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INDICATIVE PROGRAMME FOR THE
INTEGRATED DEVELOPMENT OF THE
FERTILIZER INDUSTRIAL SYSTEM IN
ETHIOPIA

SPECIAL MEASURES AND
ACTIVITIES DIVISION

PROGRAMME DEVELOPMENT
SUPPORT UNIT

VIENNA, JANUARY 1990

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PREFACE

Indicative Programme for the Integrated Development of the Fertilizer Industrial System (FERTIS) in Ethiopia covers the second level of the UNIDO system approach to project identification and formulation.

System approach has been applied to the development of agro-food industrial system (AFIS) in Africa in order to accelerate the preparation of the programme of the 1990-91 Industrial Development Decade for Africa (IDDA).

FERTIS is one of the three selected input sub-systems to AFIS in Africa (the other two being: agricultural machinery and pesticides).

At the first level of system approach, related to subsectoral typologies, 43 African countries have been classified and grouped into 10 clusters of countries characterized by the similar patterns of development of their FERTIS. Ethiopia has been located in the country-group 1 embracing: Burkina Faso, Ethiopia, Mali, Mozambique, Niger, Sudan, Tanzania and Zambia.

This study has been carried out by the Programme Development Support Unit under the supervision and general guidance of Ms. Teresa Salazar de Buckle, the Head of PDSU in UNIDO.

Mr. Elizeusz KARP, an UNIDO consultant from Poland, the main author of Indicative Programme for the Integrated Development of FERTIS in Ethiopia, has been sent on the field mission to this country in the period of December 12-27, 1989 in order to gather necessary data and to work-out this Indicative Programme in co-operation with the Ethiopian counterpart organizations related to the development of FERTIS.

It should be underlined here that the stage of defining objectives and targets for FERTIS development in Ethiopia is of crucial importance for this country before any investment decision is taken-up, in particular because of a large range of both the demand for fertilizer by 2000 and the N:P:K nutrients ratio estimated by organisations related to FERTIS development in Ethiopia.

Dynamic development of FERTIS in Ethiopia in the last years, a very high growth in consumption of fertilizers and trends showing for an important shift of N:P:K ratio in favour to nitrogen, imposes a very careful investigation of the system in this country.

It is believed that Indicative Programme for the Integrated Development of FERTIS in Ethiopia, together with the attached eight Technical Assistance Project Proposals, will be helpful in defining future strategies and scenarios for the development of the fertilizer industry in Ethiopia.

THE INTEGRATED DEVELOPMENT OF THE FERTILIZER INDUSTRIAL SYSTEM IN ETHIOPIA

A. PROGRAMME DESCRIPTION

SUMMARY

Analysis of the Fertilizer Industrial System (FERTIS) in Ethiopia indicates for the dynamic growth of fertilizer consumption in the last years, estimated by the World Bank for 18% per annum.

At present, all consumed fertilizers are imported. Steeply growing fertilizer demand justifies establishment of the fertilizer industry in the country, in order to substitute imports.

Fertilizer is an agricultural input of critical importance to attain food self-sufficiency and increase dietary energy supply (DES) per capita, thus overcoming the deteriorating influence of recurrent droughts, degradation of soils and overall weaknesses of the Ethiopian agriculture.

Two options are possible in FERTIS development by 2000:

(a) Passive option - Ethiopia would have to continue importing of all consumed fertilizer, spending valuable foreign exchange for the purchases.

(b) Active option - Ethiopia would create domestic fertilizer industry, the back-bone of which would be nitrogen and potash fertilizers based on already discovered raw materials: natural gas and potash ores.

The second option is strongly recommended in this study; the chances are that from fertilizer importer Ethiopia may become fertilizer exporter, and food self-sufficient country, exporting cash crops.

Balanced and phase-wise FERTIS development in Ethiopia would allow for the attainment of total import substitution in nitrogen fertilizers and export promotion in potash fertilizers. Additionally, import of DAP-TSP-NPK fertilizers might be partly substituted by imports of less expensive intermediates available at the international market: (ammonia), phosphoric acid and phosphate rock. There are also chances for ammonia import substitution.

FERTIS development should be supported by intensive surveys and explorations aimed for new sources of natural gas, phosphate rock, sulphur, limestone-dolomite and micronutrients.

Three different programmes are analyzed in this study in comparison with the present fertilizer industrial system. These are:

- (a) FERTIS development according to the Government's programme.
- (b) FERTIS development according to FAO recommendations (LOW SCENARIO).
- (c) FERTIS development according to recommendations of the Institute of Agricultural Research, the Ministry of Agriculture, the World Bank and the author of this study (HIGH SCENARIO).

Although the Government's programme - realized by the National Chemical Corporation - aims, in principle, in proper direction to meet the priority target of food self-sufficiency by 2000, yet some components of this programme seem to be non-optimal, in particular as far as capacities and locations of the new fertilizer complexes are concerned.

Therefore, both Low and High FERTIS Scenarios have been analyzed in the study in order to illustrate the influence of major constraints and bottlenecks for the system.

Guerilla activity, foreign exchange shortage, weak infrastructure-transportation network and an undeveloped base of FERTIS raw materials, have been reckoned to be the most important constraints for the systems.

The soon ending of the civil war, that drains the budget and deteriorates the economy, is a sine qua non condition for the implementation of any serious strategy of FERTIS development in Ethiopia. Recommended High Scenario has been built on the assumption that the civil war will cease by 1991.

High Scenario is recommended as it guarantees food self-sufficiency even in case when the acreage of cultivated land is not expanded, and there are other constraints unfavourable for the system.

High Scenario assures minimum distribution cost of fertilizers to the cropping areas in the Ethiopian Highlands (Shewa, Arsi, Gojam).

The south-west route of the natural gas pipeline, from gas well to Addis Ababa, is recommended as optimum one for import substitution scenario, with two nitrogen complexes to be located alongside this route at Yirga Alem and Mojo.

Specific investment is lower in the High Scenario than that in the Government's programme; at the same time, foreign exchange savings, food self-sufficiency ratio and DES are higher in High Scenario. Fertilizer cost loco farmer's gate is lower in this Scenario and at the same time, maximum revenues from exports of cash crops (coffee, tea, cotton, oil crops, sugar cane) can be expected in High Scenario.

High Scenario has, however, one substantial drawback: the programme is complex and large, hence its implementation by 2000 would only then be realistic if the civil war is over by 1991. If this were not the case, the programme would have to be implemented through phase-wise planning and would have to be stretched beyond 2000.

Eight Technical Assistance project proposals are analyzed in this study in order to answer the most important questions on fertilizer demand, optimum N:P ratio, and others - before final decisions on FERTIS development are taken up. TA project proposals aim also at the strengthening national capabilities in procurement and trading fertilizers, as well as in planning investment, and operation and maintenance of fertilizer plants.

A clear definition of the long-term objectives and strategies for the fertilizer industry is believed to be of greatest importance for the smooth creation of the domestic fertilizer industry, its high efficiency and reliable operation.

In order to reach full benefits from the Ethiopian agriculture, FERTIS development should be accompanied by the package of other agricultural inputs: improved seeds, pesticides, irrigation and mechanization, it is believed, however, that even with proper development of the Fertilizer Industrial System alone it would be much easier to nourish future generations and to improve greatly the level of life of the whole nation.

1. PROGRAMME CONTEXT

1.1 Description of the main components and linkages of the fertilizer industrial system (FERTIS) in Ethiopia

1.1.1 General background

The following are the main features of the country that may have impact on the Fertilizer Industrial System in Ethiopia:

- The People's Democratic Republic of Ethiopia is a sea-side located country, with the total area close to 1.2 million square kilometers, of that only about 7 million ha is estimated to be under cultivation.
- Agriculture is a mainstay of the economy, contributing about 50% to GDP (US\$110 per capita in 1987) and providing a livelihood for up to 90% of the population. The chief cash crop is coffee, grown on the plateaux in the south-west. Cotton and sugar are the other cash crops. The main food crops are maize, sorghum, wheat, barley, millet and teff. Drought, guerilla activity, soil erosion and transport problems have led to sharp drop in agricultural production, and killed much of the country's livestock. Although there are signs of improvement, reliance on food aid is expected to continue until 1990.
- The central highlands receive enough rainfall, the climate is tropical there, but moderated by altitude, with one rainy season and one dry season. On the plateaux there is also a short rainy season in winter apart from the main season (monsoon season) which allows for season crop production (double cropping area). Much of the lowlands, including south-east regions and the rift valley, have a Sahelian climate (very dry with short wet season for approximately three months); very high temperatures). Desert climate prevails at the Red Sea coast and in the eastern part of the Ogaden province (very dry with occasional flash storms and very hot summers).
- The mid-1986 population estimated at 43.5 million inhabitants, with a life expectancy of 46 years and population growth estimated at 2.9% (1986-2000) is projected at 65 million inhabitants by the year 2000.
- Average figures for 1984-86 indicated for cereals self-sufficiency ratio of 83%, and as low as 1,400 kcal-cap-day daily per capita calorie intake (2,097 kcal for sub-saharan Africa in 1986). FAO estimated that 1.3 million tonnes of food aid would be required for up to 6.5 million hungry or starving people in 1987. Since the time of serious famine in 1984-85, Ethiopia has been pre-occupied by two pressing problems - a recurrence of drought and famine, and the continuing war in Eritrea and Tigre.
- Ethiopia, with its per capita GNP in 1986 of US\$120, is one of the poorest countries in the world. With its external debt of US\$2.2 billion and net foreign trade balance - US\$650 million, the country is almost totally dependent on agricultural exports, accounting for over 90% of foreign exchange earnings.
- Priority in the budget is given to defence, and only then to agriculture, industry, mining and transport. The budget's main emphasis on defence

spending highlights a major government dilemma: in order to realize its economic potential, Ethiopia needs to end its financially draining conflicts in Eritrea and Tigre (there is also sporadic fighting in the Ogaden and in the south).

- Port in Assab plays a key role in the development of the fertilizer industrial system in Ethiopia. Through this port and associated road network all imported fertilizers (about 162,000 tonnes in 1989) are transported to the centrally located fertilizer storages in Addis Ababa and Nazareth. The only rail line in Ethiopia connects Addis Ababa with the foreign port Djibouti, and is therefore of a lesser importance to FERTIS development. See attached map for reference, illustrating main road network, rail line and connections to ports.
- The mining subsector, of vital importance for FERTIS development, contribute marginally to GDP. At present activity is limited to small scale gold mining. Untapped are reserves of potash, copper, zinc and iron ore. Not explored yet phosphate and sulphur (pyrites) deposits.
- The energy subsector is stronger, as it is characterized by considerable hydro-electric capacity (1,200 MW at present, with dynamic growth); crude oil is delivered from imports to refinery in Assab (capacity close to 1 million tonnes per annum) where it is processed to petroleum products; there are prospects of locating petroleum in the Ogaden region (Soviet and Western companies have started prospecting), at the same time oil exploration is slowly progressing in the south-west of the country. Of a very great importance for FERTIS development in Ethiopia are reserves of natural gas discovered in the Ogaden region at Calub. The reserves are estimated at about 25 billion cubic meters and are being developed with the World Bank support (small scale projects). Wood has always been a traditional source of energy, but it is hoped that increased availability of electricity will reduce usage of fuelwood, as many forests have now become severely depleted.
- Ethiopia, one of Africa's largest and potentially wealthiest countries is only to some extent dependent on foreign aid, grants and loans. Western governments have been critical of the country's rural development policies, which include collectivisation of agriculture and resettlements of "refugees". Some Western countries still refuse to give long-term development aid, preferring to channel their efforts into short-term emergency relief. Longer-term assistance is left to multilateral bodies like the World Bank and the European Investment Bank. The World Bank lends more than US\$100 million for forestry, livestock and drainage schemes during 1987. Upgrading of Assab port is under consideration by the World Bank, as there are various road improvements schemes. European Investment Bank committed US\$27.5 million to soil conservation. There are no grants in fertilizers which are imported in 100% and paid for in foreign exchange.
- Ethiopia is a member of the Preferential Trade Area of Eastern and Southern Africa. Of the greatest importance is also Ethiopia's membership in OAU, IMF, World Bank, African Development Bank, Economic Commission for Africa and United Nations.

One of the most important assumptions in this study is that regional conflicts in Ethiopia will soon be over. This is a pre-condition for the Ethiopian economy to increase significantly its performance, and sine qua non condition for any serious investment programme to become successful.

The country cannot expect much assistance from outside and has to rely on its own, undoubtedly high, but yet not developed potential. Being at a crossroads now, Ethiopia has to either end its regional conflicts and help release its economic potential, or condemn it to warfare and poverty for the rest of the century.

Agriculture is a locomotive for the Ethiopian economy, and FERTIS is one of the most important sub-systems for agriculture to increase its output, supplying domestic and export markets. FERTIS may directly contribute to foreign earnings through exports of potash, and indirectly through an increase of agricultural exports (coffee) due to more intensive application of nitrogen fertilizers (urea).

Ethiopia's strong raw material endowment in nitrogen component (natural gas) and potash component (potash ores) is the foundation on which FERTIS should be developed. That is why Indicative Programme for the Integrated Development of FERTIS in Ethiopia aims at this very direction.

1.1.2 The Fertilizer Sub-sector in Ethiopia

Ethiopia does not produce fertilizers, and so far has been fully dependent on their imports.

Application pattern of fertilizer in Ethiopia is rather simple, with only two types of fertilizer currently used: Diammonium Phosphate (DAP) and Urea (U).

The Agricultural Inputs Supply Corporation (AISCO), the only organisation in Ethiopia responsible for the procurement and distribution of fertilizers, purchased in 1989 altogether 162,000 MT of urea (20% of all fertilizer imports). Additionally, AISCO purchased about 8,000 MT of NPK fertilizers for the Ministry of Coffee and Tea Development.

The total amount of fertilizer nutrients purchased in 1989 amounted to about 100,000 MT of NP, with the resulting N:P ratio of about 1:1.5. Potash component (K) is of much lesser importance in Ethiopia at the present time, it has not been widely used yet, all the more so that domestic soils do not show generally potash deficiency. The consumption of NP nutrients has considerably increased in Ethiopia since 1961, what can be seen below:

	1961-66	1971	1973	1976	1979	1981	1985	1988	1989
NP in terms of 000 MT of N+P ₂ O ₅	1	7	19	27	37	46	66	79	98

The N:P nutrients ratio fluctuated in the range of 1:1.1 up to 1:2.5, with the nutrients ratio of about 1:1.5 prevailing in the last years. In principle, potash was not imported.

Demand for fertilizers, in particular in the last years (thanks to extension services and programmes for farmers), is steeply growing, and it is estimated that the demand is almost two times higher than the present consumption.

The fertilizer demand, derived from applications to AISCO for 1990, shows that as much as 290,000 MT of fertilizers could be consumed, had it not been for the constraints of foreign exchange availability for imports of fertilizers.

DAP is a main source of phosphate, which is applied for, and urea the main source of nitrogen. This is understandable, considering that these fertilizers are the most concentrated ones, what makes that the unit cost of nutrients delivered to farmers' gates is kept at a minimum level.

Assuming similar consumption pattern of fertilizers as in 1989 (i.e.: 80% of DAP and 20% of urea, with the resulting N:P ratio of about 1:1.5), the demand in Ethiopia for fertilizer nutrients in 1990 would be as high as about 175,000 MT of NP.

All imported fertilizers are bagged and are brought to Ethiopia through the port of Assab, from where they are transported by trucks to the main fertilizer stores in Nazareth and Addis Ababa, in order to be distributed to fertilizer consuming regions.

Three regions, namely Shewa, Arssi and Gojam, contributing some 45% of the national food production, account for about 75% of the total fertilizer consumption in Ethiopia.

