign fertilizer company will provide a preliminary assessment of the economic viability of the project. Under prevailing conditions it is difficult to suggest a viable scheme unless in depth studies are made to establish a realistic view on raw materials and fertilizer import price forecasts. As there is almost no fertilizer consumption in the country it appears also difficult to assess what share of the total demand will be covered by application of single nutrient fertilizers or whether demand for certain types of NPK formulations will be large enough to justify investment in 2 x 50 000 mtpy granulation units which are scheduled to be on stream in 1980/81.

As a result of these consideration made by UNIDO staff after having visited Guinea in May this year, UNIDO suggested that the Government should request UNIDO assistance. The Government needs to be provided with impartial advice relating to the feasibility of the chemical fertilizer complex including ship unloading, bagging and distribution facilities for the first phase of the development scheme. Some of the facilities will anyway be needed as a consequence of the Government's intention to increase consumption of fertilizer by securing steady supplies of imported products.

The very humid climate will pose considerable technical constraints on bulk unloading, storage and bagging of fertilizer material, particularly during the long rainy season. Air conditioning of storage facilities may render the project not competitive in comparison with importation of bagged fertilizers. A final appraisal of the situation will most likely be made by the Government in due course in connexion with the preliminary feasibility report which is being prepared by a consulting company.

A N N E X I

I. G E N E R A L I T E S

B. UTILISATION DES TERRES (Unité : 1000 ha)

SUPERFICIE TOTALE : GUINEE : 24.586
AFRIQUE W. : 613.338 (Guinée 4,0 %)
AFRIQUE TOTAL : 3.031.163 (Guinée 0,8 %)

	S.A.U.		TERRES ARABLES						PATURES PERMANENTES		FORETS		AUTRES SURFACES		
			TOTAL		CULTURES PERMAN.		IRRIGATION								
	% St		% S.A.U		% Ta		% Ta		% S.A.U		% S A U		% St		
(a)	32,5	7.996	49,4	3.950	1,8	70	0,3	11	37,5	3.000	13,1	1.046	67,5	16.590	
(b)	51,1	313.547	24,4	75.599	5,1	3.940	0,3	194	44,2	138.707	31,3	98.241	48,9	290.916	1961–65
(c)	54,9	1.663.154	11,5	120.453	6,3	11.930	3,1	5.891	48,5	805.343	40,1	666.358	45,1	1.363.014	
(a)	32,8	8.076	49,9	4.030	1,7	70	0,5	12	37,1	3.000	13,0	1.046	67,2	16.510	
(b)	51,0	313.039	25,3	79.351	5,5	4.369	0,3	237	44,1	138.028	30,6	95.650	49,0	291.132	1966
(c)	54,6	1.654.249	11,9	197.031	6,6	13.082	3,3	6.465	48,5	801.991	39,6	655.227	45,4	1.376.919	
(a)	33,3	8.176	50,5	4.130	1,7	70	0,4	15	36,7	3.000	12,8	1.046	66,7	16.410	
(b)	51,0	312.951	26,5	82.940	5,0	4.122	0,4	292	44,2	138.309	29,3	[illegible]	49,0	291.572	1970
(c)	54,5	1.650.644	12,4	204.844	6,5	13.327	3,4	7.020	48,4	799.280	39,2	[illegible]	45,5	1.380.524	
(a)	33,4	8.216	50,6	4.170	1,7	70	0,5	20	36,5	3.000	12,7	1.046	66,6	16.316	
(b)	51,0	312.903	26,8	83.837	5,1	4.241	0,4	358	44,4	138.835	28,8	90.180	49,0	291.336	1975
(c)	54,4	1.649.913	12,8	210.890	6,7	14.146	3,6	7.657	48,4	798.105	38,8	640.918	45,6	1.381.171	

(a) - GUINEE
(b) - AFRIQUE W.
(c) - AFRIQUE TOTAL

ANNEX II

A. Source : Computer print-out FAO Statistical Division May 1978

	Nitrogen		MT	N	Phosphate		MT	P_2O_5	Potash		MT	K_2O
	1973/74	1974/75	1975/76	1976/77	1973/74	1974/75	1975/76	1976/77	1973/74	1974/75	1975/76	1976/77
Production	-	-	-	-	-	-	-	-	-	-	-	-
Imports	800*	650*	600*	600*	100*	450	400*	300*	100*	728	500* 1000*	400
Export	-	-	-	-	-	-	-	-	-	-	-	-
Consumption	800*	650	600*	600*	100*	450	400*	300*	100*	728	500* 1000*	400

Note: * FAO estimate or non-official data

B. Source: Annual Fertilizer Review FAO 1976

	I Consumption of Fertilizer per Agricultural Area unit: 100 Gram per HA				II Consumption of Fertilizer per Arable Land and Permananet Crops unit: 100Gram per HA				III Consumption of Fertilizer per capita unit: 100 Gram per capita			
Fertilizers:	1961-65	1966	1970	1975	1961-65	1966	1970	1975	1961-65	1966	1970	1975
Nitrogeneous	1	1	2	1	1	2	4	1	2	3	4	1
Phosphate	1	1	1	1	1	1	1	1	1	1	1	1
Potash	2	3	NA	1	3	5	NA	2	4	6	NA	2
Total	3	5	3	3	6	9	5	5	7	10	5	5

Note: discrepancies due to rounding

ANNEX III

Source: Tennessa Valley Authority - National Fertilizer Development Centre (Computer print-out 1978)

		1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
		(THOUSAND METRIC TONS NUTRIENT)													
*** GUINEA															
CONSUMPTION	N	0.5	0.8	0.5	1.0	1.0	1.0	1.0	1.5	1.6	1.7	0.8	0.6	0.5	0.5
	P2O5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.4	0.4	0.3
	K2O	0.9	1.8	2.0	2.0	2.0	1.0	1.0	1.0	1.2	1.0	0.1	0.7	0.5	0.4
SUPPLY	N	0.5	0.8	0.5	1.0	1.0	1.0	1.0	1.5	1.6	1.7	0.8	0.6	0.6	0.6
	P2O5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.1	0.1	0.1	0.4	0.4	0.3
	K2O	0.9	1.8	2.0	2.0	2.0	1.0	1.0	1.0	1.2	1.0	0.1	0.7	0.5	0.4
DIST LOSS &	N	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	P2O5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
	K2O	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

Malawi

Fertilizer Use Development

Consumption of fertilizers in Malawi has expanded gradually in the period 1972 - 1977 at an average rate of 5% per year from 67,000 tons to almost 87,000 tons.

The principal types of fertilizers are various NPK and NP formulations (41% of total consumption) which are mainly used in tobacco and tea plantations, and sulphate of ammonia (46% of total consumption) which is used in tea, sugarcane maize and paddy cultivation. Other straight fertilizers, such as calcium ammonium nitrate and urea make up the balance of consumption.

Phosphate and potash are mainly applied in the form of compound fertilizer. Tobacco, with an average share of 29% in total consumption, is by far the largest consumer of fertilizer. It is followed in importance by tea (16%), sugar cane and paddy, each with about 8% in total consumption (1976). The so-called customary sector of farming (small holders growing maize, beans, cotton and also tobacco) used not less than 25,000 tons or 37% of total consumption in 1976. It is the latter sector in particular which holds a great potential for further expansion in fertilizer use. It is anticipated that by 1980 consumption will have passed the 100,000 mark. This figure may even turn out to be higher, if infrastructural problems concerning transport, storage and handling could be solved in due course.

Supplies, marketing and distribution

As no fertilizers are manufactured as yet, Malawi was to procure all its annual requirements from abroad. Major suppliers of fertilizers to the country are South Africa, Europe, Japan and the Middle East. Prior to the closure of the Rhodesian border, a significant part of the imports use to be hauled in by rail in bulk. At present all imports are in bags and handled through the ports of Nacala (40%) and Beira (60%) in Mozambique. From there they are transported by rail to the major centres of distribution in the country over distances of 500 and 355 miles respectively, at an average rate of US dollars 0.04 per ton/mile (US dollars 0.022 per ton/kilometer).

As the main period of sales starts in March and last until August/September, orders are placed in the last quarter of each year. Shipments are scheduled to arrive in the first half of the year (February - June). The average tonnage per shipment varies between 2,500 - 3,000 tons from Durban and 8 - 10,000 tons from Europe or Japan. Due to constraints in the ports, where unloading rates seldom exceed nowadays 600 tons per day and because of insufficient stores equipped adequately with railway-sidings and handling facilities in Malawi, the railways are not able to arrange for full train loads (1,000 tons) during the 5-month period that shipments arrive. Turn-around time for waggons, which should be less than 14 days, is at present not less than 30 days and the Malawian railways are unable to haul more than 10,000 tons of materials a month.

As a result the bulk of the arrivals (over 60%) has to be stored first at the port-site prior to being hauled inland. Because of the logistic problems, it nowadays takes an average of 2 to 3 months for supplies to reach the country, often too late for the season.

Distributing arrival of shipments from abroad more equally over the year is difficult to implement in the absence of sufficient storage capacity in Malawi.

Fertilizers are procured through the agency of OPTICHEM, a private company, which acts as wholesale distributor for estate farmers (tea, sugarcane, tobacco) and to ADMARC (Agricultural Development and Marketing Corporation), a semi-public organization, which undertakes the retail distribution of fertilizers to the customary sector of farming (tobacco, maize, paddy and cotton).