There are about 750 Selling Distribution Centers in Ethiopia, through intermediary of which fertilizers are delivered to over 4,000 Service Co-operatives, to reach finally peasants' farms, accounting for over 70% of the total fertilizer used in Ethiopia.

Bulk of all fertilizer is consumed in Ethiopian Central Highlands, where the surplus of agricultural production is generated. The Highlands are surrounded by the Lowlands with insufficient rainfall and mostly pasture soils, where Nomadic societies are using practically no fertilizer at all.

Of the total estimated potential of 80 million ha of agricultural land, Ethiopia's arable land potential (cropland) is estimated for about 18 million ha, however, only about 7 million ha is under cultivation at the present time, with the resulting fertilization rate of 14 kg of NPK per ha of cultivated area in 1989 (6 kg NPK per ha of arable land).

For better illustration of the fertilizer industrial sub-system in Ethiopia, see attached FERTIS block diagrams and maps, presenting a lot of additional information related to the sub-system.

1.1.3 Fertis main components and linkages in Ethiopia

According to results of subsectoral typology, analyzed at the first level of UNIDO system approach related to FERTIS, Ethiopia was included in country-group 1 - FERTILIZER IMPORT SUBSTITUTING COUNTRIES.

Though Ethiopia does not produce fertilizers yet, it may, however, soon change its position and from an importer is likely to become a relatively strong producer of fertilizers, substituting import. There are also real chances for Ethiopia to become an exporter of fertilizers, in particular potassium chloride and sulphate.

Future position of Ethiopia's fertilizer industry will depend first of all on the possibilities of how soon the regional conflicts in Eritrea and Tigre be over.

As can be seen from the description of the pattern of development across FERTIS components, Ethiopia has good prospects for the development of its domestic fertilizer industry, namely:

(a) Natural resources

The country endowed with "N" and "K" related raw materials: natural gas and potash ores. A natural gas reserve estimated at about 25 billion cubic meters has been discovered and is being developed in the Ogaden region of Ethiopia (CALUB). This area has now been reserved by the government and the USSR is undertaking further exploration.

A pre-feasibility study funded by the World Bank had earlier been carried out by the Gas Development Corporation of USA. This company have identified a number of small scale gas utilization projects (domestic and industrial fuel, vehicular fuel, electricity generation) and these projects have been started with the World Bank funding. One of the small scale projects identified but not included in the above funding is the establishment of a mini-fertilizer nitrogen plant, to be built at GODE which is about 100 kms away from CALUB. A mini-fertilizer plant would need up to 50 million cubic meters of gas per year. The government is also looking, however, to a large scale gas utilization scheme in which as much as 1.2 billion cubic meters of gas would be sent either through East-North or South-West natural gas pipeline from Calub to Addis Ababa (for reference see attachments).

In large scale gas utilization scheme, a world-scale fertilizer complex of ammonia and urea plants is considered in METAHARA. Such a complex would use up to 0.5 billion cubic meters of gas per year, and natural gas reserves would be sufficient to feed the complex for about 25 years. With other consumers included in the large scale scheme, the gas reserve would suffice only for 20 years of operation.

The Government has offered 25 oil-gas blocks to Western companies in the Red Sea, in the Ogaden and on the border with Sudan. However, only one block, on the Red Sea, has been taken up, by Chevron. It is estimated that the probability of discovering new deposits of natural gas on the Red Sea coast is high, in particular when several oil-gas blocks are taken up, in peaceful conditions, by specialised companies. Natural gas discovery on the Red Sea coast would have great significance for designing future strategy of FERTIS development in Ethiopia, in particular, as far as the planned fertilizer industry development in ASSAB is concerned.

Potash deposits are located in the Danakil Depression, some 90 km from the port of Mersa Fatma on the Red Sea Coast in Northern Ethiopia. The deposits, discovered after the turn of the century, have been worked and

explored on and off since then. In 1981, an Ethiopia-Libya joint venture (ELMICO) acquired the deposit and initiated a prefeasibility review. Initial Phase 1A report was issued in 1986. Because of the military struggle with Tigre rebel forces, the specialists of Entreprise Minière et Chimique of France still await the permission of the Ethiopian Government to visit the area, to complete Phase 1B and Phase 2 reports. A review of market prospects for potash was also completed by ECA in 1982.

The potash deposit has a number of attractive characteristics; the deposits are close to surface, permitting cheaper open pit mining and (or) solution mining. In addition to sylvite (containing an average of 33% KCl) and carnallite, kainite could also be mined to produce potassium sulphate. Estimated potash reserves a range from 10 to 18 million tons of recoverable KCl product. The deposit is close to the coast and a reasonable harbour, and advantageously located for markets in Asia and Africa, to which the projected production of 1.5 million MTPY of KCl could be directed from the potash complex.

However, the World Bank indicates for unpromising market prospects for potash (overall demand and prices are depressed), what makes that at the present prices the economics of the project seem in doubt. The World Bank points out for the complexity of the deposits which would need quite an extensive programme of the technical work, as well as technically and financially qualified partner. Also, penetration of the Asian market, which consumes about 2.8 million MTPY of KCl, would be one of major tasks. The project would need to offer a substantial price advantage as well as to establish credentials as a reliable supplier.

The two remaining raw materials of great importance to the FERTIS development in Ethiopia: sulphur and phosphate are known to occur in several locations and in different geological formations, there is a need, however, for further exploration. Sulphur and pyrite occurrences are located in Eritrea, Tigre, Harar and Shoa provinces. Results obtained so far in the exploration programme begun in 1985 by a joint EIGS-UNIDO team, proved the existence of phosphate bearing rock in the Ogaden and apatite associated with magnetite and ilmenite in the Wellega and Bale regions.

(b) Processing to intermediary products

Ammonia, sulphuric acid and phosphoric acid have not yet been developed in Ethiopia. Although small capacity sulphuric acid plant is being built at present in Nazareth (the plant is based on imported brimstone and will feed the ceramic industry - kaoline processing), the best prospects for development is seen for ammonia plants based on domestic resources of natural gas. Once studied ammonia plants based on hydroelectricity (water electrolysis to yield hydrogen), in the light of electricity prices in Ethiopia in the range of 10-45 US Cents per kilowatt-hour, cannot compete with natural gas based ammonia plants.

It is believed that to the end of the century, processing to ammonia will be substantially developed (plans for the development of a mini-fertilizer ammonia plant at Gode and world-scale ammonia plant at Metahara). The sulphuric industry may be developed on the basis of imported brimstone (elemental sulphur) by the year 2000 to some extent. The lowest prospects are for development of the domestic phosphoric acid industry (planned imports of phosphoric acid to Assab).

(c) Processing of NPK fertilizers

The processing of NPK fertilizers has not been developed in Ethiopia until now. Several alternative routes were looked into the past, but the lack of the required domestic materials, weak infrastructure, and foreign constraints have hindered action-oriented decisions in the domestic fertilizer industry.

DAP (TSP), Urea and MOP (SOP) are the fertilizers that are given priority in plans of FERTIS development in Ethiopia, as follows:

- versatile DAP (TSP) plant in Assab
- urea plants at Gode and Metahara
- MOP (SOP) plants at Dallol (potash fertilizer complex)

(d) Other operations (Bulk-Blending, Compound Granulation, Ground Phosphate rock Plants)

These operations have been the subject of intensive studies in the past, nowadays, however, these ideas have been totally abandoned in favour of syntheses of fertilizer products.

Packaging industry development is considered in order to decrease foreign exchange burden through imports of bulk fertilizers rather than bagged.

(e) Energy self-sufficiency and energy consumption per capita

These are the measure of industrial inputs and services in the FERTIS development. With the total energy self-sufficiency of about 9% in 1986 (all crude oil is imported to Assab refinery), and, thanks to quite well developed potential of hydroelectricity, with self-sufficiency in electrical energy of 100%, Ethiopia can be considered as a country characterized by a low level of development of energy sector.

Energy consumption per capita - 21 kg of oil equivalent in 1986 - is one of the lowest in the world.

And yet, in spite of these indicators, Ethiopia has some prospects for improvement in energy sector, in particular in further hydro-electricity development, utilization of natural gas and geothermal energy. There are also prospects for oil discovery in Ethiopia, provided that intensive exploration is continued in peaceful conditions. The development of energy sector is an imperative to stop the process of deforestation (fuelwood gathering), which, in turn, is the cause of the severe desertification.

(f) Storage, transport and distribution

These three factors are quantified in FERTIS by two variables, total area of the country and infrastructure and transport network. Ethiopia can be characterized in this component as the country having considerable constraints for balanced FERTIS development.

Large area of the country, mountainous sculpture of the landscape crosscut with Rift Valley, limited access to the Red Sea coast through port of Assab with the only rail-line linking Addis Ababa with port of Djibouti - these are the most important features of Ethiopia in FERTIS component 6.

Also because of that, the fertilizer farm-gate price is higher of about 50% of the fertilizer price CIF port of Assab. It is assumed, in AISCO calculations, that the total cost of handling 1 tonne of fertilizer to average farmer's gate is as high as 288 Birr, which is equal to US\$140 per tonne. Of that, US\$80 per tonne is spent for fertilizer handling in port of Assab and its transport to central warehouses in Nazareth and Addis Ababa by road.

(g) Consumption of fertilizers

This indicates for quite a considerable market in Ethiopia, about 100,000 MTPY of pure nutrients in 1989, as well as for a dynamic consumption growth of over 250% in the last decade. Further quick increase of consumption is expected by the end of the century, to as much as about 400,000 MTPY of NPK, which is considered to be a minimum consumption level, heavily constrained by the availability of foreign exchange for imports of fertilizers.

As already discussed, N:P nutrients ratio of 1:1.5 is expected to shift in the future more towards nitrogen, and N:P ratio limit value of 1:0.5 can be expected by the year 2000.

The size of the present market and fertilizer consumption growth in the last years indicate for the necessity of the creation of the domestic fertilizer industry in Ethiopia.

With low N:K ratio (below 1:0.1), and with substantial reserves of potash ores, there are good prospects for developing export-oriented production of potassic fertilizers.

(h) Demand for fertilizers in the year 2000

The demand for fertilizers is expected in the range of: minimum 400,000 MTPY of NPK up to maximum 650,000 MTPY of NPK. These LOW and HIGH fertilizer demand scenarios 2000 should be considered to be dependent on cumulative constraints that may affect future fertilizer consumption (low scenario with, and high scenario without constraints).

The fertilizer demand in Ethiopia, assumed in this study, is much higher than the demand 2000 forecasted in FAO Scenario A - 1980, UNIDO Scenario C - 1983 and fertilizer demand 2000 assumed in FAO estimations in 1988.

Low fertilizer demand scenario corresponds broadly with the demand forecast adopted in FAO study "Ethiopian Agriculture - Crop Yield Response and Fertilizer Policies", dated July 1989.

As there is no production of fertilizers in Ethiopia at present, the assumed demand 2000 is equal to the NPK gap 2000, as follows:

	<u>Low Scenario</u>	<u>High Scenario</u>
Nitrogen (N)	190,000 MTPY	418,000 MTPY
Phosphate (P ₂ O ₅)	190,000 MTPY	209,000 MTPY
Potash (K ₂ O)	20,000 MTPY	23,000 MTPY
Nutrients NPK	400,000 MTPY	650,000 MTPY

If the NPK gap is to be covered, a lot of capacities would be needed in the domestic fertilizer industry in Ethiopia by the year 2000.

The present consumption of fertilizers (98,000 MT of NPK in 1989) covers the demand 2000 in low scenario in 25% and in high scenario in 15%, this being an indication of how big increase of fertilizer delivered to agriculture would be needed.

When nutrient demand for 1990 (which is 175,000 MT of NPK) is compared with the demand 2000, one can see that forecasted growth in fertilizer demand in the next decade is as high as 230% in low scenario and 370% in high scenario. This can only be achieved, if civil war in Ethiopia is soon over, and the highest priority is given to the development of agricultural sector, including FERTIS development

(i) Fertilizer application

This is measured by consumption of NPK per hectare of arable land with permanent crops.

Therefore, fertilization rates assumed in Ethiopia by the year 2000, should be compared with analogous indicators related to the World and Africa, as follows:

	NPK demand 2000 per ha of AL + PC	NPK demand 2000 per capita
World	145 kg	36 kg
Africa	38 kg	9 kg
Ethiopia (Low scenario)	22 kg	6 kg
Ethiopia (High scenario)	36 kg	10 kg

Arable land potential in Ethiopia is estimated for 18 million ha in 2000; share of arable land in agricultural area (about 80 million ha in 2000) is equal to 22%. Potential arable land per capita in the year 2000 is estimated for 0.28 ha, which shows that the pressure on the agricultural land in Ethiopia will grow substantially by the year 2000. This is an enhancement for the development of the fertilizer industrial system in Ethiopia, all the more so that the assumption on the land resources are rather optimistic ones. Rapid deforestation, erosion and desertification of arable land, threatens the food production base of future population in Ethiopia, estimated to grow up to 65 million inhabitants by the year 2000.

It is worth noting that only about 8.5 million ha of arable land is expected to be cultivated in 2000. Accordingly, fertilization rates measured per ha of cultivated area, are expected to be rather high when compared to 1989:

	1989	2000 (Low scenario)	2000 (high scenario)
Fertilization rate per ha of cultivated area (kg NPK)	14	47	76

It is believed that, with the limited land resources and quite a substantial population by the year 2000, there is no other choice for Ethiopia but to intensify agricultural production through much higher use of different inputs, first of all fertilizers.

(j) Fertilizer impact on agricultural production

This is believed to be the highest of all the inputs considered (seeds, pesticides, irrigation, mechanization, fertilizers) for application in Ethiopia. Improving crop yields through fertilizer use is best characterized by results of FAO Fertilizer Programme on maize in Ethiopia in the years 1967-78. Country average yields of maize were at the level of 1,050 kg per ha of cultivated area, yields achieved with fertilizer used under control were at the level of 2,170 kg of maize per ha of cultivated area, while best treatment results were as high as 3,280 kg of maize per ha of cultivated area.

Fertilizer response coefficient based on fertilizer demonstrations in Ethiopia showed that as much as 16.3 kg of sorghum, 15.1 kg of maize and 7.3 kg of wheat could be yielded per one kilogram of NPK nutrients applied in best treatments.

With projected population of 65 million inhabitants, and GDP per capita much lower than in the majority of Sub-Saharan African countries, Ethiopia will be able to supply only limited inputs from the national economy to the agricultural sector. It will be, however, impossible to nourish the nation without substantially increased consumption of fertilizers. According to FAO Study "Ethiopian Agriculture - Crop Yield Response and Fertilizer Policies" of July 1989 - No Acreage Expansion Scenario (Variant A) - fertilizer consumption increase with proper related policies is a single factor that may contribute to substantial increase of food self-sufficiency and per capita dietary energy supply in Ethiopia.

Cereals self-sufficiency ratio may be raised from 74% up to 94% and DES may be increased from 1,618 up to 2,001 kcal-cap-day if consumption of fertilizers is increased from 188,000 MT of NPK up to 333,000 MT of NPK in the year 2000.

(k) The incentive to use fertilizers by farmers

This incentive, expressed as a crop price versus fertilizer price index, is of great importance in Ethiopia in order to enhance increased use of fertilizer. It is estimated, in the above mentioned FAO Study, that fertilizer price subsidy of 50% would contribute alone to fertilizer consumption increase by 20%.

Price and fertilizer subsidy policies can play an important role to stimulate agricultural production in Ethiopia in the initial stage.

The percentage of farmers adopting fertilizer use is likely to increase from about 10-15% to some 30% by the year 2000. Specific policy measures including improved extension services, demonstration trials, timely and efficient distribution of fertilizers together with subsidies and credit will be essential to ensure higher rate of fertilizer adoption by the year 2000.

The average ratio of cereal to fertilizer nutrient price has been fluctuating in Ethiopia in the range of 0.38-0.18, showing slow decline in the years of 1966-67 to 1986-87. The decline in the ratio from about 0.3 to about 0.24 has probably also curtailed the use of fertilizers.

(1) Government priority in FERTIS development in Ethiopia indicates the following:

- Though fertilizer is a very costly input, and Ethiopia faces problems with foreign exchange availability, a year by year increasing consumption of fertilizers illustrates the importance of this input to the government, allocating financial resources for imports of fertilizers.
- Government strategy is clearly set for Import Substitution, the evidence of this being plans of the development of the national fertilizer industry (projects in Assab, Gode and Metahara).
- It is felt that the strategy of Fertilizer Import Substitution are given government priority over Export Promotion strategy (plans of the establishment of nitrogen and phosphate fertilizer facilities in Assab, Gode, Metahara versus export-oriented potash complex in Dallol).
- Export of NPK fertilizers or nitrogen or phosphate related raw materials cannot be taken into account in the foreseeable future, since fertilizer industry and fertilizer raw material base are not yet developed in Ethiopia. The best chances are seen in export of potash from Ethiopia.

1.2 Quantitative description of the performance of all important components of the fertilizer industrial system in Ethiopia

The general description of FERTIS in Ethiopia presented above, should be complemented with short quantitative description of the system. This can best be done through presenting FERTIS Block Diagramme ETHIOPIA - time base 1989.

The present Fertilizer Industrial System in Ethiopia is rather simple, as all fertilizers are imported.

Altogether, about 170,000 MT of fertilizer products (DAP + Urea + NPK fertilizer), the equivalent of about 100,000 MT of NPK, were imported in 1989 for the total of about US\$44 million CIF port of Assab.

Procuring and distribution of fertilizer is the task of the Agricultural Inputs Supply Corporation (AISCO) which is operating under the Ministry of Agriculture (MOA) and has a monopoly position of this kind of activity. Procurement is done by international bidding, as well as from EEC (fertilizer quotas and pricing level set by EEC). Of the two most frequently used types of fertilizers purchased in 1989, CIF price for DAP purchased through international competition from Jordan amounted to 543 Birr (US\$186). In contrast, urea purchased from EEC cost 500 Birr (US\$242) per 1 MT of bagged product.

The farm-gate price of this latter product rose from 500 Birr CIF port of Assab, up to 788 Birr per 1 MT of bagged urea loco farmer, and the breakdown

of price increase is as follows:

(a) CIF port of Assab per 1 MT of bagged urea	-	500 Birr
(b) Product insurance (Assab-Nazareth of Addis Ababa)	-	3 Birr
(c) Bank charge (Letter of Credit)	-	21 Birr
(d) Port dues	-	1 Birr
(e) Transport and handling in the port (clearing charge) Maritime Transport Service Corp.	-	57 Birr
(f) Transport from Assab to warehouse in Nazareth or Addis Ababa (transit to warehouse)	-	108 Birr
(g) Unloading in warehouse	-	3 Birr
(h) Loading on trucks	-	3 Birr
(i) Spoilage and losses	-	<u>3 Birr</u>
(j) Sub-total		690 Birr
(k) Overhead and general expenses (Bank, insurance)	-	30 Birr
(l) AISCO overhead	-	18 Birr
(m) Contingency	-	<u>15 Birr</u>
(n) Selling price before turnover tax	-	753 Birr
(o) Turnover tax (2%)	-	<u>15 Birr</u>
(p) Selling price to Service Co-operative	-	<u>768 Birr</u>
(q) Farmer-gate price	-	<u>788 Birr</u>

Thus, the whole chain of port handling-transport-storage operations with due costs, causes price built-up per 1 MT of any type of bagged fertilizer of about 788 - 500 = 288 Birr, equivalent to about US\$140. The total value of fertilizers purchased in 1989 (CIF Assab) has been estimated for 91 million Birr, while the total value of fertilizer loco farmers' gate for about 137 million Birr.

There are no fertilizer stores, nor bagging facilities in the port of Assab. Ships calling to the port are unloaded by general cargo port facilities that handle as well bagged fertilizers.

There are plans of construction of a fertilizer store in port of Assab. The store is to have the capacity of 25,000 MT of bagged fertilizers and is to be built with EEC assistance.

At the same time, National Chemical Corporation (NCC) plans to build a fertilizer store adjacent to its DAP (TSP) versatile fertilizer plant in Assab; AISCO plans to built fertilizer bagging facilities in Assab - (for reference see attached Technical Assistance Proposals).

A fleet of trucks delivers fertilizers to central stores in Nazareth (capacity of 8,000 MT of bagged product) and in Addis Ababa (capacity of 12,000 MT of bagged product). AISCO is using government transport fleet of Ethiopia Freight Transport Corporation in order to bring fertilizers from Assab to central stores, as well as to distribute fertilizers to other regions. Through planned purchase of 50 truck-trailers, AISCO aims at

covering of up to 50% of fertilizers distributed from central stores in the country. With the World Bank funds, AISCO will also buy 3 mobile fertilizer bagging units - (see Technical Assistance proposal for reference).

AISCO is totally responsible for the supply and distribution of inputs throughout the country. This entails AISCO, as a main wholesale supplier, to organize and manage the imports, storage and distribution of fertilizers and other inputs to the extensive network of marketing centers for retail sales through Service Cooperatives to Peasant Associations and Cooperatives - (see Technical Assistance proposal for AISCO training package for reference). An efficient programme of procurement and timely distribution throughout the country is critical to meet the Ten-Year Perspective Plan, according to which fertilizer consumption should increase from 27,000 MT nutrients in 1983-84 to about 230,000 MT nutrients in 1993-94, an about eight-fold increase for a decade. In practice, the above mentioned are all industrial inputs and services connected with the fertilizer industrial system in Ethiopia. Since there is no production of straight fertilizers, nor complex fertilizers, neither bulk blending operations in Ethiopia at present, the next FERTIS component to be analyzed is FERTILIZER SUPPLY.

In 1989 only primary nutrients: NPK were supplied to agriculture, no secondary nutrients or micro-nutrients are known to be used in 1989. As already mentioned, out of about 100,000 MT nutrients delivered, nitrogen occupied some 29%, phosphate 60% and potash about 1%. The nutrients ratio, resulting from all the fertilizers imported in 1989, was around N:P:K = 1:1.54:0.03. Priority in supplies was given to DAP (75%), Urea (20%), followed by NPK (1:1:1) fertilizers (sharing about 5% of supplies). AISCO was the only purchaser and supplier of fertilizers in 1989.

There are several projects connected with import substitution of fertilizers that are planned by government - (for reference see Technical Assistance project proposals). These projects are related to primary nutrients (NPK), secondary nutrients (S, Ca, Mg), and to a lesser extent to micro-nutrients.

Total fertilizers imported are DISTRIBUTED (the next FERTIS component) by AISCO through the two channels: cooperative and state controlled. There is no private distribution channel developed in Ethiopia. The lion share of all the fertilizers distributed goes through the cooperative channel, connected with peasant sector.

Parastatal channel is connected with the Ministry of State Farm Development (large scale farms), Ministry of Coffee and Tea Development (cash crop producers), Government Resettlement Programme and other NGO's buying fertilizers from AISCO.

Over 90% of imported fertilizers are distributed in the Surplus Producing Areas (see attached map for reference), located mostly at Highlands, the remaining being shipped to Potential Surplus Producing Areas. Deficit Producing Areas. Deficit Producing Areas are in principle not supplied with fertilizers. Fertilizers are distributed from AISCO's central stores in Nazareth and in Addis Ababa to about 750 Selling Distribution Centers in Ethiopia managed by AISCO, from where fertilizers are sent to about 4,000 Service Cooperatives connected with some 20,000 Peasant Associations. From Service Cooperatives, that have their local fertilizer stores, fertilizers are

delivered to some 7 million of peasant farms. A farmer usually buys from 1 to 8 (50 kg) bags of fertilizer product.

The whole process of fertilizer supply and distribution, from request for fertilizer to its application into soil, lasts approximately one year.

About 7-8% of fertilizer is damaged in the whole chain of supply-distribution, this being of great concern to AISCO - (see Technical Assistance project proposal connected with fertilizer mobile packing unit).

CONSUMPTION of fertilizers in Ethiopia is connected chiefly with small scale farms in peasant sector, consuming over 75% of fertilizers.

Over 75% of fertilizers is consumed in 3 regions (Shewa, Arsi, Gojam), where some 15-20% of farmers use fertilizers. The rate of fertilizers adoption in the other 11 regions of Ethiopia is very low.

The largest share of fertilizer, over 80%, goes to cereal crops, and within that group about half is applied to teff, followed by wheat, barley, maize and other crops.

Large scale farms (about 5,000 ha versus 2 ha of peasant farm) consumed in 1989 about 15% of fertilizer, mostly DAP, followed by urea. Large farms under Ministry of State Farm Development share the cash crops market with the producers of coffee and tea under Ministry of Coffee and Tea Development which uses about 5% of fertilizer consumed in Ethiopia (mostly NPK fertilizers and urea, followed by DAP).

Around 5% of fertilizer consumption is shared by other organizations, including resettlement programmes.

DEMAND for fertilizers in Ethiopia at present is almost 2 times higher than consumption, and is controlled by foreign exchange availability for imports of fertilizer (there is no aid or grants of fertilizer in Ethiopia). Pricing policies (fertilizer prices, crop-fertilizer price ratio, subsidy level), having direct impact for farming efficiency also influence fertilizer demand. Fertilizer prices are relatively high, crop-fertilizer price ratio low, fertilizers are being subsidized in 7% and only for peasant sector.

The highest demand can be noted for DAP and urea, but also NPK's are looked for (mostly coffee farms). Sugar growers apply on alkaline soils ammonium sulphate (AS). Also nitrophosphates (NP) are being tested for coffee. Cotton growers use urea. Urea is also used for coffee as a top dressing fertilizer, but can be used in acidic soils only to a limited extent if soils are not limes (limestone, dolomite).

It is expected that the application of DAP will rise in future, but along with the increased residual phosphate content of the soils, being a consequence of continuous phosphate fertilization, importance of DAP will lessen, mostly in favour of urea, the application rate of which is expected to grow constantly by 2000.

Demand for different fertilizer types, clearly indicates the following:

In the group of primary nutrients N, P, K there is a shift trend from

phosphate more to nitrogen; this trend will be growing towards 2000. N:P ratio is expected to shift from the present value of about 1:1.5 towards recommended by Institute of Agricultural Research ratio of 1:0.5. Potash remain to be of lesser importance for Ethiopian soils.

- Secondary nutrients: S, Ca, Mg will also be needed in the future to control pH of soils. Alkaline soils will have to be treated with ammonium sulphate (the carrier of S), while acidic soils will have to be limed (limestone and dolomite, carrying Ca and Mg).
- There is no demand for micronutrients: Bo, Zn, Fe, Cu, Mo, Mn, Co at present in Ethiopia.

Defining the optimum future nutrients ratio is perhaps of greater importance for Ethiopia than defining quantitative demand for nutrients by the year 2000 - (for reference see Technical Assistance project proposal regarding a seminar on fertilizer demand and nutrient ratio). Present N:P ratio is around 1:1.5. This ratio is, to some extent, dictated by the transport unit cost of fertilizer (concentrated DAP and urea are preferred). FAO's latest recommendations are set for the nutrient ratio of N:P = 1:1 by the year 2000. Local IAR recommends future nutrient ratio for N:P = 1:0.5.

As already discussed, LOW fertilizer demand scenario (in line with FAO recommendation) should be set for 400,000 MTPY of NPK by 2000, while HIGH fertilizer demand scenario (in line with opinions of the Ministry of Agriculture and Institute of Agricultural Research) might be set for 650,000 MTPY of NPK by 2000, provided that the civil war in Ethiopia will soon be over and that there will not be constraints limiting fertilizer use, in particular foreign exchange availability constraint will be eliminated. The amount of fertilizer product by 2000 will be directly dependent on the nutrients ratio and types of fertilizer products selected and may vary in the range of 700,000-1,400,000 MTPY. Because of great differences in opinions on future demand and optimum fertilizer nutrients ratio, a seminar is recommended to be held on this topic.

The EXTENSION SERVICES are recognized to be of utmost importance for agricultural production increase in Ethiopia. Extension services are supervised at the level of the Ministry of Agriculture through Agricultural Extension Department. In each of 30 provinces (administrative regions) and in each of the 107 districts, there are Heads, Group Leaders (extension) and Subject matters Specialists (SMS) that supervise extension services. In each district SMS supervise Development Agents (DA) who are in direct touch with Contact Farmers and through Follower Farmers they reach about 5 million peasants in Surplus Producing Areas. DA's operate in 1,607 Development Centers bringing in extension information every 15 days to over 79,000 Contact Farmers all over Ethiopia. Average ratio DAs:Farmers is as 1:1,300, and over 2 million farmers are reached through Training and Visit Model in 107 districts.

The extension services are in particular important for the increase of the rate of fertilizer adoption by farmers and, though extension services have been improved significantly in the last years, it is critical that the agricultural extension service is sufficiently endowed with funds and staff to be able to reach an increasing number of farmers, especially in the peasant sector.

Policies in FERTIS development embrace several issues, such as:

- Peasant's access to technology packages, i.e. fertilizers together with delivery of improved seeds which is of particular relevance for agricultural production increase in Ethiopia,
- Facilitation in absorption of technology and access to industrial inputs and services (improved agricultural methods, extension and advisory services, fertilizer storage and fertilizer handling facilities and infrastructure), which is estimated to be one of the highest constraints inhibiting agricultural growth in Ethiopia, all the more so that agricultural credit has, in principle, never been a problem to the farmer to such an extent as absorption of technology and access to industrial inputs,
- Government priorities in allocation of financial resources. For instance export of coffee in 1989 brought earnings over US\$250 million, while the cost of fertilizer used was about US\$3 million. Priority in access to fertilizer has, however, been given to food crops (cereals). If priority were given to coffee, access to industrial inputs and capability in absorption of technology would be a constraining factor rather than a financial resources for the purchase of fertilizers for coffee growers,
- Pricing policies: price of fertilizer, subsidy level, crop price versus fertilizer price in order to increase incentives for fertilizer use and rate of fertilizer adoption in Ethiopia. Pricing policies are recognized to be one of the most important component to halt declining per capita food production in Ethiopia during the last two decades, and to reach acceptable level of domestic food security.

See also Technical Assistance project proposal connected with training package to AISCO.

1.3 Importance of the Fertilizer Industrial System in the Ethiopia economy and Government development objectives related to the FERTIS

According to the Ten-Year Perspective Plan 1984/85 to 1993/94 one of the principal objective is accelerating growth of the Ethiopian economy through the expansion of the country's productive capacities in agriculture, mining and industry.

Attainment of food self-sufficiency and at least a three month food security reserve by the end of the plan period by raising agricultural production is the most important of the adopted plan strategies, to which a strategy of enlarging and diversifying exports and promoting import substitution wherever it is found economically feasible should be added, as they are closely related to FERTIS development in Ethiopia. To intensify inter-sectoral linkages particularly among agriculture, mining and industry, the plan would promote import substitution based on the country's resources. Industry is planned to commence the production of fertilizers in order to, at least partially meet the requirements of agriculture for this input. In a similar manner the mining sector would produce (inter alia) potash and limestone. In order to raise overall agricultural productivity, increasing the supply of improved agricultural inputs to farmers will be essential. In this respect, the agriculture sector plan envisages importing in greater

quantities fertilizers, while agricultural research will be directed towards raising the yield of indigenous crops through better application of fertilizers. Total fertilizer consumption which amounted to 48,000 MT in 1983-84 is planned to increase to 395,000 MT by 1993-94, bringing the per hectare rate of fertilizer use from 7.1 kg to 51.7 kg by 1993-94.