ADMARC handles some 50 per cent of the country's fertilizer sales. Current quotations for fertilizer sold ex-central warehouse at Limbe and Lilongwe amount for urea (46N) to K 193 per ton ($230);

for CAN (26N) to K 150 per ton ($188); and

for AS (21 N) to K 142 per ton ($170).

Deducting K 12 for railing and another K 12 per ton for handling, clearance, duties and commissions, then the cost at which urea is delivered free out Beira/Nacala amounts to about K 170 or US dollars [illegible] per ton.

Fertilizers are mainly sold for cash to small growers at a standard price which is annually fixed and which includes a subsidy of about 10% that broadly covers costs for local transport and distribution.

Raw materials

Malawi has no deposits of petroleum, and it is unlikely that they may exist. Coal is known to occur at various locations. Those at Ngana in the north, have been explored and studied to a great extent. The coal of this deposit may be graded as sub-butimous non-coking coal. Run-of-mine reserves are estimated at 7 million tons. Yields of washed coal product having a caloricvalue of only 24 MJ/kg.(5,700 Kcal/kg.) and an average ash content of 17.5%, are estimated at 3.5 million tons or 50% of the proven reserves. No appreciable quantities can be mined by open-pit and at an annual rate of production of 200,000 tons, mining life would not last for longer than 17 to 20 years. The country has a vast potential for hydro-power generation. Installed capacity at the Tedzani and Nkula Falls amount to 55 MW with a potential for some 400 MW. An expansion project, presently under construction, will add another 40-60 MW to the power ratio generation capacity. The existing infrastructure at Nkula Falls alone leaves a spare capacity of some 50 MW which could be tapped by installing additional turbines and power generating equipment.

Phosphate rock deposits occur at Tundulu near Lake Chilwa and Chingale in the very southern part of the country. Both occurences are of igneous origin. Those at Tundulu include carbonatite and felspar breccia, while the Chingale deposit of apatite occurs in weathered pyroxenite rock. Apatite of the Tundulu deposit consists of finely-grained Pinkish coloured particles constituting 30 to 90% of the ore body by volume.

Latest investigations based on core-recovery yields of 90-100%, reveal reserves up to 1.25 million tons averaging 15% P_2O_5. They include a richer zone, containing 900,000 tons averaging 22% P_2O_5. Laboratory analysis gave as major gangue minerals: quartz, calcite, altered felspars and ankerite. Tests indicated that the apatite is potentially available for recovery at a probable grade of 36.6% P_2O_5. Little preferential sliming of iron minerals was observed, indicating that no serious problem for the liberation of the apatite by a selective

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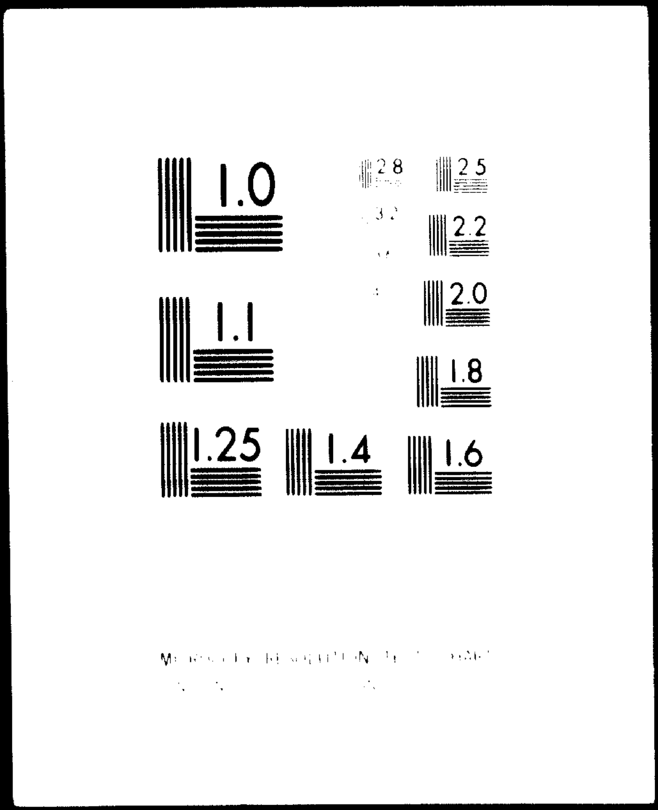

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floatation process would occur.

The chingale apatite rock has not been studied to the same extent. Reserves are estimated at 0.22 million tons with an average grade of only 3.8% P_2O_5. Whereas mining of the latter deposit would appear to be much easier because of the weathered character of the rock, the industrial value of the Tundulu deposit is distinctly better and by far the most promising of the two deposits.

Iron pyrite and pyprhotite bearing quartz gneisses occur at four different locations. The mineral is mainly disseminated in fine grains throughout the rock or it occurs in irregularly shaped patches and veins. It is estimated that some 2.5 million tons of sulphur is contained in some 34 million tons of rock at a grade of 8 to 10%. The deposit at Chisepo situated some 25 miles north-west of Lilongwe, having an estimated reserve of some 1.3 million tons of sulphur, appears to be by far the most promising as regards quality and quantity. Besides, the ore containing rock is suited to open cast mining.

There are no known deposits of potassic salts but potash-rich felspars have been located at various places.

Bulk Blending

OPTICHEM has recently installed a steam-granulation plant at its works near Blamtyre.

The plant has a capacity of 10 tons per hour (60,000 tons per year) and is capable of formulating and granulating most of the NPK compounds the country needs.

Sulphate of ammonia, CAN, MAP, TSP, SSP and potash salts will be used as intermediates. They have to be imported in bags, losing the price differential (22-25/ton) as compared to imports in bulk.

The cost of machinery, equipment and auxiliaries (furnace, boiler) is estimated at 2 million dollars. Fixed costs at a 100% utilization rate of installations, are therefore not less than US dollars 3 per ton. The compounds as demanded by the market could have easily been produced by the simple technique of bulk blending crystalline of granular intermediates. The cost of investment would have been no more than US dollars 250,000 and fixed costs less than US dollars 0.4 per ton.

As the operational costs for a granulation plant are usually 8 to 10 dollars higher than for a bulk blending unit, an element of cost increase rather than reduction has been introduced by installing a steam-granulation plant.

Prospects for the local manufacturing of fertilizers

The market for nitrogenous fertilizer, as anticipated for the early 80's, the cost at which they are at present delivered and the logistic problems associated with the large tonnage of imports to be hauled inland, would seem to justify considerations for the manufacturing of such materials from locally available energy or raw material resoures.

It would be technically feasible to manufacture ammonia from the Ngana or other coal deposits. Yet, the quality of the (upgraded) coal and more in particular its low C.V., varying and relatively high ash content, will pose difficult engineering problems. Producing ammonia from coal would also require relatively high investments in processing installations and off-site facilities and a highly-skilled team to run the plant. Based on an ex-pit coal price of some $20 per ton, ammonia manufacturing costs would be not less than $250 per ton. Besides, the limited life time of the coal reserves at Ngana makes it very doubtful whether the investments in such a venture would be justified. Hydro-power, on the other hand, offers Malawi an economic as well as an operationally attractive alternative to coal. Employing the full potential of the Nkula Falls would only require investments in additional power generation facilities.(turbines, generators) Investments in ammonia production facilities will be limited to electrolysis units, air-fractionating unit and ammonia synthesis loop together with compressors.

Nevertheless, to produce ammonia for less than US dollars 200 per ton will imply that electricity should be made available to the plant below a rate of US mills 10 per KWH, which is feasible.

With regard to phosphatic fertilizer production, the ore at Tundulu has sufficiently been studied to qualify it as a potential source of raw material for phosphoric acid and fertilizer manufacturing in Malawi. Yet, the small size of the market (3000 tons of P_2O_5) would not justify the implantation of installations that would have to operate below an economically justifiable scale of 10,000 tons of P_2O_5 per year unless a captive source of low-cost sulphuric acid would become available.

The pulp and paper project, scheduled for implementation in the northern parts of the country would require annually some 50,000 tons of sulphuric acid. On this scale, the production of acid from local pyrites would certainly be economically viable. It would also offer an opportunity of supplying, low cost acid to a small phosphate ore processing plant, producing a product at a price that would be acceptable to the market.

A decisive answer as to the viability of the manufacturing of various fertilizers from local resources, can only be provided by an in-depth feasibility study so as to determine which technology, raw materials and scale of operations would ultimately be the best in the interest of the country's economy.

Country: **Malawi**

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1968/69	1980	Fertilizer Recommendations Formula	Kgs/ha	Total Consumption 1975	1976	%total	Area fertilized %total	Forecast
Estate farming									
1. **Maize**			30-20-10	150	440	1,700	2.4	100	
2. **Tobacco**	26		CAN		4,368	3,900			
			nitrate of soda		358	650			
			2-18-15(S)		470	480			
			6-18-15(S)		8,288	11,800			
			4-18-15(S)		3,584	2,500			
			6-18- 6(S)		308	400			
			Others		866				
					18,242	19,730	29.0	100	
3. **Tea** (1976)	17		25-5-5		4,888	6,990			
			SA		5,819	6,765			
					10,707	10,755	16.0	100	
4. **Sugarcane**	9.6		SSP/TSP		250	530			
			KCl/K_2SO_4		820	1,313			
			SA		7,400	3,800			
					8,470	5,643	8.0	100	
Small Scale Farming									
5. Rice	48		20-20-0		1,200	1,300			
irrigated(1976)	3		SA		3,800	4,000			
					5,000	5,300	7.6		
6. Various projects			SA		13,656	19,611			
Maize	1055		20-20-0		1,367	2,848			
Cotton	36		CAN		1,312	1,351			
Tobacco	34		Urea		210	133			
			Mixture		804	1,293			
					17,349	25,236	37.0	12	
Gardening			SA		392	750			
			Total consumption:		60,600	69,114			
			of which compounds:		21,411	29,311			

Country: Malawi

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1977	1978	1980
NPK: 25-5-5	tea				7,967	7,321	3,686	4,888	6,990	9,000	10,800	13,000
3-2-1	maize						552	440	1,700	2,575	2,500	3,000
A: 2-18-15	tobacco				251	683	457	470	480	630	1,000)	
B: 4-18-15	"				2,756	2,937	3,399	3,584	2,500	2,679	2,500)	
C: 6-18-15	"				4,651	5,274	7,827	8,288	11,800	14,433	13,500)	
D: 8-15-10	"				224	195	30	33	-	-	-)	20,000
L: 8-10-15	"				664	394	457	495	-	-	-)	
M: 10-12-12	"				249	97	70	242	-	-	-)	
S: 6-18-6	"				172	297	296	305	400	395	425)	
X: 20-10-5	"				169	63	78	96	-	-	-	
NP 20-20-0	rice/maize/cotton				6,462	6,227	1,712	2,567	4,148	6,215	0	7,000
Straight: SA (21N)	tea/sugar cane/maize/rice				34,304	30,149	34,553	31,067	31,926	40,416		45,000
CAN(26 N)	rice/maize/cotton				6,681	8,398	4,271	5,680	5,251	7,972		10,000
urea (46 N)	rice/				295	4,143	990	540	303	287		
nitrate of soda (16 N)	tobacco				340	266	418	358	650	780		
SSP (18-20 P_2O_5)	sugar cane				151	173	194	193	350	235		
TSP (44-46 P_2O_5)	sugar cane				93	141	60	57	180	100		
KCl (60 K_2O)	"				127	79	189	242	400	50		
K_2SO_4 (50 K_2O)	"				4	10	15	16	20	20		
Others					1,353	307	401	804	1,293	1,025		
	Total consumption:				66,993	67,151	59,655	60,368	68,391	86,812		100,000
	of which compounds:				23,645	23,488	18,564	21,411	28,018	35,927		40,000

Mali

Fertilizer use development

Fertilizer use has developed rapidly during the last 10 years. It has increased from a mere 4,000 tons in 1968 to about 22,000 tons in 1976.

The use of compound fertilizers, 14,500 tons in 1976 or 66% of the total, is well established. The main formulations in use are the 18-31-0 or the 14-23-14 (12,500 tons), which are sulphur based and mainly used for cotton production. DAP follows in importance (2,000 tons in 1976). It is mainly used for rice and sugarcane. Single superphosphate (4,000 tons) and urea (3,500 tons) figure as the principal straight fertilizers in use for groundnuts, and rice/sugarcane respectively.

Cotton heads with 12,000 tons or 56% of total consumption, the list of fertilizer consuming crops. Over 90% of the land under cotton cultivation is regularly fertilized.

Groundnuts with 4,000 tons or 18% of total consumption follow next in importance, approximately 40% of the area under groundnuts is being manured annually. Cereals like rice and maize which a few years ago hardly played a role of significance, shared in 1976 with 4,000 (18%) and 1,500 tons (7%) respectively in overall pattern of consumption.

Fertilizer consumption is anticipated to reach 54,500 tons by 1980 of which 25,500 tons or almost 50 per cent will be in compound form. This figure seems realistic in view of the targets of production set by the Government for the various agricultural promotion schemes.

Fertilizer supply, marketing and distribution

Mali has no local production of fertilizers and has to import all materials. Compound fertilizers are usually procured from Senegal, while straight fertilizers, mainly urea and occasionally also single superphosphates, are shipped in from overseas.

The state organization SCAER (Société de Credit Agricole et d'Équipement Rural) is in charge of procurement, and distribution of imports to the central depots in the interior, from where the fertilizers are distributed to the various organisation in charge of agricultural productivity schemes for cotton, cereals etc. To ensure a timely arrival, fertilizer procurement takes place 9-12 months ahead of the season. In general, arrivals are completed 2-4 months prior to distribution to consumers. Fertilizers are partly transported by railroad from Dakar or by road from the Ivory Coast over distances of respectively 900 - 1,200 km at an average freight rate of US$0.12 per ton-km. The existing infrastructure situation will pose serious logistic problems with regard to the distribution of fertilizers anticipated to be used in the period after 1980, as at present it is virtually impossible to transport more than 2,500 tons a month from the coast to the various inland destinations.

In 1976, the cost of fertilizers delivered at a central store in Mali amounted to US$280 - 300 per ton of urea. They were heavily subsidized by the state (up to 50% of real costs) and sold to farmers on credit, which is recouped at the time of harvest.

Price ratios between fertilizers and crops are marginally profitable to farmers. This does not seem to constrain the increase in consumption in Mali, where fertilizer use is vigorously being promoted.

Raw materials

Apart from phosphate rock of low quality, Mali does not dispose of other raw materials for the production of fertilizers. It would nevertheless be feasible to produce single superphosphate from local rock and sulphuric acid imported from Dakar.

Bulk blending

The market for compounds is sufficiently large to justify the establishment of a local blending plant, operating at a 2 shift-basis all the year round. However, in the absence of local supplies, the intermediate materials required for the formulation of the various mixtures, i.e. straight nitrogenous, phosphatic and potassic fertilizers have to be imported.

The viability of such an enterprise will, therefore, mainly depend on the possibility of receiving those intermediates in bulk in quantities of at least 5,000 tons in the ports and forwarding them inland to the blending plant. This would not seem to be feasible at present in view of the infrastructural constraints.

Local blending of intermediates imported in bags, will bring about a saving in foreign currency, but it would not contribute to a reduction in cost, subsequently, no alleviation to the financial burden of yearly subsidies. The situation would improve, if local production of single superphosphate is substituted for imports and the phosphate component in the mixtures would be supplied from local sources. This is consistent with the finding of an earlier UNIDO mission to Mali (1975).

Investments

The cost of investment required for installing blending facilities with an annual output of 40,000 - 50,000 tons is estimated at US$600,000 of which US$250,000 in foreign currency to finance equipment and machinery. The balance is in local currency to cover cost of land, site preparations and roads, civil engineering, bulk storage and product storage facilities.

Approximately, the same amount of investments will be required to set up a simple unit for the production of single superphosphate with a daily capacity of 70 tons and an annual output of 20,000 tons of product, based on supplies of local phosphate rock and sulphuric acid imported from Senegal.

Country: Mali

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha)		Fertilizer Recommendations		Total Consumption			Area fertilized	Consumption Forecast
	1976/77	1980	Formula	Kgs/ha	1975	1976	%total	%total	1980
Cotton: total	88	150	18-31-0-6	150	8,930	12,500	56	90	22,000
intensive	70	120	14-23-14-5	200					
Groundnuts	150	180	super-phosphate	65	5,000	4,000	18	40	10,000
Rice: total:rain fed	130	250	urea	175		2,000	18	12	8,000
irrigated	42	130	urea	325		2,000			3,000
water controlled	44	-							
Millet/sorghum	1,100	1,500	urea/DAP						
Maize: total	81	400	urea	100		1,500	7	80	8,000
intensive	18	90							
Sugar cane	1.7	3.5	urea/DAP	300		-			1,500
Vegetables	0.3	3.0	urea	200		80			600
Tobacco									
			Total fertilizer consumption:			22,080	100		53,000
			of whcih compounds:			14,500			

Country: **Mali**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1977	1980
NPK: 18-31-0-6S	cotton				11,250	16,000	7,150	8,930	12,500	-	-
14-23-14-5S	cotton				-	-	-	-	-	22,500	22,000
NP: 18-46	rice, sugar, cane			5,400	200	650	650	1,200	2,000	2,000	3,500
Straight: urea (46 N)	maize, rice			1,700	2,250	7,800	-	800	3,500	5,000	18,000
sulfate of ammonia (21 N)	tobacco,			2,700	100	150	150	700	-	-	-
superphosphate (18% P_2O_5)	groundnuts			2,500	1,900	4,800	1,650	5,000	4,000	7,000	11,000
TSP (45% P_2O_5)	rice, sugar cane tobacco						45	50	50	-	
KCl (60% K_2O)	vegetables										
K_2SO_4 (50% K_2O)	vegetables, tobacco			90	130	-	165	-	-	-	
Others	-			50	50	-	700	20	30	200	
Total consumption:				12,440	15,800	29,400	10,510	16,700	22,080	36,700	54,500
of which compounds:				5,400	11,450	16,650	7,800	10,130	14,500	24,500	25,500

Niger

Fertilizer Use Development

In Niger no more than 3,000 tons of fertilizer materials were consumed in 1976; a very low figure if compared to the area under cultivation.

The principal fertilizers are urea and TSP; the use of compound fertilizer is insignificant.

Urea is mainly used for irrigated rice and TSP for beans. Some 60% of the area under rice, 3% of the area under beans and only 9% of the area under cotton received fertilizers in 1976.

The land-locked nature of the country and its inherent supply problems make it virtually impossible to expect fertilizer consumption to surpass 10,000 tons by 1980, in spite of existing plans to promote agricultural production vigorously.