Closely connected with FERTIS sub-sectors of industry, such as: the non-metallic mineral products, chemicals and metal industries are given emphasis in the Perspective Plan, as they are key sub-sectors for supplying agricultural sector essential inputs like fertilizers, and are expected to lay down the basis for building heavy industries and to accelerate national economic development. These sub-sectors are expected to grow at the rate twice higher than the average rate of growth in industry.

Production target of fertilizer is to obtain from domestic facilities by 1993-94 as much as 270,000 MT of fertilizers of value estimated for 386 million Birr.

From the view point of the objective of transforming the production structure of industry and, especially, of supporting agriculture, the chemical industry deserved a great emphasis in the Perspective Plan. Hence, a substantial investment amounting to 935 million Birr or 22% of the total has been allocated to this sector. The number of projects under this sub-sector are 52, among which are FERTILIZER FACTORIES.

On the other hand, the strategies in the mining sector recognized exploration of petroleum and natural gas as the dominante in the geological survey's sub-sector list of projects (47% of the estimated investment requirement). At the same time, potash development has been given priority in investment requirements for the mineral development sub-sector (55% of the estimated investment requirements), as this project is oriented both for domestic and export markets.

The following are the major projects in the transport sector that are planned to be executed during the ten-year plan period:

- Addis Ababa - Assab Railway line construction;
- Improvement of Addis Ababa - Djibouti Railway line;
- Acquisition of locomotives and wagons;
- Acquisition of buses and trucks;
- Expansion of Assab and Massawa ports.

The objectives, strategies and priorities set up in the Perspective Plan indicate importance and key position of the Fertilizer Industrial System in the development of the Ethiopian economy, in particular agriculture, being the foundation of the country's economy and playing a major role in generating the financial surpluses, especially in foreign exchange, needed for financing long-term industrialization programme in Ethiopia.

Linking priority projects in agriculture, industry, energy, mining and transport sectors, FERTIS by itself can be recognized as a system to which the highest priority is being given in long-term plans of development of the Ethiopian economy.

1.4 Ongoing development activities related to the FERTIS

The most important activities, directly or indirectly related to FERTIS, known to be undertaken in Ethiopia are listed below:

A. Agriculture and rural development

(a) Inter-American Development Bank (IDA) - US\$85 million.

Support for the government's reform-minded peasant agricultural development programme, which has considerably liberalized grain marketing, will help sustain the movement toward improving the sector's incentive framework, facilitate the production response among peasants, and mobilize support from other donors. Total cost: US\$118.6 million.

(b) Peasant Coffee Development (IDA) - US\$40 million

The project would strengthen Government support services for food and coffee production in the major coffee producing areas. Support would also be given to expanding washed coffee primary processing factories, rehabilitating coffee hulleries and improving export processing facilities.

(c) IDA - US\$7 million

Through the construction of small-scale irrigation schemes in drought affected areas, together with conservation and agricultural support in Hararhge region, the problems caused by frequent drought and increasing desertification will be addressed. Co-financing is anticipated from International Fund for Agricultural Development (IFAD) - US\$12 million, the Organisation of Petroleum Exporting Countries (OPEC) - Special Fund - US\$4 million, and the World Food Programme (WFP) - US\$1 million. Total cost: US\$33.7 million.

B. Transportation

(a) IDA - US\$72 million

The turn around time of export-import cargo will be speeded up by directly addressing the bottlenecks in the port of Assab, freight forwarding, customs, and road transport - particularly the road from Assab to Addis Ababa. Co-financing is anticipated from the African Development Bank (AfDB) - US\$55 million and the European Investment Bank - US\$12.5 million. Total cost: US\$164.6 million.

(b) The Public Investment Program (PIP)

Road Transport Equipment (224.3 million Birr); Railways (113 million Birr); Ports and Shipping (173.1 million Birr); Road Construction (511 million Birr).

Congested ports due to the limited berthing storage capacity, old and inadequate cargo handling equipment; insufficient road carrying capacity and availability of vehicles to get goods moved inland from the ports of Assab and Massawa due to an old and limited trucking fleet; insufficient rail carrying capacity to move goods inland from the Port of Djibouti due to an old railway; a striking lack of roads (both primary and rural) throughout the country - these are the main issues addressed by the Public Investment Programme.

Note: The uncertainty surrounding the Addis Ababa - Assab Railway Project has tended to cloud the effort to relieve urgent transport constraints. The high cost of the project suggest that the Government will be unable to mobilize necessary resources. This project would be of great importance to FERTIS development (transport of imported fertilizers to central stores, movement of DAP (TSP) from Assab to central stores, shipment of ammonia from nitrogen fertilizer complexes in the country to Assab).

C. Mining and energy

(a) IDA - Mining and energy - about US\$55 million

Five major components:

- (i) power transmissions and distribution;
- (ii) small-scale gas utilization;
- (iii) rehabilitation, modernization and expansion of Assab oil refinery;
- (iv) petroleum exploration promotion; and
- (v) mining sector development.

Note: It is important to analyze how the demand for refined petroleum products would change if the exploitation of gas reserves in Ogaden were to prove economic. Donor support for gas development and marketing studies and an overall sub-sector strategy review are the logical next steps.

The feasibility work on the development of the Dallol potash deposit has been delayed because of the financial problems of ELMICO; the second phase of the feasibility work will need to carefully consider the market possibilities. The potash exploration and development funds for ELMICO envisaged for 1986-1989 amounted to US\$5.0 million.

D. Industry

(a) Public Investment Programme (PIP)

About 125 million Birr is allocated for the chemical sub-sector which includes a total of six projects. A review of these projects shows that most of them are new. They do not appear to have been subjected to adequate preparation and appraisal and their chances of implementation are therefore minimal.

Notes:

- (i) As compared to many Sub-Saharan African countries, the manufacturing industry in Ethiopia operates at a fairly high capacity.

- (ii) The Government declared objectives of promoting the small-scale sector, therefore it would be desirable to increase the share of the small-scale industries in investment at the cost of reducing the share of the new large-scale projects which are concentrated in capital-intensive undertakings. Mini-fertilizer plant project meets this criterion, together with the criterion of small-scale gas utilization, and project A. c. above.
- (iii) The main strategy in the Public Investment Programme focuses on peasant agriculture and incorporates the concept of selectivity, with investments concentrated in areas of highest production potential. The high potential districts would receive priority allocations of fertilizers and other inputs. This criterion, in turn, would be met by large-capacity ammonia-urea complex planned by National Chemical Corporation at Metahara. Also, alternative scenario (discussed in detail later on), envisaging the construction of ammonia-urea plants at the region of Yirga Alem and at Mojo, meet the above criterion even better.
- (iv) Fertilizer DAP (TSP) versatile plant in Assab is highly connected with the projects related to de-bottlenecking of port of Assab, improvement of road transport Assab-Addis Ababa, and the Addis-Ababa-Assab (suspended!) project.
- (v) Potash development to export-oriented project is related to intensify road transport from the port of Massawa, as well as the port of Assab.

1.5 Institutional framework for the development of the system

The Ten-Year Perspective Plan 1984-85 to 1993-94 is the most important document binding the Ethiopian Government and its organization in the development of economy. FERTIS finds its place and investment outlays in this plan, however, not as an isolated system, but rather as a system the elements of which are intervene into different sub-sectors of the economy.

The Government of Ethiopia launched a Three-Year Development Plan (TYDP) in July 1986, as the second phase of the Ten-Year Perspective Plan, with the purpose of consolidating the recovery from the recent drought and overcoming the long-term stagnation of the economy. This Plan reviews the Public Investment Programme (PIP), being a framework for some of the projects related to the development of FERTIS.

To institutional framework should also be included all these projects that are embraced within the scope of International Co-operation, and are related to FERTIS development in Ethiopia, namely:

- (a) The ninth session of the Joint Commission for Economic, Scientific and Technical Co-operation between the People's Democratic Republic of Ethiopia and the German Democratic Republic was held in June 1988 in Addis Ababa. Addis Ababa - Assab Railway Project was discussed.
- (b) The Tenth Session of Ethio-Yugoslav Joint Committee for Economic, Scientific and Technical Cooperation was held in December 1988 in Belgrade. Lime Processing Plant Project was discussed.

- (c) The Eight Session of the Inter-Governmental Ethio-Soviet Commission for Economic, Scientific and Technical Cooperation and Trade was held in Addis Ababa in January 1989. The new project: Fertilizer Plant based on local Natural Gas was discussed.
- (d) UNIDO Pipeline Project: Consultancy in evaluation, production and technology of industrial minerals and rocks.
- (e) Status of Industrial Projects Financed from Bilateral and Multilateral Sources (as of December 1988):

Fertilizer Factory - Romania - Preliminary Report submitted by the Romanian side reviewed. Final report under preparation.

Aluminum Sulphate Factory - Poland - Detailed design under preparation. Project indirectly related to FERTIS as it develops sulphuric acid technology needed in future for the fertilizer industry, however, on much bigger scale.

Another Fertilizer Factory - not allocated donor or source of financement.

One of the most important institutional framework for FERTIS development in Ethiopia are loans and credits approved by Agricultural and Industrial Development Bank that has a fairly wide set of duties which enables it to play effectively its development role and has the obligation of making positive contribution to the economic development by providing production and investment credits to all sectors of the economy. For instance, loans approved in 1987 to Agriculture - 400 million Birr, Industry - 25 million Birr, Other Sectors - 74 million Birr. Total of 500 million Birr.

2. PROGRAMME JUSTIFICATION

2.1 Problems to be addressed: bottlenecks and constraints hindering the development of the system towards the Government objectives

The annual growth rate of fertilizer consumption in Ethiopia is estimated by the World Bank for 18%. If the consumption of fertilizer nutrients amounting to 100,000 MT of NPK in 1989 is projected at this growth rate by the year 2000, the resulting forecasted consumption of fertilizer would be as high as:

$$(1.18)^{11} \times 100,000 \text{ MT of NPK} = 618,000 \text{ MT of NPK.}$$

This growth rate underscores the necessity of immediately considering the question of establishing fertilizer manufacturing plants in Ethiopia, which is in full correspondence with the assumptions of the Ten-Year Perspective Plan 1984-85 to 1993-94.

There are, however, important bottlenecks and constraints that hinder the development of FERTIS in Ethiopia. The constraints are of different nature and affect simultaneously several FERTIS components, thus bottlenecking its development in many ways, causing cumulative, negative effects in the system. The most important constraints are listed below:

- (a) Civil war in Ethiopia, draining the budget and weakening the whole economy, causing general instability and breaking important connections and the access to all regions, is a single, most constraining factor, also affecting FERTIS development.
- (b) Availability of foreign exchange is recognized to be one of the strongest constraints in FERTIS development. The priority in access to foreign exchange with the proper policy measures aiming at balanced FERTIS development is therefore critical to attaining food self-sufficiency in Ethiopia.
- (c) Generally poor infrastructure and weak rail-road transport network in mountainous country is considered a great bottleneck in the development of the fertilizer system, in which great masses of raw materials and products are being handled.
- (d) Insufficient developed raw material base is again one of the most important constraints to developing fertilizer industry in Ethiopia. Since raw materials play a decisive role in development of the national fertilizer industry, there is an urgent need to accelerate and expand surveys for FERTIS related raw materials connected with primary and secondary nutrients as well as with micro-nutrients.

This latter constraint is recognized as the most characteristic one for the system, and it is therefore analyzed below in more detail in the context of problems to be addressed in order to develop FERTIS towards the Government objectives and priorities (import substitution and export promotion):

Natural gas has been found lately in the Ogaden region of Ethiopia. This region is, however, characterized by a relatively poor general infrastructure,

the gas deposit is located in remote area, the distance to crops producing areas (highlands) is substantial, all these causing difficulties in the quick development of the gas deposit.

And though there is a high demand for nitrogen fertilizers in Ethiopia, the establishment of a large-scale capacity ammonia-urea complex in this area (Calub or Gode) would not be justified because:

- there is no market for nitrogen fertilizers in this area;
- investment location factor would be at least around 2.0, compared to the investment location factor of around 1.5 in the locations with some infrastructure;
- the cost of transporting urea from Calub-Gode area to the cropping areas at the Ethiopian Highlands would be in the range of at least US\$100-US\$120 per 1 MT of urea, thus all the potential competitiveness to imported urea would be lost.

The NCC plan of constructing an ammonia-urea mini-fertilizer plant in the natural gas deposit area (Gode) seems to have also many drawbacks:

- the plant capacity would not fit to steeply growing nitrogen demand in Ethiopia, and still considerable investment would be necessary for the next nitrogen fertilizer plants;
- there is no sufficient demand for urea in the Ogaden region and high urea transportation cost would be involved to bring the product to the highlands, unless there is an export agreement signed with Somalia for urea deliveries to Belet Uen region;
- not only location factor for investment would be high, but also economy of scale would not be gained, thus substantially increasing manufacturing cost of urea and lowering the efficiency of production, hence, decreasing viability of the project.

On the other hand, the construction of a large-scale ammonia-urea complex in the cropping area (in order to win the economy of scale and to bring the product as close to consuming areas as possible to avoid its costly transportation) is also not an easy option as it is inevitably connected with the necessity of pipelining natural gas to the plant site which, in turn, would increase the total investment cost of the whole enterprise (investment for the pipeline).

All this shows that an optimum solution should be looked for in the development of the nitrogen fertilizer industry in Ethiopia.

Also, further intensive surveys and exploration of potential new sources of natural gas (in particular on the Red Sea coast) are highly recommended, as the new gas deposits may prove to be more suitable located for the development of the domestic nitrogen fertilizer industry.

The realization of the planned Addis Ababa - Assab Railway Project might also have an impact for the development of nitrogen fertilizer industry in Ethiopia, as it might then be reasonable to substitute ammonia imported to

Assab with ammonia produced in a large-scale ammonia plant located in central provinces.

Though there are known occurrences of phosphates, apatites and sulphur bearing raw materials in Ethiopia (see enclosed Technical Assistance project proposal and enclosed maps), the raw material endowment and the stage of their development is not sufficient to plan at the present time production of phosphate fertilizers basing on domestic raw materials.

Therefore either phosphoric acid and (or) phosphate rock and sulphur will have to be imported to Ethiopia in the foreseeable future in order to manufacture phosphate fertilizers. The Government's plan of establishing a phosphate fertilizer complex (DAP, TSP) in the vicinity of the port of Assab seems therefore to be justified. At the same time, intensive surveys and exploration of domestic resources: phosphate rock (apatite) and sulphur (pyrite) are of a great importance for decreasing dependency on imported phosphoric acid.

Sulphur, needed in the manufacture of phosphate fertilizers, may also be used as a secondary nutrient when applied in such fertilizers as ammonium sulphate, single superphosphate and potassium sulphate. Again, the prospects of development the sulphuric acid industry by the year 2000 on the basis of domestic raw materials seem to be remote.

Potash ores have been found long ago, and a lot of work have been done so far, however, because of the guerilla activity in Tigre region (Dallol and Musley potash orebody area) the feasibility study had to be stopped in 1986, thus hindering the development of the system towards the Government's objectives aiming at the establishment of the export-oriented world-scale capacity potash fertilizer complex.

There are a lot of limestone-dolomite occurrences in Ethiopia, in particular in the eastern regions of the country, that could be relatively soon developed to serve as a source of secondary nutrients (Ca, Mg) and as liming materials to decrease acidity of soils. Since acidic soils are located mostly in western regions of the country, once again logistics and transportation constraints come into consideration.