The use of compound fertilizer is anticipated to reach 2,400 tons by 1980.

Supply, Marketing and Distribution

All fertilizers have to be imported, in bags, from overseas via the port of Abidjan or Cotonou, first by rail followed by road or what is increasingly taken place, by truck straight from the ocean port to the central ware houses in the interior of the country.

The distance to be covered amounts to 1,700 km via the Ivory Coast route and 1,100 km if transport is taken place through Benin.

The latter route is in spite of high freight rates ($0.09 per ton-km). $100 per ton for entire distance is not frequently used due to congestions. Transport via Abidjan costs about $120 per ton ($0.07 per ton-km) but is much faster and more reliable.

The Ministry of Agriculture procures and acts as a wholesaler for the various state agencies in charge of crop-production schemes.
Because of the infrastructure situation, fertilizers are ordered 9 to 10 months ahead of the season and deliveries at the central depots are scheduled to be completed some 3 - 4 months ahead of the season.

Because of their high cost, i.e. US$ 290-300 per ton of product delivered to central warehouse, fertilizers are heavily subsidized (60% and more) and sold to farmers on credit. A substantial part of the imports is financed under various aid-schemes, as the state lacks the means to finance and subsidize them.

Raw Material Supplies

The phosphate rock deposits recently discovered 200 km south of Niamey are similarly in characteristics to those of Upper Volta. They would enable the country to establish a small-scale SSP plant, if sulphuric acid could be manufactured locally.

For all other fertilizer, the country will have to remain dependent on supplies from overseas.

Prospects for Bulk Blending

The volume of sales anticipated for compound fertilizers by 1980 will not justify the establishment of local bulk blending operations as the size of a unit should be minimum 5 tons/hour or 40 tons/day (10,000 tons/year).

Country: **Niger**

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976/77	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1975	Total Consumption 1976	Total Consumption %total	Area fertilized %total	Forecast
Cotton: total	16		TSP	80					
water controlled	0.7	4.0	SA	120		280	9	9	400
			19-12-21	100					
Groundnuts	256		SSP	75					
Beans	920		TSP	50		1,300	43	30	3,000
Rice: total	15		urea	150					
irrigated	3.7		SA	300		1,350	45	60	2,600
									1,000
Sorghum/millet	2,700		urea/TSP						
			14- 7 - 7						2,000
Sugar cane	2		15-15-15						200
Vegetables						100			
Total consumption:						3,030			9,200
of which compounds:						-			2,400

Country: **Niger**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980
NPK: 15-15-15	Sugar cane	-	-	-	-	308	52	100	-	2,200
14- 7- 7	Sereals	-	-	-	-	3	11	9	-	30
6-20-10							3			
20-20-10										
Straights: Urea (46 N)	Rice,Cotton	-	-	-	-	350	111	355	1,500	2,400
SA (21 N)	Cotton	-	-	-	-	4	88	465	-	1,900
SSP(18-20P_2O_5)	Groundnuts	-	-	-	-	199	166	819	-	6,800
TSP (45 P_2O_5)	Beans, Cotton Groundnuts	-	-	-	-	-	41	206	1,425	740
KCl (60 K_2O)	Vegetables	-	-	-	-	-	7	46	100	150
Total consumption:						944	479	2,000	3,025	14,220
of which compounds						391	66	109	-	2,230

Rwanda

Fertilizer Use Development

The use of fertilizers in Rwanda increased from 500 tons in 1971/72 to some 3,000 tons in 1977/78, mainly for tea, cultivated on estates (550 ha), and by small growers (3,000 ha.)

Coffee, which is exclusively grown by small peasants on a total of 29,000 ha. of land, constitutes the country's main source of foreign currency earnings. Yet, fertilizers are no longer applied to coffee trees because of inadequate returns to growers.

In accordance with the planned expansion of the tea area, it is expected that consumption of fertilizer will reach 4,500 tons by 1980. There is at present hardly any prospect of extending fertilizer use to other crops due to the high price farmers have to pay for them.

Supply, marketing and distribution

Some 50 per cent of the country's annual budget is currently financed by foreign assistance. The means to finance imports and subsidies for fertilizers are limited. Yet fertilizers have to play a vital role in meeting the agricultural production targets of this country, which is one of the most densely populated and poorest in Africa and where over 90% of the population depends on agricultural production for their livelyhood.

Half of the fertilizer imports in the years 1977/78 were supplied free of charge Mombasa by the IFSS (International Fertilizer Supply Scheme) to the Ministry of Agriculture for Delivery through the OCIR (Office des Cultures Industrielles) to the tea growers. The other half was financed by own resources and procured by tender from Europe and Kenya.

For a land-locked country like Rwanda, the communications with the sea are long (1700-2000 km) and most difficult. The unbalanced ratio between imports and exports (3 to 1) further aggravates the situation. Consequently, costs of transport are extremely high and may fluctuate sharply from month to month according to demand.

There are three principal routes connecting the country with the Indian Ocean.

1. The trans-Tanzanian route leading from Dar-es-Salaam to Lake Tanganika (railways) and proceeding onwards via the lake to Bujumbura (barges) and further on to Kigali (by road);

2. The Uganda-Kenya route using the railways from Mombasa to Kasese or Kampala and subsequently the road to Kigali;

3. The route by road from Mombasa to Kigali via Nairobi and Kampala (2000 km).

The first-mentioned route is hardly used any longer. Im- and exports are nowadays mainly handled through the port of Mombasa. The desintegration of the Central African Railways and the consequential influence it had on transit transport resulted in a shift to road transport. As it avoids theft, pilferage, losses, transloading delays, the latter route is nowadays the most reliable and preferred, but it is also the most expensive one.

Hauling fertilizers from Mombasa to Kigali by road costed mid-1978 F.rw.21,000 per ton ($230), double the amount paid earlier this year, or some US cents 12 per ton/kilometer. While road transport is completed within 5 to 10 days, it may take 2 to 3 months before fertilizers landed at Mombasa reach Kigali.

An important element in the delays and in the cost of transport between Rwanda and the Indian Ocean is the congestion, handling and storage in the port of Mombasa, and difficulties in passing frontiers.

It also partly explains the high price of imports Port Mombasa which currently amounts to F.rw. 22,000 ($245) per ton for small lots of urea (potassium chloride and TSP) delivered on liner term basis.

As a result, fertilizers are at present supplied to central stores at Kigali at a cost of F.rw. 43,000 per ton ($475). After adding local transport and distribution costs, the price which the customer has to pay is not less than F.rw. 49,000 or $545 per ton.

Raw materials

No deposits of phosphate, potash salts or sulphur have been discovered so far in Rwanda. On the other hand, the country possesses vast resources of hydro-power (over 1000 MW), peat (3.0KM.^{3}) and natural gas (methane equivalent 45 KNM^3)*, to reduce its imports of fuel, to arrest depletion of dwingling wood resources, and to substitute local manufacture of nitrogenous fertilizer for imports. Most of these resources are located at the Frontiers with neighbouring countries and their exploitation necessitates co-operation with Zaïre for electricity and natural gas (Lake Kivu), with Tanzania for electricity (Kagera River Basin) [illegible] Burundi for peat (Akanyaru [illegible])

* [illegible]

NOR-CONSULT and ELECTRO-WATT recently completed an extensive pre-feasibility study on the development of the Kagera River Basin with the proposal to establish power-generating capacities amounting to 150 MW, the main part of it to be consumed by an ammonia-nitric acid fertilizer complex.

The natural gas occurrence in Lake Kivu is unique and has been the subject of several studies in the past. At a depth between 270 and 450 metres the water layers are saturated with natural gas of the following composition:

	Top layer	Bottom layer
CO_2	72	78
CH_4	26	21
CH_4/water	0.4	0.48
Gas/water	1.6	2.2

This gas has been exploited in the past 15 years on a very small scale (700 NM^3 crude gas/hour) to meet the fuel requirements of a brewery at Gisenyi.

The winning of this gas in quantities exceeding 16,000 NM^3/hour equivalent to 8,000 M^3 gaseous lake water as required for a 100 tons/day ammonia plant, may seriously perturb the hydrological equilibrium in the gas-bearing zones, unless a proper technique for the extraction of gas has been developed and tested.

The company jointly established by Zaïre and Rwanda for the exploitation of the gas reserves of Lake Kivu is presently requesting the European Development Fund to finance a detailed study on the inventory and the hydrological implication of winning gas from it in large quantities so as to establish permissible levels of extraction and to define the method of winning and treatment of the gas for the purpose of utilization as feedstock and fuel to industries.

Bulk Blending

The market for fertilizer and in particular for compound fertilizer is far below the economics of scale to consider the implantation of an NPK formulation plant in Rwanda, or even bagging facilities based on intermediates imported in bulk.

Prospects for the local manufacturing of fertilizers

The extremely high prices at which fertilizer become available in Rwanda, makes it imperative and most likely highly economical to consider seriously the manufacturing of nitrogenous fertilizers from locally available resources of feedstock or energy.

According to the studies of NOR-CONSULT and ELECTRO-WATT, the cost of electricity generated by the proposed hydro-power stations in the Kagera River Basin, would be about 12-16 US Mills per KWH. The cost of ammonia to be produced from hydrogen recovered by the electrolysis of water would amount to no less than US dollars 220 per ton, of which the cost of electricity alone will amount to US dollars 145 per ton(12,000 KWH/ton ammonia at US Mills 12/KWH).