Though the use of micro-nutrients in the Ethiopian agriculture seems to be premature at the present time, the activities connected with surveying and prospecting to micronutrients (Bo, Zn, Fe, Cu, Mn, Mo, Co) should start in the nearest future in order to work-out the foundations for exploration, processing and deliveries of micro-elements to agriculture by the year 2000.

The list of constraints and bottlenecks hindering the development of the fertilizer industrial system in Ethiopia is far from exhaustion, the above examples showing only how complex situation might be.

The remote location of raw materials, availability of energy and water, insufficient storage capacity, lack of unloading facilities in ports, shortages of trucks and wagons, difficulties in access to import (export) markets, lack of experience in investment, operation and maintenance of fertilizer plants and complexes, environmental impact of fertilizer industry, insufficient recognition of optimum N:P:K:S nutrient ratio and optimum types of fertilizers to be used, effectiveness and incentives of fertilizer use,

extension services, policy measures, pricing relations, and others - are to a different extent problems and issues that may influence negatively for FERTIS development in Ethiopia if not handled and solved timely and properly.

The more ambitious targets and objectives of FERTIS development based on the domestic fertilizer industry, the more constraining influence of the discussed bottlenecks for the system will be, therefore of great importance are analyses of alternative development strategies and various options for overcoming bottlenecks and constraints of the system.

2.2 Analysis of alternative development strategies

Insufficient justification of future fertilizer demand in Ethiopia and expected optimum N:P:K nutrients ratio, have led to analysis of the FERTIS alternative strategies. These strategies are presented in FERTIS block diagrammes: Programme Minimum (Low scenario) for the time-base: year 2000, and Programme Maximum (High scenario) for the time-base: year 2000 and beyond.

Although the Government objectives and FERTIS development strategies aim at the proper directions, they cannot be, however, supported to the full extent for reasons already discussed and described in relevant to the Technical Assistance project proposals enclosed in this study. The most important issues related to the Government programme embrace:

(a) DAP (TSP) versatile plant in Assab

The versatility of the plant is a drawback in adopting newest DAP pipe reactor technology and would cause limitation of achieving maximum daily and yearly capacities, thus increasing manufacturing cost, all the more so that investment for a versatile plant would be higher than for recommended DAP plant. DAP is a fertilizer mostly looked for, production of DAP guarantee achieving highest revenues per unit of valuable foreign exchange. Unloading of liquid ammonia and phosphoric acid might be realized (similarly as in Senegal) out of the shore, from buoys located on the sea shelf, thus reducing unloading costs. Unit cost of DAP (18-46-0) transported to Nazareth-Addis Ababa is lower than that of TSP, when pure nutrients are considered (note: TSP-0-46-0). In the light of foreign exchange deficit, investment in DAP should get priority over TSP. Triple superphosphate, needed for pulses and oil crops destined for export, should be imported in the first phase, all the more so that urea should be given priority in investment plans over TSP. TSP plant might be built in the second-third phase of FERTIS development in Ethiopia.

(b) Ammonia-urea mini-fertilizer plant at Gode

This had been already broadly discussed. The plant does not fit to a very high nitrogen demand in Ethiopia, all the more so that N:P nutrient ratio is expected to shift in favour to nitrogen. High investment location factor, high manufacturing cost of urea, high transportation cost to urea market centers (as there is no market in Gode) indicates that this idea is not an optimum one, all the more so that a world-scale ammonia-urea plant is planned at Metahara soon after plant in Gode.

Ammonia-urea plant in Yirga Alem area is recommended in Programme Minimum, and ammonia-urea in Yirga Alem (Phase I), supplemented with an

ammonia-urea complex in Mojo (Phase II), is recommended in Programme Maximum. South-west natural gas pipeline route is considered to be more advantageous in FERTIS import substitution scenario that east-north route of natural gas pipeline (see attached map for reference).

(c) World-scale ammonia-urea complex at Metahara

This idea is right in principle, however, other locations for nitrogen fertilizer complexes seem to be more advantageous, both from the point of view of import substitution scenario, as well as broader range of urea distribution at the Ethiopia Highlands (Yirga Alem + Mojo). Natural Park and wildlife sanctuary in Metahara region do not favour this location because of environmental impact of nitrogen fertilizer complex for game reserve and plant habitat. Metahara is not an optimum location for coffee growing areas, where urea is demanded.

(d) Potash fertilizer complex at Dallol

Based on the domestic potash ore and export-oriented is right idea. The project should be, however, either phased to save valuable foreign exchange for other fertilizer plants, or scheduled in investment plans of FERTIS development in the most convenient time for the overall programme. Decisions on potash project, because of guerilla conflict in Tigre region, cannot be treated as firm ones, but rather indicative. The Potash project is recommended to be phased. Programme Minimum includes Phase I by 2000. Programme Maximum includes Phases I and II in one step by 2000 or beyond 2000.

2.3 Quantitative analysis of various options for overcoming bottlenecks and constraints in order to reach FERTIS priority targets

Food self-sufficiency is recognized to be first priority target in Ethiopia, while: civil war, availability of foreign exchange, poor transport network and infrastructure, insufficiently developed raw material base - have been recognized as major constraints and bottlenecks hindering FERTIS development.

Designed options aim therefore at reaching priority target and at overcoming (diminishing) bottlenecks and constraints of the system.

Programme Minimum (Low scenario)

This option of FERTIS development is designed on the bases of fertilizer recommendations presented in FAO Study "Ethiopian Agriculture - Crop Yield Response and Fertilizer Policies", Variant D4 (High Acreage Expansion to 8.5 million ha of cultivated area by 2000, High Subsidy to Fertilizer 30%, High Adoption of Fertilizer by Farmers 45%), in which the total nutrients delivered to soils estimated for 389,000 MT of NPK by 2000 with N:P ratio 1:1. Variant D4 assumes surplus of cereals by 2000 around 1 million tonnes, self-sufficiency ratio in cereals of 108%, and per capita DES 2,326 kcal.

Programme Minimum (Low scenario) assumes that civil war in Ethiopia will be ended not later than till 1993, thus substantially lessening the foreign exchange burden by 2000, providing access to all regions (including port of Assab, Assab-Addis Ababa Corridor, Dallol potash deposit, and access to deposits of other raw materials). Also, this would make it safe to built - at

least first phase of a south - west natural gas pipeline segment connecting Calub and Yirga Alem.

Programme Minimum (Low scenario) envisages:

- Construction of DAP plant of the capacity 800 TPD in Assab;
- Construction of Ammonia-Urea complex of the capacity 500 TPD of ammonia and 800 TPD of urea in Yirga Alem area (Phase I of the nitrogen industry development in Ethiopia);
- Construction of Muriate of Potash (MOP) plant of the capacity 2000 TPD and Sulphate of Potash (SOP) plant of the capacity 400 TPD in Dallol (Phase I of the potash fertilizer complex in Ethiopia);
- Development of the domestic deposits of phosphate rock (apatite) and sulphur (pyrite);
- Development of secondary nutrients (Ca, Mg - limestone and dolomite for liming acidic soils).

Programme minimum envisages supplementary import of:

- liquid ammonia 56,000 MTPY and phosphoric acid 120,000 MTPY of P_2O_5 to feed DAP plant in Assab,
- nitrogen and phosphate fertilizers DAP, TSP, NPK in order to add 32,000 MTPY of N and 84,000 MTPY of P_2O_5 to the nutrients supply balance (approximately 30% of fertilizers would be imported.).

Note: Imported fertilizers might be brought to Assab in bulk and packed at the site, if the viability of PE-PP packaging unit would be confirmed.

The total nutrients delivered to soils would amount to 400,000 MTPY of NPK, with the resulting N:P:K ratio of 1:1:0.1.

Fertilizer application rate would grow to 47 kg NPK per hectare of cultivated area (around 22 kg NPK per ha of arable land with permanent crops).

The total fertilizer product delivered to soils would amount to 700,000 MTPY, of that to the peasant sector about 550,000 MTPY.

Programme minimum envisages export of potash (MOP + SOP) from Dallol amounting to 0.44 million MTPY of K_2O .

Programme Maximum (High scenario)

High scenario of FERTIS development in Ethiopia has been designed on the basis of recommendations of Institute of Agricultural Research and Ministry of Agriculture, and confronted with World Bank opinion.

If the World Bank assumption on fertilizer consumption growth of 19% per annum is taken into consideration, fertilizer demand as high as about 620,000 MTPY of NPK should be assumed by the year 2000.

Taking into account recommendations of IAR on an optimum level of fertilization rate of minimum 80 kg NPK per hectare of cultivated area and assuming the acreage of cultivated area for 8.5 million ha by 2000, one can estimate demand for NPK nutrients for:

8.5 million ha x 80 kg NPK per ha = 680,000 MTPY of NPK.

Average NPK demand 2000 derived from the estimates of the World Bank and IAR amounts to about 650,000 MTPY of NPK.

Recommended by IAR nutrient ratio N:P = 1:0.5 implies respective balances of nitrogen, phosphate and fertilizer products to be supplied to soils by 2000 (see FERTIS Block Diagramme for reference).

Programme maximum (High scenario) envisages:

- Construction of DAP plant of the capacity 800 TPD in Assab,
- Construction of DAP-TSP versatile plant in Assab of the capacity 600 TPD,
- Construction of NPK plant in Assab of the capacity 500 TPD,
- Construction of Ammonia-Urea complex of the capacity 500 TPD of A and 800 TPD of U in Yirga Alem area,
- Construction of Ammonia-Urea complex in Mojo of the capacity 2 x 500 TPD ammonia and 2 x 800 TPD urea,
- Construction of Ammonium Sulphate plant in Mojo of the capacity 250 TPD (based on imported sulphur to feed sulphuric acid plant of the capacity 200 TPD),
- Construction of MOP plant 4,000 TPD and SOP plant 800 TPD in Dallol,
- Development of domestic raw materials: phosphate rock (apatite), sulphur (pyrite), limestone (colomite) and some micro-nutrients based on local resources.

Programme maximum envisages supplementary import of:

- liquid ammonia 102,000 MTPY and phosphoric acid 216,000 MTPY of P₂O₅ and phosphate rock 40,000 MTPY to feed DAP-TSP-NPK complex in Assab.

Note: Import of ammonia might be substituted from ammonia plant in Mojo, subject of the realization of the Addis Ababa-Assab Railway Project.

- elemental sulphur (brimstone) 20,000 MTPY to feed SA plant in Mojo.

No fertilizer products are envisaged to be imported.

Programme maximum assumes Fertilizer Import Substitution Scenario.

The total nutrients delivered to soils would amount to 650,000 MTPY of NPK, with the resulting N:P:K ratio of 1:0.50:0.06.

Fertilizer application rate would grow to 76 kg NPK per ha of cultivated area (around 36 kg NPK per ha of arable land with permanent crops).

The total fertilizer products delivered to soils would amount to 1,340,000 MTPY, of that to the peasant sector around 1,100,000 MTPY of fertilizer.

Programme maximum envisages export of potash (MOP + SOP) from Dallol, amounting to 0.9 million MTPY of K_2O .

Because of existing FERTIS constraints, Programme maximum may go beyond 2000 in order to cover broad list of planned investment projects.

2.4 Evaluation and selection of preferred strategy

It is very difficult to select preferred strategy of the FERTIS development in Ethiopia, as the country is involved in guerilla conflicts (that may either cease or intensify).

Soon ending of civil war is a pre-condition for any serious strategy of FERTIS development.

If the assumption of civil war ending is adopted, Programme maximum (High scenario) seems to be a much more attractive strategy than the Low scenario for the following reasons:

- (a) High scenario assures the attainment of the Government's priority target of food self-sufficiency in Ethiopia. Even in the case of great difficulties to reach planned targets of cultivable area expansion up to 8.5 million ha, what may be endangered for many reasons (quick deforestation, desertification and soil degradation), the supply of 650,000 MTPY of NPK by 2000 would probably guarantee the attainment of food self-sufficiency with the present acreage of cultivated area, estimated for about 7 million hectares.
- (b) High scenario strategy bases on domestic raw materials: natural gas and potash, aiming on the one hand at the total import substitution of nitrogen fertilizers (and possibly ammonia to be used in DAP plant in Assab - subject of completion of Addis Ababa - Assab Railway Project), and on the other hand at export promotion of potash fertilizers, thus aiming at decreasing foreign exchange burden in the country.
- (c) High scenario assumes shifting of N:P ratio to be recommended by IAR value of 1:0.5, which imposes to give a priority to nitrogen component in the system. Thus, ammonia and urea would be the backbone of FERTIS development strategy in Ethiopia.
- (d) Huge capacity of ammonia-urea plants on the one hand utilize the economy of scale, and on the other hand help to justify expenses for the construction of a natural gas pipeline Calub-Addis Ababa.
- (e) The foreign exchange burden may force to built a natural gas pipeline in two phases. High scenario envisages this option. Phase I pipeline might end at Yirga Alem area, where the first nitrogen

fertilizer complex is to be located, mostly in order to boost coffee output for export and to earn foreign exchange for the Phase II of the programme (nitrogen complex at Mojo).

- (f) South-west route of natural gas pipeline is recommended in this study, as this option is more justified for FERTIS development based on import substitution scenario. Landed cost of imported urea loco Yirga Alem is estimated for about US\$325 per 1 MT (of that about US\$140 for transport of 1 Mt of urea from Assab to Yirga Alem area). It is therefore assumed that urea manufacturing cost at Yirga Alem nitrogen fertilizer complex may be competitive to the cost of imported urea sent to Yirga Alem. South-west route of the pipeline is safer when guerilla activity is considered, than east-north natural gas pipeline.
- (g) South-west route of the natural gas pipeline from Calub to Addis Ababa guarantee selection of better locations for nitrogen fertilizer complexes in Phase I (Yirga Alem area) and Phase II (Mojo) when distribution of fertilizers is taken into consideration (cropping areas located at the Ethiopian Highlands, mostly in shewa, Arsi and Gojam). Mojo is located between central stores. For reference see attached maps.
- (h) High scenario envisages the construction of a fertilizer complex in Assab producing DAP, TSP, NPK, hence fully harmonized with the growing demand for those fertilizers in Ethiopia (TSP for oil crops and pulses and NPK for coffee).

In the past alternative only phosphate component may be kept imported to Assab by 2000, as both ammonia and muriate of potash could be delivered to Assab from domestic production (Mojo, Dallol).

Discovery of the new natural gas deposit on the Red Sea coast (shelf) is also very probable, as Sudanese and Yemen examples show, in particular in peaceful conditions when gas exploration is intensified by using the most modern computer techniques.

Also, phosphates and sulphur might be eliminated from imports after 2000, if only intensive surveys and explorations are continued.

The Assab fertilizer complex may as well be phased (subject to foreign exchange availability), for instance: Phase I - DAP; Phase II - DAP-TSP; Phase III - NPK.

- (i) Export-oriented potash project in Dallol, envisaged in High scenario for the capacity of 0.9 million MTPY of K_2O , could also be phased depending on the recognition of foreign markets for MOP and SOP and on foreign exchange availability.
- (j) High scenario gives a flexibility in phase-wise planning and investing in FERTIS development, as major fertilizer complexes in Mojo, Assab and Dallol might be phased.
- (k) Fertilizer balances have been designed in High scenario for 650,000 MTPY of NPK, with the assumption of a relatively high On-stream

factor around 0.9 (about 300 days of plants operation per year). However, if 70% of designed capacity utilization is assumed, only 455,000 MTPY of NPK would be delivered to agriculture. High scenario should therefore be considered as the one guaranteeing to achieve easily Low scenario targets, even when general industrial conditions are unfavourable.

- (l) Steeply growing quantity of fertilizer products, the distribution of which may pose some problems, should be recognized as the biggest drawback of High scenario. Phase-wise realization of the investment programme, harmonized with the general development of infrastructure, is believed to be the best answer to this constraint and to foreign exchange availability constraint. A considerable distance between planned fertilizer complexes in Assab, Yirga Alem, Mojo and Dallol, and the possibility of using ports of: Assab, Massawa, Mersa Fatma and Djibouti should be a guarantee of the elimination of major bottlenecks in transport and distribution of FERTIS raw materials and products.
- (m) High scenario is designed for the time base by 2000 and beyond 2000. Therefore, depending on the level of the overall country's recovery after civil war, High scenario can be flexibly adjusted to the real potential of the Ethiopian economy in allocating investment sources for PESTIS development.

High scenario is designed for a long-term programme (therefore referred to in this study as Programme Maximum). The situation may as well exist that the programme fits rather to the years 2005-2010 than to the year 2000. This, however, will be dependent first of all on how soon civil war may end, to enable dynamic growth of the Ethiopian economy.

2.5 Expected end-of-programme situation

A comparison of the stage of development of the fertilizer industrial system in Ethiopia in 1989 with the Government's targets and programmes designed according to Low and High scenarios is presented below (all capacities expressed in 000 MTPY of product):

LOCATION	FERTIS 1989	GOVERNMENT TARGET 2000	LOW SCENARIO 2000	HIGH SCENARIO 2000 AND BEYOND
Assab	Imports of fertilizer (170)	DAP (TSP) 240 (170)	DAP (240)	DAP (240) + DAP-TSP (70-100) + NPK (160)
Gode	-	Ammonia + Urea (50)	-	-
Metahara	-	East-North NG Pipeline A (450) U (750)	-	-
Yirga Alem	-	-	South-West NG Pipeline A (150) U (260)	South-West NG Pipeline A (150) U (260)
Mojo	-	-	-	South-West NG Pipeline A (300) + U (460) + AS (75)
Dallol	-	MOP (1,300) SOP (240)	MOP (650) SOP (120)	MOP (1,300) SOP (240)
Ethiopia	-	-	Development of: P, S, Ca, Mg	Development of: P, S, Ca, Mg, Micro-nutrient

In recommended High scenario, anticipated foreign exchange earnings would be derived from:

- Assab DAP-TSP-NPK complex, substituting imports of fertilizers for imports of ammonia, phosphoric acid and phosphate rock.
- Yirga Alem Ammonia-Urea complex, delivering urea mostly to regional coffee and cash crops growers on a competitive basis to imported urea, thus providing foreign exchange savings from imports of urea and generating foreign exchange from increased exports of coffee.
- Mojo Ammonia-Urea-Ammonium Sulphate complex, delivering fertilizers to the Highlands, thus providing foreign exchange savings from import substitution of urea and generating foreign exchange from

import substitution of food crops and from increased exports of cash crops.

- Dallol MOP-SOP complex, generating foreign exchange from exports of potash fertilizers.

In High scenario, imports of fertilizers would be (in principle) totally substituted by domestic production. At the same time export of potash would be promoted.

3. INTEGRATED DEVELOPMENT PROGRAMME

3.1 Programme objectives

The Indicative Programme for the Integrated Development of the Fertilizer Industrial System in Ethiopia aims at:

- Strengthening the Government's capability for planning and coordination of development in the fertilizer industry subsector.
- Helping in the formulation of Government policies related to the development of the Fertilizer Industrial System in Ethiopia.
- Strengthening the capabilities of AISCO in procurement, trading and logistics in fertilizer distribution, beginning with the international market and ending with fertilizer delivery to the farm gate.
- Strengthening the capabilities of the National Chemical Corporation in planning investment, selection technological processes and economical options optimum for FERTIS development.
- Helping ELMICO with promoting potash export oriented project.
- Defining the long-term objectives and strategies for the creation of the domestic fertilizer industry in Ethiopia, taking into consideration different options, techno-economic alternatives and scenarios.
- Defining phase-wise alternative FERTIS development scenario, in order to improve national plans of investment into the fertilizer industry.

Overall Programme Objectives are best defined when comparing actions in investment and Technical Assistance actions between FERTIS country-group I and Ethiopia. The identification of group-specific actions by the year 2000 is presented below:

IDENTIFICATION OF GROUP-SPECIFIC ACTIONS IN SURVEY, PREPARATION AND IMPLEMENTATION OF REHABILITATION, MODERNIZATION REVAMPING AND NEW INVESTMENT PROJECTS IN THE FERTILIZER INDUSTRIAL SYSTEM "FERTIS" IN AFRICA BY THE YEAR 2000.

3.2 Policy measures

In order to facilitate the implementation of FERTIS programmes and targets, a number of policy issues should be studied in detail and appropriate measures to resolve them should be taken in the course of implementation of the Integrated Development of the Fertilizer Industrial System in Ethiopia.

The most important policy issues are listed below:

- (a) Food and nutrition priority policies, in order to provide peasant farmers with:
 - access to technology packages (fertilizers, seeds, pesticides, credit, etc.)
 - access to agricultural extension and advisory services
 - rural infrastructure development, especially access roads, storage facilities, marketing centers, etc.
- (b) Price determination and pricing policy (crop producer price incentives and access to markets; crop vs. fertilizer price ratio, fertilizer price subsidy, etc.).
- (c) Policies related to technology transfer and development:
 - research and development promotion and capability in FERTIS;
 - technology transfer and adaption capability in FERTIS;
 - training in technology information collection and exchange within industry sector. including fertilizer industry;
 - research and development programmes relating to the various subsectors of agriculture, in order to accelerate the process of transferring, adapting and absorbing agricultural inputs and technologies;
- (d) Policies related to the promotion of import substitution and export promotion strategies, directly related to FERTIS.
- (e) Investment related policy issues, in order to strengthen the capabilities of contracting technologies and equipment needed for the creation of domestic fertilizer industry and its proper functioning in the future (manpower training, technical norms and standards, environmental protection standards, etc.).
- (f) Sectoral and subsectoral policies in agriculture, industry, mining, energy, water resources, construction, trade (foreign and domestic), transport, manpower - in order to assure FERTIS integrated and balanced development, fully harmonized with the development of the overall economy.

Policies relating to: soil conservation, supply of spare parts to fertilizer plants, exploration of FEKTIS related raw materials,

natural gas development, water protection from fertilizer pollution, fertilizer installations assembly and civil works execution, fertilizer procurement, ports and transportation network rehabilitation and improvement, and manpower training for FERTIS - may be quoted here as the most relevant to FERTIS development in Ethiopia.

3.3 Technical assistance projects

A list of technical assistance (investment) projects relating to FERTIS development in Ethiopia has been presented below:

FERTILIZER INDUSTRIAL SYSTEM IN ETHIOPIA LIST OF TECHNICAL ASSISTANCE/INVESTMENT PROJECT DOCUMENTS

1. National Chemical Corporation - CONSULTANCY SERVICES ON AMMONIA-UREA MINI-FERTILIZER PLANT AT GODE.

Continuous assistance from inquiry and bid evaluation, through pre-qualification of contractors, preparation of technical appendixes to the contract, evaluation of technical documents of the contract, up to the technical assistance of the plant operation for one year after its commissioning and start-up.

The project includes also component of staff training in Assab refinery in Ethiopia and outside Ethiopia in: management, operation and maintenance of ammonia/urea plants.

Indicative cost of the project to be borne by UNIDO - US\$ 400,000.

Project realization time-base: 1990-1994.

2. National Chemical Corporation - TECHNO-ECONOMIC APPRAISAL OF THE VIABILITY OF AMMONIA-UREA COMPLEX LOCATED IN THE CROPPING AREA WITH THE NATURAL GAS PIPELINING TO THE NEW LOCATION.

The project is an alternative scenario for the project no. 1 above.

Indicative cost to be borne by UNIDO - US\$ 100,000.

Project realization time-base: 1990.

3. National Chemical Corporation - TRAINING SERVICES RELATED TO DAP/TSP COMPLEX IN ASSAB.

The project related to institutional strengthening of NCC management to be prepared to negotiate contracts for DAP/TSP versatile plant, including ammonia/phosphoric acid/phosphate rock storage facilities in the port, as well as long-term agreements on purchasing/counter-trading, bartering ammonia, phosphoric acid and phosphate rock.

Indicative cost to be borne by UNIDO - US\$ 100,000.

Project realization time-base: 1990.

4. Ethiopian Institute of Geological Survey - FEASIBILITY STUDIES ON RAW MATERIALS RELATED TO FERTIS DEVELOPMENT.

The project related to surveying, mapping and exploration of apatite, phosphate rock, pyrites and limestone in Ethiopia, in order to back-up in the future the fertilizer industry with domestic raw materials.

Indicative cost to be borne by UNIDO - US\$ 3 million.

Project realization time-base: 1990-1993.

5. Agricultural Input Supply Corporation - THE PACKAGE OF TRAINING PROGRAMMES TO STRENGTHEN MANAGERIAL AND OPERATIONAL CAPABILITY OF AISCO in:

- operation and maintenance of mobile fertilizer bagging units;
- procurement/contracting and trading imported fertilizers;
- logistics, storage, transport and distribution of fertilizer.

Indicative cost to be borne by UNIDO - US\$ 300,000.

Project realization time-base: 1990-1991.

6. Agricultural Input Supply Corporation - PRE-FEASIBILITY STUDY ON THE VIABILITY OF THE ESTABLISHMENT OF PE/PP FERTILIZER PACKAGING UNIT IN ASSAB.

The project aims at decreasing the cost of imported bagged fertilizers: DAP and Urea through production of own PE/PP bags and bagging fertilizers imported in bulk.

Indicative cost to be borne by UNIDO - US\$ 50,000.

Project realization time-base: 1990/1991.

7. Ministry of Agriculture, Ministry of Industry, Ministry of Mines and Energy, FAO, UNIDO - SEMINAR ON FERTILIZER DEMAND BY 2000, OPTIMUM N:P:K RATIOS, OPTIMUM TYPES AND GRADES OF FERTILIZERS, FERTILIZER AFFINITY TO THE LOCAL SOILS AND CROPS.

The aim of the project is to define and specify more precisely the future objectives and targets in FERTIS in order to reach full agreement and coordination of objectives in fertilizer demand, fertilizer production and exploration of the domestic raw materials related to FERTIS. An UNIDO/FAO study may follow-up in a later stage.

Indicative cost to be borne by UNIDO for seminar - US\$ 50,000.

Project realization time-base: 1990.

8. Ethiopia-Libya Potash Company - STAND-BY PROJECT RELATED TO POTASH EXPLORATION IN DALLOL IN ETHIOPIA.

The final target of the project is to establish open-pit/solution potash mine yielding muriate of potash, sulphate of potash (and possibly other salts) in the world-scale capacity potash complex. Both deposits and the quality of potash ores with kainite give very good prospects for potash export-oriented project delivering MOP and SOP to Eastern Africa and Indian Ocean countries.

THE PROJECT IS STAND-BY BECAUSE THERE IS AT PRESENT NO ACCESS TO THE DEPOSITS LOCATED IN THE TIGRE AREA IN THE CIVIL WAR ZONE.

Indicative cost depends on the time base and the scale of activities UNIDO could undertake in continuation of this project. This can only be assessed when the civil war in Ethiopia is over.

US\$ 2 million have been envisaged tentatively for the complex programme.

TOTAL INDICATIVE COST TO BE BORNE BY UN AGENCIES IS ESTIMATED FOR APPROXIMATELY US\$ 5 MILLION.

Out of the eight Technical Assistance Project Proposals, six are directly or indirectly relating to the potential investment actions that may be taken up in the course of creating the national fertilizer industry in Ethiopia.

It is believed that TA project proposals will be helpful in answering the most important questions on fertilizer demand and optimum N:P ratio, and in defining future strategies and scenarios in the FERTIS development, before final investment decisions are undertaken.

Clear definition of the long-term objectives and strategies for the FERTIS development is believed to be of paramount importance for the smooth creation of the national fertilizer industry, its high efficiency and reliable operation.

The whole time schedule for implementation of the programme for the Integrated Development of the FERTIS in Ethiopia is estimated for the duration of 52 months. In this period UNIDO may be involved either directly or indirectly into Technical Assistance projects included in the programme.

TA projects Nos. 2 and 7 are believed to be the most urgent, not to hamper investment decisions relating to fertilizer plants planned in Assab and Gode, but to accelerate rather the whole process of FERTIS development in Ethiopia through defining optimum investment options and strategies, backed by proper policy measures. Therefore, both TA projects (T-E appraisal of the viability of ammonia-urea complex in the cropping area with the natural gas pipelining to the new location; and seminar on fertilizer demand by 2000, optimum N:P:K ratios, optimum types and grades of fertilizers, fertilizer affinity to the local soils and crops) are expected to be launched in the second quarter of 1990.

It is extremely difficult to define time schedule for the stand-by TA project related to potash exploration in Dallol, as it is directly relating to the situation in the Tigre region gripped by the guerilla activity. Therefore, according to assumptions of High Scenario, this TA project is expected to commence in the beginning of 1991.

The TIME SCHEDULE for the TECHNICAL ASSISTANCE PROGRAMME is seen below.

3.4 Investment projects

As already discussed, it is difficult to decide on the investment projects in Gode (A-U mini-fertilizer plant) and in Assab (DAP-TSP versatile plant) before the most important questions on FERTIS development strategies are answered. Technical Assistance projects aim at this end.

However, it is believed that it would be worthwhile to present a tentative comparison of the investment programmes according to Government strategy and High scenario of this study, as follows:

LOCATIONS	GOVERNMENT PROGRAMME			MAXIMUM PROGRAMME		
	Plants	Nutrients	Investment	Plants	Nutrients	Investment
Assab	DAP-TSP	116	100	DAP+TSP + NPK	316	200
Gode	A + U	23	130	-	-	-
Metahara	A + U	345	740	-	-	-
Yirga Alem	-	-	-	A + U	120	410
Mojo	-	-	-	A + U + SA + AS	249	490
Dallol	MOP + SOP	900	700	MOP + SOP	900	700
Total	7 Plants	1,384	1,670	11 Plants	1,585	1,800

Notes: Nutrients (NPKS) expressed in 000 MTPY; Investment in million US\$

Tentative Basic Indicators of analyzed investment programmes

Indicator	Government Programme	Maximum Programme (High Scenario)
Specific investment in 000 US\$ MT of NPKS	1,207	1,136
Average distance to Central FERTIS Stores and cropping areas	600 km	400 km
Cost of distribution of 1 MT of fertilizer	US\$140	US\$100
Foreign exchange savings (generating) from FERTIS CIF (FOB) Assab, without agricultural exports	US\$330 million	US\$410 million
Estimated food self-sufficiency ratio when no acreage expansion assumed, and FERTIS reliability decreased to 80% of nominal capacity	92%	112%
DES (dietary energy supply) for assumptions as above (in Kcal-day-capita) by the year 2000	1,950	2,370
Time base of the whole programme (year), assuming that civil war is ended by 1991	2000 and beyond	2000 and beyond
Number of programme phases	3 or 4	4 or 5

P R O J E C T D O C U M E N T S

PROJECT OF THE GOVERNMENT OF ETHIOPIA

Title:	Consultancy services of Ammonia-Urea mini-fertilizer plant at Gode
Number:	
Estimated duration:	15 months
Estimated UNDP contribution:	US\$400,000
Estimated Government cost-sharing:	US\$150,000
Estimated Government input:	150,000 Birr

A. DEVELOPMENT PROBLEM TO BE ADDRESSED BY THE PROPOSED PROJECT

1. Development problem at (sub-)sectoral (macro) level

Agriculture is the mainstay of the Ethiopian economy, providing employment to nearly 85% of the population and accounting for about 90% of the total foreign exchange earnings. In order to increase agricultural productivity at the farm level and to fulfil the nation's target of raising the standard of living of its population there is a need to intensify cultivation through the increased use of fertilizer.