With this in mind, economic considerations would certainly favour ammonia production based on feed gas recovered from Lake Kivu instead of from an hydro-power source, if the methane could be supplied for less than US cents 8 per NM^3, which is most likely the case. The gas reserves of Lake Kivu, estimated at 45 x 10^9 NM^3, methane equivalent are sufficient to support an ammonia plant of 100 to 200 tons per day. Consuming 300 to 600,000 NM^3 of methane per year or 0.6 to 1.2 million over a 20-year period.

Producing ammonia by gasification of peat is not recommendable for various reasons, mainly because it would certainly be more expensive than production based on either methane feedstock or hydro-power.

Once the approximate cost of recovery and treatment of the gas from Lake Kivu is known, a detailed feasibility study should be undertaken to establish the cost price of ammonia production and the off-take potential for nitrogenous fertilizer in the domestic market as well as in the neighbouring countries with which Rwanda has entered into commercial treaties.

The findings should provide the essential data to determine the location of the plant, the capacities and products to be manufactured as well as the off-site and infrastructural facilities to be established. The same study should define the degree of purity of methane to be delivered by the gas-treatment plant to the fertilizer factory (humidity, nitrogen, sulphur, CO_2 and oxygen content, heating value), the quantities of gas to be supplied at an hourly (daily) basis and the most appropriate technology of processing the gas to final fertilizer product.

Country: **Rwanda**

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha)		Fertilizer Recommendations		Total Consumption		Area fertilized	Forecast
	1975	1980	Formula	Kgs/ha	1977	%total	%total	1980
Tea	3.5	10	20-10-10	500	750			
			urea	200	750			
			TSP	200	750	100	100	4,500
			KCl	200	750			
Coffee	29.0		20-10-10				-	
Pyrethrum	4.0							
Sugarcane	0.2							
Vegetables								
			Total consumption:		3,000			4,500
			of which compounds:		750			-

Country: **Rwanda**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1977	1978	1980
NPK: 20-10-10	coffee, tea									750	750	
Straight: urea	tea			400	170	150	300	280	300	750	750	
TSP	tea			-	60	100	180	140	160	750	750	
KCl	tea			160	300	330	400	90	160	750	750	
	Total consumption:			560	530	580	880	510	620	3,000	3,000	4,500
	of which compounds:			-	-	-	-	-	-	750	750	

Somalia

Fertilizer use development

Fertilizer use has developed rapidly during the last 10 years. Consumption of fertilizer has increased from about 8,000 mt before 1970 to 20,000 mt in 1976. This is due to emphasis placed by the Government to put as much land under plow as possible so that the country becomes self-sufficient in food in near future. As a result, intensive cultivation is also practised for certain crops.

The total land of the country is about 63.8 Mill Ha. The broad classification of available land is shown in annexure A. It can be seen that in 8.00 Mill hectares of cultivable land, 0.65 Mill hectares is being cultivated, out of which 0.10 Mill hectares is irrigated. To improve this, barrages and dams over the main rivers Jubba and Shabelle are underway or being planned.

Somali Government is at present also engaged in settling drought affected nomads in 3 agricultural settlements, Vil Dujuma, Sablale and Kurtenwary projects for a total planned area of 68,000 hectars. In addition, there are 3 major agricultural projects, Viz Balad, Lipsome and Jananle, which will increase agricultural land by 27,000 hectares in next 3 - 5 years. Along with this, about 25,000 hectares of land will come under co-operative sector for cultivation. Further, there can be increase of cultivable land by 40,000 hectares of individual farmers, of which about 50% can be expected to be fertilized. As a result of above steps, the total irrigated area may go up to 150,000 hectares by 1980. (However, another estimate, shown in Annexure B-1 and B-2, indicates the irrigated area will increase up to 256,000 hectares in 1980; this estimate looks rather optimistic).

The use of compound fertilizers, 9,000 mt in 1976, is well established. This forms about 48% of present total fertilizer usage in the country. MAP (monoammonium phosphate 11-52-0) used is 5,000 mt and DAP (diammonium phosphate) is 4,500 mt. The former compound is applied for cotton, grandnut and maize while the latter is used for rice and maize. The complex fertilizer 16-8-22 of NPK formulation is being tried out in smaller quantities. Urea, 7,500 mt, is the most common straight nitrogen fertilizer used. Potassium sulphate (48% K_2O) is preferred to the chloride due to saline nature of the soil. About 2,500 mt of this fertilizer is being used currently per year.

Major commercial or cash crops of Somalia are banana, sugarcane, maize, cotton, rice, sesame and sorghum. Except banana, all the other commodities are for internal consumption.

Banana

National Banana Board at Moghadisciu organizes the intense cultivation of banana. This is grown specially well in the mouth of Shabelli River near Afgoye and that of Jubba River near Jelab close to Kismanyo in the south. About 75% of cultivation is done by Somalis who do not generally apply much fertilizers. Rest owned by Italian farmers come under intense cultivation. Banana consumes about 9,000 mt of total fertilizers,forming about 40% of all fertilizers used in the country. The extent of banana acreage may go up by 3-4,000 hectares in next 4-5 years, although the same has remained steady since the 70's. Correspondingly fertilizer consumption may go up by 3,500 mt at that time. The normal yield of bananas is 150-200 quintals per hectare., while the high yield level is 350. Urea, some phosphate complex and all the imported potash are used for banana cultivation.

Sugarcane

In the Jowhar estate, about 90 KM from Moghadisciu, approximately 7,000 hectares are under cultivation. The sugar agency, SNAI, takes care of the intense cultivation of the crop. Extent of sugarcane cultivated area is likely to go up by 8,000 hectares in 1980 when the new project near the Jubba River is completed. Only urea is normally applied to sugarcane crop.

Maize

Maize is another major crop which is cultivated in 172,000 hectares. Part of this comes under intensive cultivation with fertilizer applied. MAP, complex and DAP are used for this cultivation. Present estimated consumption is about 5,500 mt/year.

Fertilizer supply, marketing and distribution

Somalia has no local production of fertilizers, and has to import all fertilizers, urea, DAP, MAP, NPK 16-8-22 and potash. The main sources of supply are UK., Holland, Germany, Middle East, Italy and East European countries. Purchasing is made by the lowest price offered. The state organization ONAT is responsible for purchasing of fertilizers. It also arranges for importation, storage, unloading at Port, reloading and transport to the user at the right time. For the crops, there are seasons in the year, each of 3-4 months. The first season commences in April and second one in September. Order for fertilizer is placed about 3 months prior to season commencement.

About 50% fertilizer is unloaded in the southern port of Kismanyo and the balance at Moghadisciu. Both ports have adequate capabilities to unload ships of 5-6,000 mt dead weight capacity.

Somalia has no railway. All fertilizer is transported by road only to the farmer. Present transport infrastructure would appear satisfactory, and with completion of highway between Afgoye and Jeleb, it will be much better. The imported fertilizer cargo comes in bags, unloading at the port is done at the rate of 500 mt/day.

Raw materials supply and cost

Somalia does not possess fertilizer raw materials like phosphate rock, potash, sulphur or natural gas in commercially exploitable quantities. However, a refinery is being set up to process imported crude from Iraq. A study has been made to possibly use the naphtha from refinery for manufacture of ammonia and urea. Efforts are also being made to locate natural gas source in the country which can form a cheaper fertilizer feedstock for ammonia/urea manufacture.

Prospects for local manufacturing of compounds

In the absence of local manufacture, all fertilizer compounds are separately imported in bags. The market is sufficiently large to the extent of 10,000 mt of compound fertilizers to justify installation of bulk blending facilities. However, the viability of such an enterprise will depend on

1) Procurement of raw materials from overseas in bulk quantities of at least 5,000 mt per consignment. Handling of such loads appears possible in Moghadisciu and Kismanyo ports;

2) Use of locally manufactured packing materials or competitively purchased bags: Government has recently been studying possibility of cultivating kenaf and producing sack material from this crop;

3) Possibility of reuse of bags at least partly, to reduce cost to the farmer.

Somalia has a coastline with harbours and can advantageously import bulk fertilizer at cheaper rate (say 15-17 $/mt) due to better loading, unloading and higher stowage capacity of ships. There can be additional cost savings due to difference in cost of bags and bagging between the suppliers point and at Somalia port. This savings can be \$10-12/mt. Thus a total savings of \$20-25/mt can be expected if bulk fertilizers are purchased. A 10 MTH operating capacity plant for bulk blending can cost about \$450,000. Assuming about 10,000 mt are handled by this plant per year, one shift basis, the payout time will be 1 3/4 years which is very attractive.

As an alternative, Somalia can consider a bagging plant alone at a much cheaper cost than the above. Such a plant will immediately help to improve the manpower infrastructure that will be needed for industrialization of the country.

Project design with cost of a bulk blending plant of this capacity is contained in UNIDO publication Monograph No.8.

A specimen proforma of plant and machinery is to be attached to this report if sent to the Government of Somalia to recommend the bulk blending plant. The proforma of cost may be obtained from leading suppliers of such a plant.

It is understood that IDA has offered a credit of \$5.0 mill to the Somali Government owned Development Bank of Somalia. This project can be financed from the IDA loan.