2. Problem addressed by the project

The formation of state farms and farmers cooperatives, improved government services in input distribution and credit financing, as well as agricultural education through extension activities, have increased the consumption of fertilizers in Ethiopia. Growing demand for fertilizer, estimated for one million tonnes by the year 2000 provided the necessary foreign exchange funds become available for importation, justifies consideration for the establishment of a nitrogen fertilizer plant in the country based on domestic natural gas deposit.

B. CONCERNED PARTIES AND TARGET BENEFICIARIES

1. Problem identification

A natural gas reserve estimated at about 25 billion cubic meters has been discovered and is being developed in the Ogaden region of Ethiopia. A number of small-scale natural gas utilization projects have been identified and the World Bank has earmarked US\$30 million for their implementation. One of the small scale projects identified but not included in the World Bank funding is the establishment of a mini-fertilizer ammonia-urea plant. The plant is to be located at Gode which is about 100 kms away from the natural gas well site and the gas pipeline has to be built to cover that distance.

2. Target beneficiaries

National Chemical Corporation assumes that the establishment of a mini-fertilizer nitrogen complex at Gode would encourage the intensive usage of urea by peasants in the neighbouring regions, thus assuring the increase of agricultural productivity in one of the least developed region in Ethiopia. At the same time, consultancy services on ammonia-urea mini-fertilizer plant at Gode would strengthen technical and institutional capabilities of NCC, thus allowing for the preparation of the Ethiopian specialists to contractual negotiations and related investment procedures.

C. PRE-PROJECT AND END-OF-PROJECT STATUS

1. The pre-project situation

Based on a pre-feasibility study, NCC has decided that the implementation of a world-scale nitrogen fertilizer complex/utilizing natural gas reserves from Ogaden/would require huge investment and long time for realization, and therefore it is necessary to look into alternative for implementation of a mini-fertilizer plant. NCC has sent Pre-qualification Tender for the establishment of a mini-fertilizer plant in Ethiopia to reputable and

experienced international firms in order to solicit technological and commercial offers for the supply of a mini-fertilizer plant on a semi-turn key basis. This Technical Assistance project aims at supplying to NCC consultancy services on ammonia-urea mini-fertilizer plant at Gode.

2. End-of-project situation

Continuous assistance to NCC, from inquiry and bid evaluation, through pre-qualification of contractors, preparation of technical appendices to the contract, evaluation of technical documents of the contract, up to the technical assistance of the plant operation after its commissioning and start-up, would strengthen capabilities of NCC in the realization of a mini-fertilizer plant project.

Technical Assistance projects includes also component of staff training in Ethiopia and abroad in management, operation and maintenance of ammonia/urea plants.

D. SPECIAL CONSIDERATIONS

1. Special considerations

Given the foreign exchange constraint for the construction of a large-scale nitrogen fertilizer complex NCC and the Ministry of Industry is seeking Suppliers' Credit covering the foreign exchange component of a mini-fertilizer project. There are, however, potential drawbacks of the decision to invest into mini-fertilizer plant at Gode. These are:

- (a) Demand for nitrogen fertilizers/urea/ in Ethiopia is much higher than nitrogen production capacity of any mini-fertilizer plant, even including plans of construction DAP plant in Assab.
- (b) Gode is quite a reasonable location for the minimalization of investment cost/small plant and short gas pipeline/, however, Gode is located in desert, nomadic region which cannot absorb urea production even from mini-fertilizer plant and urea would have to be transported to cropping areas, thus substantially increasing cost of fertilizer to the farmer.

Therefore, in order to reach optimum decisions, UNIDO proposes to carry-out techno-economic appraisal of the viability of ammonia-urea complex in the new location in the cropping area. This project is an alternative scenario to the present Technical Assistance project.

2. Potential negative effects

There is no sufficient urea demand in Gode region to justify decision on the establishment of a mini-fertilizer plant in this location on the basis of the foreign exchange constraint for investment. Landed cost of urea to farmers in other regions will be high. Through import-substitution of urea and boosting agricultural output, the planned nitrogen fertilizer complex should rather be located in cropping region with proper infrastructure, and the capacity of the plant should be harmonized at least to regional demand. Through optimum planning a new project may generate higher benefits and in the process save more foreign exchange than planned mini-fertilizer plant.

E. RELATED TECHNICAL ASSISTANCE ACTIVITIES

Decision on the location and capacity of the ammonia-urea complex in Ethiopia is of a key importance for the FERTIS development scenario in this country. Therefore this Technical Assistance project is directly related to the most of the other Technical Assistance projects related to FERTIS development in Ethiopia, and first of all to:

- (a) Techno-economic appraisal of the viability of A/U complex located in the cropping area with the natural gas pipelining to the new location.
- (b) Training services related to DAP/TSP complex in Assab /in particular as for as the decision on DAP/TSP versatility is concerned/.
- (c) Pre-feasibility study on the viability of the establishment of PE/PP fertilizer packaging unit in Assab.
- (d) Seminar on fertilizer demand by the year 2000, optimum N:P:K ratios, optimum types and grades of fertilizers, fertilizer affinity to the local soils and crops.

F. DEVELOPMENT OBJECTIVE

The establishment of a mini-fertilizer plant at Gode aims at decreasing dependency on imported fertilizers through natural gas utilization. The impact of the project for the national economy would, however, be of limited importance, as the mini-fertilizer plant could cover only small-scale markets in Gode neighbouring regions. The establishment of a mini-fertilizer plant at Gode is justified by close access to the gas field, low capital investment needed, small-scale irrigation project and resettlement programme realized in this region.

It is believed that alternative scenario with ammonia-urea complex of a higher capacity and located in the cropping area should also be appraised.

G. MAJOR ELEMENTS

Immediate objective 1

The immediate objective of this Technical Assistance project is to strengthen NCC in particular at the stage of the preparation of tendering documents related to a mini-fertilizer project, evaluation of offers, preparation of technical appendices to the contract and pre-qualification of contractors.

Responsible party
NCC + UNIDO

Output 1.1

Activities 1.1.1

Preparation of tendering documents related to a mini-fertilizer plant and evaluation of offers, aiming at the optimum techno-economic solutions of the investment projects.

Activities 1.1.2

Preparation of technical appendices to the contract, suggestions on the pre-qualification of contractors and technical assistance in contractual negotiations.

Output 1.2

Activities 1.2.1

Preparation of training programmes for the management, operation and maintenance of the mini-fertilizer plant.

Activities 1.2.2

Preparation of the technical assistance programme of the mini-fertilizer plant operation for the period of twelve months after its commissioning and start-up.

Immediate objective 2

The immediate objective 2 of this Technical Assistance project is to assess the viability of a small-scale natural gas utilization project into ammonia-urea production versus other options such as domestic and industrial fuel, vehicular fuel, electricity generation and others.

H. PROJECT STRATEGY

1. Direct recipients

The Technical Assistance project discussed here would provide the background for the decisions on the establishment of a mini-fertilizer plant and for the coordination of further activities of NCC and other Ethiopian companies involved into contractual negotiations, construction of the plant, staff training and the operation of the ammonia-urea mini-fertilizer plant at Gode.

2. How will the benefits reach the target beneficiaries?

Urea produced in mini-fertilizer plant would be delivered to peasants and cotton producers in the area as well as transported to farmers in neighbouring cropping regions.

Construction of a mini-fertilizer plant at Gode would strengthen the technical and general infrastructure in the town. Through the construction of a mini-fertilizer plant NCC and its affiliated companies would acquire technical experience that could be used in the future in investment, operation and maintenance of the domestic fertilizer industry.

3. Implementation arrangements

Before implementation of this Technical Assistance project, the economic viability of the investment into mini-fertilizer plant at Gode should be carefully examined and compared with viability of the investment into larger ammonia/urea plant located in the cropping area/Alternative Scenario/. This Technical Assistance project should therefore be considered as a TENTATIVE.

4. Alternative strategies considered

Ammonia/urea complex of larger capacity, better harmonized to the future nitrogen demand, and located in the cropping area should be considered as an alternative strategy.

Despite the constraining influence of a higher investment cost needed for a longer natural gas pipeline and for a larger capacity plants, there are several obvious benefits in such a scenario, and therefore this alternative strategy should be considered before FINAL Technical Assistance project is implemented.

I. HOST COUNTRY COMMITMENT

1. Government commitment

Though NCC and the Ministry of Industry have already approved the strategy of investing into mini-fertilizer plant at Gode, it is believed, however, that the Ethiopian Government should be aware of the Alternative Scenario to the mini-fertilizer plant project at Gode before any final decisions are taken.

2. Legal arrangements

Legal arrangements might be necessary with the licensors of ammonia and urea processes regarding the overall capacities for which the processes are licensed/the rights for the future capacity expansion at the same or other locations in Ethiopia/.

J. RISKS

The following are significant risks which could seriously delay or prevent the achievement by the project of its outputs and objectives.

Estimated likelihood of occurrence (i.e. high, medium, low)

1. Major risks

The location of a mini-fertilizer plant in Gode with lack of sufficient demand for urea, hence with the necessity of bearing high transportation cost of urea deliveries to neighbouring regions, and too small a capacity of the plant in the light of future nitrogen demand in Ethiopia, these are the major risks that should be seriously considered when analyzing plans for the construction of a mini-fertilizer plant in Gode region, characterized also by relatively weak infrastructure.

High

2. Risks to be monitored

Instead of monitoring risks, alternative scenario to mini-fertilizer plant project should be considered.

K. INPUTS

1. Skeleton budget: Provide a summary estimate of total costs by major budget category.

	<u>National inputs</u> (specify currency)	<u>External inputs</u> (specify currency)
Personnel	_____	<u>US\$300.000</u>
Sub-contracts (specify types of goods or services)	_____	_____
Training	<u>150,000 Birr</u>	<u>50,000</u>
Equipment	_____	_____
Miscellaneous	<u>150,000 Birr</u>	<u>50,000</u>
Totals Tentatively	<u>450,000 Birr</u>	<u>US\$400,000</u>

UN exchange rate: \$1.00 = 2.07 Birr

2. Comment on any proposed inputs which may raise policy issues on which Headquarters guidance is sought.

If the decision on the construction of a mini-fertilizer plant at Gode is finally accepted by the Ethiopian Government, it is suggested that the policies related to the development of Gode region should be given special attention and priorities.

Person primarily responsible
for this formulation framework: _____
Signature

Name:
Title:

PROJECT OF THE GOVERNMENT OF ETHIOPIA

Title: Techno-economic appraisal of the viability of ammonia/urea complex located in the cropping area with the natural gas pipelining to the new location

Number:

Estimated duration: 3 months

Estimated UNDP contribution: US\$100,000

Estimated Government cost-sharing:

Estimated Government input:

A. DEVELOPMENT PROBLEM TO BE ADDRESSED BY THE PROPOSED PROJECT

1. Development problem at (sub-)sectoral (macro) level

Agriculture is the mainstay of the Ethiopian economy. One of the most important inputs to agriculture is increased use of fertilizer. Nitrogen fertilizers are believed to be of the greatest importance for the increase of agricultural output. There are different recommendations for nutrient ratios in Ethiopia varying from N:P = 1.5 to 1:0.5. FAO recommends ratio N:P = 1:1, while Institute of Agricultural Research N:P = 1:0.5. At the present time DAP and Urea/ concentrated fertilizer/ are mostly imported to Ethiopia with the resulting ratio approximately N:P = 1:1.5.

2. Problem addressed by the project

As the DAP/18 - 46 - 0/ and Urea/46 - 0 - 0/ are widely used in Ethiopia, mostly in order to reduce unit transport and distribution cost of fertilizers delivered to the farm-gate, it is assumed that in the future DAP and Urea will remain the main source of nitrogen and phosphate delivered to soils. Taking into account differences in projections of fertilizer demand by 2000, that vary four-fold from 350,000 MT up to 1,200,000 MT depending on the source of data and assumptions adopted for the scenario in question, as well as differences in the recommendations of N:P ratio that vary three-fold from 1:1.5 to 1:0.5, there is no doubt that an optimum scenario for FERTIS development in Ethiopia should be looked for. One of the most important assumptions in this scenario is the capacity and the location of Ammonia/Urea complex in Ethiopia.

B. CONCERNED PARTIES AND TARGET BENEFICIARIES

1. Problem identification

Problem has been identified by UNIDO consultant on his field work, in Ethiopia mostly through discussions in National Chemical Corporation/NCC/ on the plans of construction of a mini-fertilizer A/U plant at Gode and world-scale A/U complex at Metahara. Taking into account opinions of NCC, MOA, IAR regarding demand 2000 for nitrogen and phosphate fertilizers and assumed different N:P ratios, an optimum solution emerge after the present Technical Assistance project is executed.

2. Target beneficiaries

The Government of Ethiopia, all organizations involved in the development of the fertilizer industry and agriculture, Ethiopian peasants and the whole nation would benefit from the allocation of valuable and scarce foreign exchange for the investment in the Ammonia/Urea complex of optimum capacity and location. Given a foreign exchange burden for imports of fertilizers and a very strong constraint of foreign exchange availability for investment, the decision on the construction of A/U complex is of key importance for achieving food self-sufficiency in Ethiopia.

C. **FRE-PROJECT AND END-OF-PROJECT STATUS**

1. The pre-project situation

According to NCC plans of fertilizer industry development in Ethiopia by 2000, three projects are considered:

- a mini-fertilizer A/U plant at Gode
- a world-scale A/U complex at Metahara
- a DAP/TSP versatile complex in Assao

Given the growing demand for fertilizers in Ethiopia and future trends to use fertilizer with N:P ratio more in favour of nitrogen, the decision on the construction of a mini-fertilizer A/U plant at Gode, followed by a world-scale A/U complex at Metahara seems to be not sufficiently justified.

2. End-of-project status

This Technical Assistance project is an alternative scenario for the Technical Assistance project related to consultancy services on A/U mini-fertilizer plant at Gode. It is assumed that after the techno-economic appraisal on the viability of A/U complex/located in the cropping area to which natural gas would be pipelined/ is executed, the final conclusions on the capacity and location of the new nitrogen fertilizer complex in Ethiopia/Gode, Metahara or the new location/ will be reached.

D. **SPECIAL CONSIDERATIONS**

1. Special considerations

The capacity of an ammonia plant in the new A/U complex is directly related to the assumed demand for fertilizers by 2000 and N:P ratio, and may vary in the range of 100 TPD up to 1,500 TPD of ammonia. For the fertilizer demand 680,000 MTPY set by FAO/assured food self-sufficiency; NP demand 389,000 MTPY; N:P = 1:1/ the resulting capacity of ammonia to cover only urea plant capacity would be over 500 TPD. If nutrient ratio is assumed for N:P = 1:0.5 the resulting capacity of ammonia plant would be over 850 TPD. The strategy of the selection of the capacity of ammonia plant should be treated as a special consideration in this Technical Assistance project. The capacity of ammonia plant may be designed alternatively to cover the capacity of:

(a) Urea plant

(b) Urea plant and DAP plant/import substitution of ammonia/. All the potential options, including logistics in pipelining or DAP should be treated as special consideration of this Technical Assistance project. Ammonia plant may also be built in two phases:

Phase I - Ammonia Line I

Phase II - Ammonia Line II

2. Potential negative effects

No negative effects are foreseen in connection to the elaboration of the discussed techno-economic appraisal of the viability of Ammonia/Urea complex located in the cropping area.

E. RELATED TECHNICAL ASSISTANCE ACTIVITIES

The two Technical Assistance projects connected with FERTIS development in Ethiopia are in particular related to this Technical Assistance project. These are:

- Consultancy Services on A/U Mini-fertilizer Plant at Gode.
- Seminar on Fertilizer Demand by 2000, Optimum N:P:K Ratios, Optimum Types and Grades of Fertilizer, Fertilizer Affinity to the Local Soils and Crops.