Country: **Somalia**

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1975	Total Consumption 1976	Total Consumption %total	Area fertilized %total	Consumption Forecast 1980 (mt)
Cotton: total	9,000	16,000	**MAP**	100	500	500	2.60	75	1,000
			urea	100	500	500	2.60		500
			16-8-22	**expt.**	100	100	0.53		100
intensive									
Groundnuts	500	500	**MAP**	100	50	50	0.26	100	50
Rice: total	7,000	7,000							
irrigated	4,000	4,000	16-8-22	160	600	600	3.13	75	600
			DAP	100	400	400	2.09		
water controlled	3,000	3,000							
Millet/sorghum	388,000	433,000	-	-	-	-	-	-	-
Maize: total	172,000	219,000							
intensive	70,000	107,000	**MAP**	300	3,500	3,500	19.27	20	4,450
			16-8-22	200	1,000	1,000	5.22		3,000
			DAP	100	1,000	1,000	5.22		2,000
Sugarcane	7,000	15,000	**urea**	300-350	2,000	2,000	10.44	100	4,500
			16-8-22	**expt.**	500	500	2.60		-
Sasame	7,000	7,000	-	-			-	-	-
Banana	7,400	12,000	**urea**	130	5,000	5,000	26.11	75	5,000
			DAP	34	1,000	1,000	5.22		2,000
			Pot.sulphate	370	2,500	2,500	13.05		4,500
			16-8-22	**expt.**	500	500	2.60		1,300
Total fertilizer consumption:					19,150	19,150			28,900
of which compounds:					9,150	9,150			14,900

Note: The total tonnage and the individual fertilizer quantities are reliable. However, the distribution towards various crops cotton, rice and maize is somewhat approximate.

Country: **Somalia**

Table 2

Fertilizer Consumption Trends

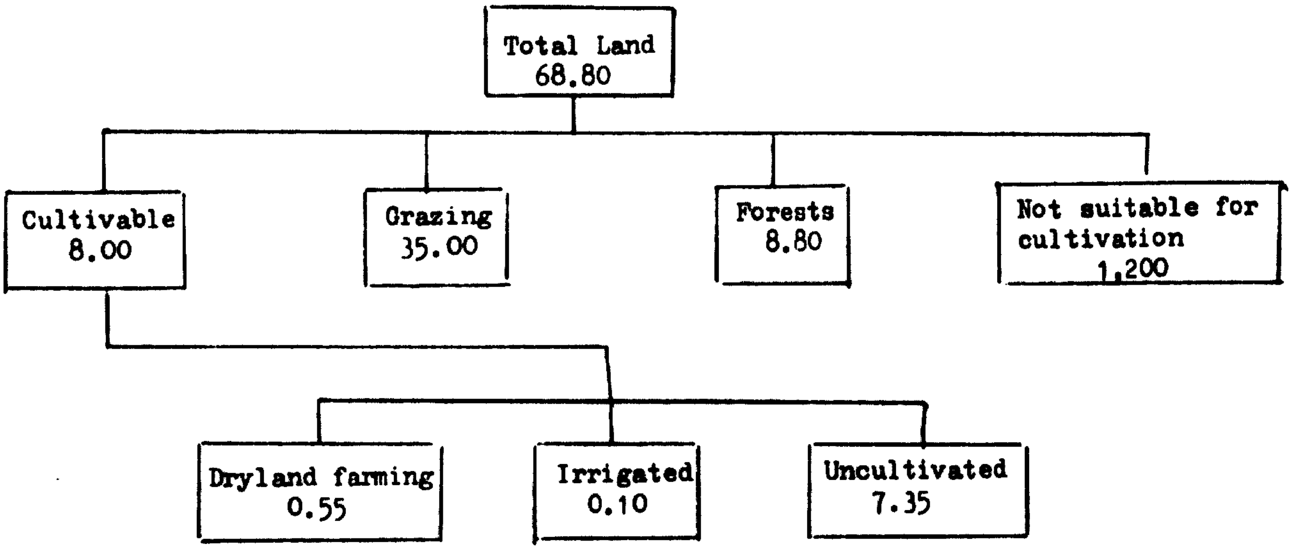
Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980
Urea	Sugarcane cotton, banana				4,000	5,000	5,000	7,500	7,500	10,000
MAP 11-52-0	cotton, groundnuts, maize							4,050	4,050	5,500
DAP 18-46-0	rice, maize, banana							2,400	2,400	4,400
NPK 16-8-22	cotton, rice,1/ maize, banana				500	500	1,000	2,700	2,700	5,000
K_2SO_4 (48% K_2O)	banana				1,600	1,600	1,600	2,500	2,500	4,000
Total consumption:					6,100	7,100	7,600	19,150	19,150	28,900
of which compounds:								9,150	9,150	14,900

1/ experimental

Annexure A

Somalia

Mill Ha.



Annexure B-1

Development of irrigated area in Somalia 1977-1980 in hectares Broken down into regions

Region	1977	1978	1979	1980
Hiran	8,600	9,600	10,600	12,000
Middle Shabelle	19,820	23,320	28,320	22,320
Lower Shabelle	100,200	110,200	120,200	129,840
Gedo	6,200	6,200	6,200	6,200
Middle Jubba	20,430	27,830	33,830	39,830
Lower Jubba	21,310	26,810	30,810	34,810
Total	176,560	202,460	229,960	256,000

Source: Ministry of Agriculture, Dept. of Planning ans Statistics

Annexure B-2

Development of the irrigated area in Somalia in hectares, broken down into projects

		Area
1.	Balad irrigation project	6,000
2.	Libsome Irrigation project	4,000
3.	Settlement project	6,000
4.	Janale project	13,400
5.	Crash programme	4,540
6.	SNAI	4,000
7.	Custody crops	1,000
8.	Ministry of Agriculture	2,500
9.	Co-operatives	18,000
10.	Banana growers	20,000
	Total increase 1977-80	79,440
	Area 1977	176,560
	Planned at 1980:	256,000

Sources of Information

1) UNDP/UNIDO project SM/007 report
2) Annual report of Central Bank of Somalia, 1977
3) Report of Planning Commission of Somalia, 1977
4) Discussion with
   a) Mr. Zachariah, Res.Rep. UNDP
   b) Mr. Mohammed Hiod, APO, UNDP
   c) Director General, Ministry of Industry, Government of Somalia
   d) " " " " " Agriculture, " "
   e) Director, ONAT, Government Import Corporation, Mogadisciu
   f) Manager, National Banana Board, Government of Somalia
   g) Chief Chemist, National Banana Board, Government of Somalia
   h) General Manager, SNAI, National Sugar Organization, Government of Somalia
   i) Mr. Robertson, FAO, Adviser
   j) UNIDO Industrial Economist, Ministry of Industry

Sudan

Fertilizer Use Development

Fertilizer consumption over the past 10 years almost doubled from 90,000 tons in 1968 to some 170,000 tons in 1978. This increase related strictly to the past expansion of the area under controlled water supply and the increase in the rates of application per unit of cultivated land (cotton).

The market is dominated by urea. The use of sulphate of ammonia which up to 1972 played a role of significance, has faded out. Equally compound fertilizers are hardly used. Cotton in 1975/76 accounted for a consumption of about 95,000 tons of urea which equals 56.5% of the total (168,000 tons). It is followed in importance by wheat (55,000 tons or 33% of total consumption and by sugar cane (12,000 tons or 7% of the total). A sector analysis of future demand would indicate that by 1980 and in conformity with new areas to be brought under irrigation, consumption would reach some 200,000 tons, mainly in the form of urea. However, this target will be difficult to reach unless some basic problems inherent to the current infrastructure of transport and storage are solved.

Supplies, marketing and distribution

The Sudan is unusual in that almost the entire consumption of fertilisers is accounted for by a few large public or semi-public corporations.

The current pattern of distribution (1976) among them is as follows:

	Urea	TSP	Total	% Total
1. The Sudan Gesira Board	110,650	750	111,400	66.5
2. The Agricultural Production Corporation	44,600	-	44,600	26.5
3. The Rasad Agricultural Corporation	-	-	-	-
4. The Agricultural Bank 1/	(10,500)	-	(10,500)	-
5. The Sugar Corporation	12,000	-	12,000	7.0
		TOTAL:	168,000	100.0

1/ Carry-over stock not distriubted in 1976/77.

The above corporations haul their supplies from Port Sudan to their stores in the interior from where they are distributed to the field. Overall capacity of stores owned by the Sudan Gezira Board and the Agricultural Bank alone amounts to some 160,000 tons of which about 70,000 tons exclusively for fertilizers.

All fertilizers are presently imported, mainly from Kuwait under a special 5-year credit agreement which expired in 1976 but which has since been extended on a year to year basis. In addition, the IFSS (International Fertilizer Supply Scheme) provided the Sudan with 5,500 tons of urea in 1975 and subsequently with another 3,000 tons in 1977. Upon arrival at Port Sudan, fertilizers are hauled by rail to the major agricultural centres, mainly the areas around Khartoum. The basic difficulty is that this communication consists of a single track of medium gauge railway line, which slows the speed. The average travel time for a train between Port Sudan and Khartoum, a distance of about 1,000 km, is 5 days. Yet, it takes at present 2-3 months for fertilizer arrivals to reach the interior, mainly because of the congestion at Port Sudan and the railway's inability to cope with the increased tonnages of transport. Since the bulk of the fertilizer has to be on the spot 6 weeks before cotton planting starts (end of July), shipments from overseas are scheduled to arrive in the period January-June.

This period coincides with the exports of cotton and it is precisely during this period that there occurs a noticeable slow-down in the turn-around time for waggons. The magnitude of the problem is best illustrated by the fact that during the first 6-months of this year the railway hauled 15,000 to 18,000 tons of fertilizer a month against a requirement of 25,000 to 30,000 tons.

A two-lane asphalt road between Khartoum and Port Sudan which is scheduled for completion by 1980, will offer an alternative to the existing infrastructural bottlenecks and simultaneously means to consider transport of fertilizer in bulk rather than in bags from the port direct to the centres of consumption in the interior.

Prices quoted in 1977/78 for urea landed CIF free out at Port Sudan amount to £ Sud.80 or to US dollars 200 per ton. Haulage by rail to Khartoum costs only £Sud.6 per ton equal to US Cents 1.5 per ton/kilometer, the cheapest rate in Africa. On the other hand, various financial charges amounting to not less than 41½% on CIF value (£ Sud. [illegible]/ton) and handling/clearance costs at Port Sudan (£ Sud. 2.5/ton) add [illegible] total of £ Sud. 41 to the landed price, lifting the price of fertilizers delivered at the central stores in the interior to £ Sud.121/ton or the equivalent of 302 in US dollars.

Raw Materials

The Sudan is poorly endowed with natural resources for the manufacturing of fertilizers.

Natural gas has been discovered off-shore near Port Sudan, but no figures on proven reserves are available. Hitherto, no crude oil has been found, but there are indications for its occurrence in the South West of the country, where exploration work is being carried out.

Deposits of phosphate rock, potash salts and sulphur have as yet to be located.

Bulk Blending

In the absence of a market for compound fertilizers in the Sudan and in view of the predominant position of nitrogenous fertilizers in the consumption pattern, the country has no need for a NPK formulation plant.

On the other hand, the structure of the marketing and distribution system, the favourable conditions offered by a dry-sub-tropical climate and the fact that fertilizers are increasingly applied to the soil by mechanical equipment, would warrant the change in distribution of bagged to bulk materials.

A comprehensive study should be initiated to (1) establish an appropriate plan for the distribution of fertilizer in bulk from the point(s) of supply to the various centres of consumption in the interior; (2) determine the investments required to store and transport fertilizer materials in bulk and handle them at the port and in the interior; and (3) assess the economic and operational benefits to derive from a distribution system dealing with bulk instead of bagged materials.

Prospects for local manufacturing of fertilizers

The Government of the Sudan recently concluded an agreement with the N-Ren Corporation to establish an ammonia-urea complex with an annual capacity of 180,000 tons in the vicinity of the terminal of the existing pipeline, connecting Khartoum with the refinery at Port Sudan.

The complex will be self-supporting as regards power, steam and water supplies, while the feedstock, i.e. light naphtha, is supposed to be procured from the refinery.

The implementation of the US dollars 120 million venture is scheduled in two stages: installed capacity by 1980-81: 90,000 tons of urea

" " " 1981-82: 180,000 tons of urea

About 70 per cent of the capital is secured by equipment suppliers credit arrangements (Austria and Canada) while the balance will be provided through equity financing by N-Ren (33½%) and the State of Sudan (66½%).

The price of urea ex-factory is estimated to be US dollars 230 per ton during the first 12 years of operation. Thereafter it is supposed to come down to about US dollars 100 per ton (!).

The project, if implemented and in operation, would alleviate in a significant way existing infrastructural problems, particularly in combination with distribution of fertilizer in bulk.

Country: Sudan

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1975/76	Total Consumption %total	Area fertilized %total	Forecast 1980
Cotton: irrigated	400	440	urea	200-250	95,000	56.50	100	105,000
rain fed	20	20	-					
Sugarcane	25	50	sulp.amm.		-	-	-	-
			urea	500	12,000	7.00	100	30,000
Dura(sorghum)	90		urea		-	-	-	-
Wheat, irrigated	277	300	urea	200	55,000	33.00	-	60,000
			TSP	100	-	-	-	-
Paddy, irrigated	10	14	urea	160	1,500	1.30	100	2,000
			TSP	80	750			1,000
Vegetables			urea compounds		3,750	2.20	-	4,000
Total consumption:					168,000	100.00	-	202,000
of which compound fertilizers:					-	-		-

Country: **Sudan**

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1977	1980
NPK	**vegetables**	-	-	-	-	-	-	-	-	-	-
Straight:											
Urea (46N)	**cotton, wheat, rice, sugarcane vegetables, paddy**	92,000	91,000	112,000	115,000	120,000	131,000	167,433	179,966	170,428	201,000
Sulphate of ammonia (21 N)	**sugarcane, vegetables**	16,000	11,000	15,000	34,000	-	-	-	-	-	-
TSP ($46\ P_2O_5$)	**paddy, wheat**	-	-	-	-	300	-	614	627	715	1,000
	Total consumption:	108,000	102,000	127,000	149,000	120,300	131,000	168,047	180,593	171,143	202,000
	of which compounds:	-	-	-	-	-	-	-	-	-	-

Tanzania

Fertilizer use development

The use of chemical fertilizer in Tanzania, which was almost negligible in the early 1960's has made rapid strides during the last decade, though pro-hectare and per capita use of fertilizer remains low.

In 1970 already some 27,650 tons were used, a figure which increases to about 100,000 tons in 1976. Of this total some 27,000 tons or 27% of overall consumption was applied in the form of compounds.

Tobacco and tea are the crops with the most intensive use of fertilizers. Almost 100% of the total planted area, both estate and small holdings, is regularly fertilized.

Fertilizer use on cotton is in comparison still very low, whilst for coffee it is practised only by the large plantations (7.5% of the planted area). Other cash crops, like sisal, oil seeds and pyrethrum receive very little or no fertilizers at all. With regard to maize, which is the most important food crop, no more than 10 - 12% of the sown area is using fertilizers at present.

Forecast of fertilizer demand made by the NIDC (National Industrial Development Corporation) indicates that consumption would triple from the 1974 level by 1983 which seems to be unlikely to happen. Yet it seems realistic to assess 1980 demand to surpass a total of 150,000 tons, of which probably some 40,000 to 50,000 in compound form, if current trends are extrapolated.

Supplies, Marketing and Distribution

A considerable part of the country's fertilizer needs is being covered by the output of the TFC plant (Tanzania Fertilizer Corporation) at Tanga. It came into operation in the second half of 1971 but because of teething problems did not attain full production until recent years.

The installed capacities of the main units amount to 90,000 tons/year of sulphuric acid and 28,000 tons/year of phosphoric acid. The plant also comprises down-stream units for the production of (1) sulphate of ammonia (20,000 tons/year), (2) triple superphosphate (25,000 tons/year), (3) diammonium phosphate (15,000 tons/year) and (4) compound fertilizer (NPK's: 45,000 tons/year). Capacity utilization in 1975/76 almost reached 75% and is supposed to have attained 90% by now after debottlenecking and mechanical overhaul work.

In addition, a major expansion programme is being implemented involving the installation of an additional SA plant (40,000 tons/year) and a small single superphoshpate plant (SSP) of 5,000 tons/year capacity.

Upon the completion of overhaul work and the installation of the new facilities, the capacities of the expanded plant, operating at 90% utilization rate will be able to supply annually:

SA:	54,000 tons (11,500 tons N)
TSP:	23,000 tons (11,000 tons P_2O_5)
SSP:	4,500 tons (900 tons P_2O_5)
DAP:	14,000 tons (2,200 tons N and 7,000 tons P_2O_5)
NPK compounds:	41,000 tons (of various composition)

This will be sufficient to satisfy domestic demands for compounds and phosphatic fertilizers until the mid-80's. For nitrogenous fertilizers, the country will become increasingly dependent on ammonia supplies from overseas to fill the anticipated supply/demand gap unless a small ammonia unit will be installed.

The wholesale distribution is now entrusted to TFC. Supplies from local production and imports are channelled through TFA (Tanganyika Farmers' Association), NAFCO (Food Crop Estates) and the various crop authorities (for cotton, tea, tobacco, coffee ans sisal), acting as agents for TFC, to the end-user, being it estate or co-operative. Very little trade in fertilizers, if any at all, is presently conducted from retail shops.

The main season of fertilizer usage falls in the period October - January.

In the past between 80 and 90% of all movements have been made by rail. Due to shortcomings in the railway system, a substantial tonnage is being hauled at present by raod,which is much more expensive.High production and transport costs necessitate the Government to subsidize prices (up to 50%) of fertilizers to make them remunerative to farmers.

Raw materials

All of the major raw materials for the TFC plant at Tanga are at present imported i.e. sulphur, rock phosphate, ammonia and potash.

Yet, the country disposes of rich off-shore resources of natural gas whilst phosphate rock occurs at various locations. Several studies have been made in the past, but none of those deposits have been brought into commercial exploitation so far.

The reliance on oversea supplies of vital feedstock materials has severely affected fertilizer production and costs in the past. It is now being planned to set up an ammonia-urea complex to be based on natural gas, and a techno-economic feasibility study is being undertaken.

Prospects of Bulk Blending

The existing compounding-granulation units at Tanga have sufficient in-build capacity to satisfy domestic demands for NPK fertilizers till the mid-80's. There is consequently no need of considering the establishment of bulk blending facilities in Tanzania.

Country: Tanzania

Table 1

Fertilizer Use by Crops

Crops	Cultivated Area (1000 ha) 1976	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1975	Total Consumption 1976	Total Consumption %total	Area fertilized %total	Forecast 1980
Maize, total	1.100		AS	100-150			20	12%	
intensive	20-30		TSP	50	18,960				
Sugarcane	12.9		AS/CAN TSP	300 50	4,582	–	5	100%	
Tea, plantations	9.15	18.350	AS						
small holdings	9.20		TSP 25-5-5	600	11,090		12	100	
Coffee, plantations	11.6	154.	AS/CAN						
small holdings	142.4		20-10-10 TSP/KCl	170	13,462		14	7.5	
Cotton	550.0		AS, TSP	300	17,396		19	10-12	
Tobacco, plantations	4.0	27	4-25-18	800	21,284		23	100	
small holdings	23.0								
Sisal	215.0				450				
State farms					6,240		7		
Groundnuts	60.0								
Coconuts	90.8								
Others	50.5								
Total consumption:					93,564		100		
of which compounds:					-		-		

Country: **TANZANIA**

Table 2

Fertilizer Consumption Trends

Type of fertilizer		Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980
NPK: Compounds 1	20-10-10 25-5-5	cotton, tea, coffee	-	2,310	6,880	7,460	6,240	11,240	) 25,520	27,800	40,000
Compounds 2	4-25-18	tobacco	-	10,190	8,330	8,260	11,990	15,890		-	
Straight: ASN/CAN/urea		maize, coffee, sugarcane	-	3,300	8,150	7,330	8,330	4,920	10,695	9,700	20,000
SA (21 N)		coffee, maize, cotton, tea, sugarcane	-	7,410	12,260	19,330	28,900	34,070	43,382	42,000	60,000
TSP		maize, sugarcane, cotton coffee, tea	-	3,270	5,820	8,030	9,450	14,460	13,325	20,000	30,000
KCl ($60 K_2O$)		coffee, sisal	-	1,170	1,980	2,260	1,520	1,990	642	500	
		Total consumption:	-	27,650	43,420	52,670	66,370	82,570	93,564	100,000	150,000
		of which compounds:	-	12,500	15,210	15,720	15,690	25,700	-	27,800	40,000

Upper Volta

Fertilizer Use Development

Fertilizer use in Upper Volta has steadily increased from a mere 1,250 tons of materials in 1968 to 8,850 tons in 1976. Not less than 6,200 tons or 56% of total consumption (1976) was in compound form.

The main formula in use is the 18-35-0 compound, which is applied for cotton and cereals, i.e. sorghum and millets. Straight fertilizers such as sulphate of ammonia, SSP, TSP and potassic fertilizer are used for crops like sugar cane, groundnuts, rice, maize and vegetables.

It is anticipated that fertilizer consumption will reach 17,000 tons by 1980 of which 12,000 tons (70%) in compound form. Cotton, with a share of 36% (3,200 tons) in total consumption leads the list of fertilizer consuming crops. Some 35% of the area planted with cotton received fertilizers in 1976. The strength of the organization for cotton production, as well as the plans for the expansion of the area under intensive cultivation justifies the forecast that by 1980 cotton alone will use some 9,000 tons of compound fertilizer.

The share of sugar cane in overall consumption amounted to 29% (2,650 tons). In the context of the cane planting development programme, fertilizer consumption is expected to reach 4,000 tons by 1980. Cereals, like sorghum and millets, follow closely with 25% in overall consumption. Yet, the area which received fertilizer during 1976 was not more than 1% of the area cultivated. The scope for a general take-off in fertilizer use is small, because of lack of incentives due to low cost/benefit relationship of fertilizer use.

Likewise groundnuts have little importance in the overall fertilizer consumption pattern. On the other hand, the use of fertilizer on rice (DAP and urea) will have significantly increased by 1980 (1,500 tons).

Fertilizer Supply, Marketing and Distribution

In the absence of local production, all fertilizer metrials have to be imported. Compound fertilizers and SSP are procured from the fertilizer plant at Abidjan, Ivory Coast. The other fertilizers are shipped in from abroad via Abidjan.

The state agencies responsible for the procurement and distribution of fertilizers are the ORD's (Offices Régionaux de Développement).

Bagged fertilizers are transported from Abidjan to two main railway-heads in Upper Volta, i.e. Bobo-Dioulassu and Ouagadougou, over a distance of 850 and 1,200 km respectively at an average rate of US$0.04 per ton-km. The railway's capacity would allow an average transport of 50-100 tons per day of fertilizer which is sufficient to meet requirements. It enables the country to ship in its total annual demand within 3-4 months prior to the start of the season or aften shorter as in the case of cotton.

Fertilizer delivery prices in 1976 were high, namely US$280-290 per ton of compound or urea. Consequently, they are heavily subsidized by the state (up to 50% of real costs) and distributed on term for payment at the time of collection of the harvest by the state organizations. Subsidized fertilizers are remunerative to growers of cotton, vegetables and rice but less favourable to growers of other crops like cereals and groundnuts.

Raw Material Supplies and Costs

Upper Volta disposes of no other raw material for the manufacture of fertilizers than phosphate rock.

The rock deposits have as yet not fully been explored but the indications are that sufficient quantities of high-grade rock could be extracted by manual open air operations to supply feed material for a modest small scale SSP plant which could deliver the product at a price of less than $100/ton ex-factory, against a current price for imported material of about $140-150/ton ex-central store. The sulphuric acid needed for the production of SSP, could be shipped in via rail from facilities located at Abidjan. Other ingredients for formulating fertilizer blends have to be procured from overseas.

Prospects for installing Bulk Blending Facilities

By 1980 the market for compound fertilizer should have sufficiently expanded to justify the installation of a minimum-size bulk blending facility (5 tons/day, operating on a one shift basis for 250 days a year).

However, in accordance with the conclusions of previous UNIDO missions to Upper Volta (1972/75), the viability of such an enterprise will be largely determined by the country's ability to order shipments of 4,000 - 5,000 tons of ingredients a time in bulk, for onward forwarding and blending in Upper Volta or to blend ingredients at a suitable port site in Abidjan and to transport the blended materials inland.

This latter operation is already being done for Upper Volta by the existing fertilizer plant at Abidjan, the capacity of which is large though to meet demands of Ivory Coast and the neighbouring countries.

Different would be the case when the Tambao manganese project in Upper Volta will come into operation by 1980-82. Towards that time, the manganese ore will be transported from Tambao to Abidjan at a rate of 2000 tons per day. The returning train-cars will be empty and available for inland shipment of fertilizer materials in bulk at favourable freight rates ($0.01 per ton-km versus the current rate of $0.04 per ton-km distance Abidjan-Ouagadougou: 1,200 km).

A bulk blending cum bagging facilities located at any strategically site along the railway could well serve the markets of neighbouring countries as well. The scale of operations could then easily be designed to receive, handle, store and blend some 50,000 to 80,000 tons annually which would substantially enhance the viability of the project.

On the basis of 1976 cost calculations, the prices for compound fertilizer could be cut by 30-40 per cent, government expenditure on fertilizer subsidies drastically be reduced and substantial savings in foreign currency be achieved.

Investment Costs

Cost of investments for installing bulk blending facilities with capacities between 50,000 to 80,000 tons are estimated to be $0.65 million, of which $0.30 for equipment and machinery installed, and the balance for site development, civil engineering and storage buildings.

Country: Upper Volta

Table 1

Fertilizer Use by Crops

Crops		Cultivated Area (1000 ha) 1976/77	Cultivated Area (1000 ha) 1980	Fertilizer Recommendations Formula	Fertilizer Recommendations Kgs/ha	Total Consumption 1975	Total Consumption 1976	Total Consumption %total	Area fertilized %total	Consumption Forecast 1980
Cotton:	total	120								
	intensive	32	80	18-35-0	100	3,200		36	35	9,000
Groundnuts		140		Superphosphate	75	570		6	6	1,000
Rice:	total	45		DAP, urea	50	230		2	12	1,500
	irrigated	2.2								
Millet/Sorghum		1,800		18-35-0	100	2,300		25	1	2,300
Maize		84		Urea	50	-				
Vegetables		0.3		Urea, DAP, KCl		200		2	-	600
Sugar cane		2,25	4	Sulphate of ammonia		1,750				
						750		29	100	4,000
				TSP, KCl		150				
				Total consumption:		9,150				18,400
				of which compounds:		5,500				12,300

Country: Upper Volta

Table 2

Fertilizer Consumption Trends

Type of fertilizer	Crops	1968	1970	1971	1972	1973	1974	1975	1976	1980
NP: 18-35	Cotton, cereals	853	1,284	1,719	1,999	2,410	4,182	4,800	6,200	11,300
16-48	Rice	-	-	-	135	237	362	315	-	1,000
Straights: Urea (46N)	Rice, sugar cane	-	-	308	350	686	1,506	500	-	2,700
Sulphate of ammonia (21N)									1,750	-
Superphosphate 18-20 P_2O_5	Groundnuts	327	277	312	310	270	652	-	-	1,000
Triple superphosphate (45° P_2O_5)	Sugar cane	-	-	-	4	2	-	300	750	1,200
Chloride of potash (60 K_2O)	Vegetables	72	325	-	26	245	118	411		
Sulphate of potash (50 K_2O)	Sugar cane				32	70	65	346	150	
Various							133	19		300
Total consumption:		1,252	1,886	2,339	2,856	3,930	7,318	6,691	8,850	17,750
of which compounds:		853	1,284	1,719	2,134	2,647	4,544	5,115	6,200	12,300

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche

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