F. DEVELOPMENT OBJECTIVE

In contrast to the Ethiopian plans of setting-up a mini-fertilizer A/U plant at Gode, this Technical Assistance project is an Alternative Scenario in which development objective is aimed at the selection of an optimum location for A/U complex with the capacity of ammonia plant harmonized to future trends in fertilizer demand and nutrients ratio in Ethiopia.

The project aims also at defining FERTIS development scenario assuring the maximum foreign-exchange benefits from its implementation.

G. MAJOR ELEMENTS

Immediate objective 1

The immediate objective of this Technical Assistance project is to find an optimum location and capacity of A/U fertilizer complex in Ethiopia.

Responsible party
UNIDO + FAO + NCC

Output 1.1

Activities 1.1.1

Agree on the fertilizer demand in Ethiopia by 2000 and recommended N:P ratio in order to work-out nitrogen and ammonia balances by 2000.

Activities 1.1.2

Analyze relations between domestic production of fertilizers and imports and decide on the development scenario for the nitrogen component, taking into account potential option of import substitution in ammonia.

Output 1.2

Activities 1.2.1

Search for the optimum location of Ammonia/Urea complex in the cropping area taking into consideration the distance for the pipeline of natural gas and logistic in urea distribution to marketing centers.

Activities 1.2.2

Decide on the capacities of ammonia and urea plants looking into different technological possibilities and alternative scenarios.

Immediate objective 2

Appraise overall techno-economic viability of the establishment of an A/U fertilizer complex in the new location and compare it with plants of the establishment of an A/U mini-fertilizer plant at Gode and world-scale A/U fertilizer complex at Metahara.

H. PROJECT STRATEGY

1. Direct recipients

The Technical Assistance project discussed here would provide the background for the decisions on the establishment of an Ammonia/Urea fertilizer complex in Ethiopia, and for further activities of NCC and other Ethiopian companies involved into development of the national fertilizer industry.

2. How will the benefits reach the target beneficiaries?

Urea produced in A/U fertilizer complex at the cropping area will be distributed directly among the farmers and in the neighbouring regions.

Through the techno-economic appraisal, NCC and cooperating companies would acquire better understanding of FERTIS and its linkages within the system.

Once the optimum solution is found and properly justified, it may then be quickly implemented as it would guarantee the highest foreign exchange savings.

3. Implementation arrangements

The techno-economic appraisal of the viability of A/U complex located in the cropping area may be prepared within 3 months, after full understanding of this idea and the cooperation in its implementation are agreed between UNIDO and the responsible Ethiopian organizations.

4. Alternative strategies considered

The establishment of a mini-fertilizer A/U plant at Gode, according to the plans of National Chemical Corporation is considered as an alternative strategy for the present Technical Assistance project.

Though a mini-fertilizer A/U plant at Gode is for sure an option to minimize investment cost, it is assumed, however, that this option is not an optimum one because it does not fit to the future nitrogen demand in Ethiopia and, what is even more important, there is no sufficient market for urea in Gode region even delivered from a mini-fertilizer plant of small capacity.

I. HOST COUNTRY COMMITMENT

1. Government commitment

Commitment of the Ethiopian Government is a pre-condition for this Technical Assistance project to be realized.

2. Legal arrangements

No legal arrangements are necessary at the stage of elaboration of a techno-economic appraisal.

J. RISKS

The following are significant risks which could seriously delay or prevent the achievement by the project of its outputs and objectives.

Estimated likelihood of occurrence
(i.e. high, medium, low)

1. Major risks

The lack of commitment of the Ethiopian Government or the lack of interest from the NCC side in analyzing other options for the establishment of A/U fertilizer complex but in Gode and/or Metahara, are considered to be major risks for this Technical Assistance project.

Low

2. Risks to be monitored

No risks need to be monitored.

A. DEVELOPMENT TO BE ADDRESSED BY THE PROPOSED PROJECT

1. Development problem at (sub-)sectoral (macro) level

Ethiopia is predominantly an agrarian country with nearly 85% of the population being engaged in the agricultural sector which is characterized by low productivity. Food production has to increase significantly in order to fulfill the nation's targets of achieving self-sufficiency in crop production. One of the major means of achieving this would be the increased use of fertilizers being recognized as the major input in the increase of crop production for domestic use and for export.

2. Problem addressed by the project

The current domestic annual imports of mineral fertilizers has reached a level over 150,000 MTPY and demand projection based on a recent pre-feasibility study (Industrial Project Service of Ethiopia) indicates that fertilizer demand is very high and may reach 500,000 MTPY by the year 1995. By the 2000 demand is estimated to be about 1,000,000 MT of fertilizer product. This demand is heavily constrained by foreign exchange availability in Ethiopia.

B. CONCERNED PARTIES AND TARGET BENEFICIARIES

1. Problem identification

The fertilizer demand by 1995-2000 justifies to consider the establishment of a fertilizer complex in Ethiopia. The major fertilizer inputs that has been widely practiced within the country were highly concentrated fertilizers DAP, Urea, TSP and to a lesser extent NPK. If the country is to import continuously all the fertilizers it requires, the foreign exchange requirements would grow tremendously approximately up to US\$300 million CIF per annum. Therefore, it is assumed to establish a fertilizer complex in Assab to produce DAP/TSP based initially on imported ammonia, phosphoric acid and phosphate rock to be eventually substituted by domestic raw materials.

2. Target beneficiaries

It is assumed that the establishment of a fertilizer complex in Assab will substantially contribute to foreign currency savings for the Ethiopian economy and would contribute to stop the on and off supply of fertilizers for agriculture. The establishment of the complex in Assab would in particular encourage the intensive usage of fertilizers by the peasant sector which, thanks to good extension services in Ethiopia, uses at present nearly 80% of fertilizers. The domestic production of fertilizers will decrease the farm-gate price of fertilizers and will contribute to consumption growth through higher incentive of fertilizer use, as well as the yield of cash-crops (coffee).

C. PRE-PROJECT AND END-OF-PROJECT STATUS

1. The pre-project situation

A pre-feasibility study has already been conducted by IMPROCHIM of Romania and IPS of Ethiopia, showing that the project in Assab is technically,

economically and financially viable. According to the project idea, there is a need to construct terminals with piers and unloading facilities for phosphoric acid, ammonia and phosphate rock brought to Assab by sea-going vessels. One versatile DAP/TSP plant is to be built of the maximum capacity 240,000 MTPY of DAP or 170,000 MTPY of TSP according to slurry-process. Two storages are envisaged for final products. Both the DAP and TSP product will be packed in Assab based on imported PE/PP bags (altogether 10 mh PE/DP bags). In order to get better acquainted in similar complexes, facilities, management and procurement of inputs to be imported, there is a need to promote the experience of the key managerial staff connected with the project by giving them practical training on similar facilities.

2. End-of-project status

After execution of the a.m. managerial in-plant orientation project, National Chemical Corporation specialists together with specialists representing Assab Port Authority, would be prepared to proceed with the preparation of the contract that is to be signed in 1990. Meanwhile, long-term agreements on supply of phosphoric acid, ammonia and phosphate rock have to be included. At the same time, NCC specialists would be in a position to define optimum configuration of the DAP/TSP complex including capacities of basic and off-sites units as well as to define an optimum production programme for DAP/TSP fertilizers.

D. SPECIAL CONSIDERATIONS

1. Special considerations

Versatile production of the DAP/TSP complex involves careful consideration of optimum capacity units within the complex. For the TSP plant, phosphate rock grinding facilities and fluorine absorption/processing units should be envisaged to yield fluorine marketable products. Typical slurry DAP/TSP process can be used for versatile complex. DAP pipe newest production process cannot be used. Recirculation ratio being higher for TSP production will limit the production capacity as compared to DAP. Liquid storage for phosphoric acid should be equipped with sludge drainage/utilization system. Ammonia atmospheric storage should be designed as a cold storage for -33 grade C with special precautions (poisonous gas). Fuel oil should be taken from the Assab Refinery to generate heat and electricity in fertilizer complex. Well water should be developed in the Assab area as there is a shortage of this type of water.

2. Potential negative effects

Environmental pollution from:

- potential ammonia leakages
- fluorine eff-gases from TSP plant
- phosphate rock dust

E. RELATED TECHNICAL ASSISTANCE ACTIVITIES

1. Training of Assab fertilizer engineers is recommended to be carried in the Assab Oil Refinery.

2. The University of Addis Ababa and NCC specialists as well as the Research Department should look for the optimum possibilities of the utilization of fluorine gases to Na_2SiF_6 or other fluorine compounds.
3. Research should be conducted on utilization of sludges from phosphoric acid.

F. DEVELOPMENT OBJECTIVE

Immediate objective 1

The immediate objective of the project will be the strengthening of NCC and related organizations in order to prepare them for the contractual negotiations related to fertilizer complex in Assab, through institutional building.

Responsible party: NCC

Output 1.1

Activities 1.1.1

Specific recommendations will be prepared as far as the DAP/TSP optimum technical configuration of versatile plant is concerned. Detailed report will be prepared after the project is executed.

Activities 1.1.2

Techno-economic analysis will be carried out in order to define the Ethiopian capability and contribution in the design and selecting optimum technological options and additional technological units.

Output 1.2

Activities 1.2.1

Long-term preliminary agreement and "letters of intent" on phosphoric acid trade and delivery conditions to Ethiopia will be negotiated including payment conditions and necessary technical arrangements (Morocco-tentatively).

Activities 1.2.2

As above for ammonia long-term trade, barter possibilities and payment/pricing conditions (USSR, Persian Gulf Producers-tentatively).

Activities 1.2.3

As above - phosphate rock - trade agreement/barter/price (Jordan).

Immediate objective 2

Specialists from Assab/Ethiopian Port Authority will get acquainted with all the main technical conditions and standards relating to handling, storing, unloading of chemical commodities not known in Ethiopia at present.

A separate report should be prepared as far as adaption/expansion/modernization of port facilities, piers, berths, etc. are concerned.

H. PROJECT STRATEGY

1. Direct recipients

The Technical Assistance Project discussed here would provide the background for the coordination of further activities among other Ethiopian companies involved into contractual negotiations, construction of the complex, its start-up and safety operation. Assab Port Authority will closely co-operate in all the stages of the establishment of the fertilizer project in Assab.

2. How will the benefits reach the target beneficiaries?

The availability of domestic supply of fertilizers will benefit in foreign exchange savings for the national economy. At the same time farmers will be able to purchase domestic fertilizers at a lower price. Construction of domestic fertilizer industry in Assab shall create job opportunities and strengthen technical and professional capabilities of NCI and cooperating organizations.

3. Implementation arrangements

Before implementation of this technical assistance project, which should be considered as a TENTATIVE, the economic viability of Assab DAP/TSP versatile plant project should be carefully examined. This Technical Assistance Project should be executed as soon as the economic efficiency of Assab complex has been proven.

4. Alternative strategies considered

Complex Feasibility Study on Fertilizer Production in Ethiopia can be considered as an alternative strategy in which the optimum capacity of the Assab plant with recommended DAP or TSP product only (and not versatile DAP/TSP plant) together with the optimum capacity of Ammonia/Urea Plant should be designed for Ethiopia, taking into account NPK demand 2000, N:P:K ratio and types of fertilizers to be used in the future.

K. INPUTS

1. Skeleton budget: Provide a summary estimate of total costs by major budget category.

	<u>National inputs</u>	<u>External inputs</u>
Personnel	18,000 Birr	US\$30,000
Sub-contracts (specify types of goods or services)	12,000 Birr	20,000
Training	20,000 Birr	25,000
Equipment	4,000 Birr	2,000
Miscellaneous	<u>30,000 Birr</u>	<u>3,000</u>
Totals	<u>84,000 Birr</u>	<u>US\$80,000</u>

UN exchange rate: \$1.00 = 2.07 Birr

2. Comment on any proposed inputs which may raise policy issues on which Headquarters guidance is sought.

Person primarily responsible
for this formulation framework:

Signature

Name:
Title:

PROJECT OF THE GOVERNMENT OF ETHIOPIA

Title: Fertilizer raw materials exploration and evaluation

Number: Duration 3 years

Project site: Ethiopia

Sector: Mining industry

Subsector: Fertilizer raw materials

Host country: Ethiopia

Implementing Agency: Ethiopia Institute of Geological Survey

Executing agency: UNIDO or UNDP

Estimated starting date: 1990

Government inputs: 2,577,960 Birr

Brief description: The Ethiopian Economy, being mainly agricultural, depends on imported fertilizer and other chemicals, which demands hard currency. In the past few years EIGS has carried out systematic investigations on potential areas for phosphorite and apatite minerals. Studies were conducted based on recommendations by R.P. Sheldon (1984), and V.N. Serguenks (1984), which included the following priority areas and geological formations;

- Phosphorite Auradu series in the Ogaden
- Igneous apatite Gabbro-anorthorite, biotite pyroxmte; carboratite, syenite
- Metamorphic Metamorphic sediments (i.e. strometaties and associated sedimens, skarus)
- Biogenic guano (bore beds, bat guaro)
- Residual weathered roles of various types where apatite is enriched

Results obtained so far proved the existence of phosphorite bearing rocks in the Ogaden and apatite associated with magnetite and ilmenite mineralization in Wellga and Bale Administrative regions.

1. To manufacture phosphate fertilizer from phosphate rock sulphuric acid is an important component. Sulphuric acid can be prepared from sulphur and/or sulphide minerals such as pyrite. In Ethiopia there are a number of occurrences of sulphur and pyrite but none have been studied in detail. To ensure a continuous supply of sulphuric acid to the fertilizer plant the domestic source of sulphur should be

evaluated carefully. In this respect the known occurrences and other sources will have to be studied.

2. Of the various factors that affect soil fertility, soil PH is one that can be controlled by the addition of calcium materials such as limestone. This process is commonly known as liming. It requires abundant source of limestone and/or dolomite within a range of and acceptable distance. The source of liming materials and areas of high priority will be assessed and field trials will also be carried out to study its effectiveness.

A. CONTEXT

Soils in Ethiopia are known to be deficient mainly in phosphorous and nitrogen. Hence, the continued supply of sulphur for phosphate fertilizer manufacture, and limestone and dolomite for liming are necessary materials to reduce the acidity of soils.

B. PROJECT JUSTIFICATION

1. Problem to be addressed

At present all fertilizer requirements of the country are met by import. There is grave shortage of food and other agricultural products. The decline in this sector of the economy is believed to have been contributed due to general factors of which one is the depletion of the soil fertility. Absence of domestic supply of fertilizer is another factor that severe limitations on the performance of the agricultural sector as a whole.

There is at the moment, a plan to construct a phosphate fertilizer plant which will operate using imported raw materials. To date there is only one possible deposit of low grade deposit (apatite) studied to a reasonable detail. In order to establish an economically viable fertilizer industry, more exploration on other potential areas should be conducted.

2. Expected end-of-project situation

The selected target areas and others which will be discovered in due course will be explored in detail and information concerning mineralogy, texture, structure of deposit, reserves, and relevant data which enables to decide on its utilization will be studied. Thus selected deposits will be mined, upgraded and used in place of imported raw material. Liming trials and identification of resources is believed to minimize acidity problems.

3. Target beneficiaries

The availability of domestic supply of fertilizer will benefit the national economy, in addition to the farmers who will be able to buy at a lower cost. The contribution in terms of the job opportunities and professional training is also important.

4. Project strategy and institutional arrangements

The project will be executed in close association between EIGS and UNIDO and will contact other Professionals/Organizations concerned with various aspects of fertilizer raw materials, i.e. phosphatic.

5. Reasons for assistance from UN agencies

Transfer of know how, organisation of supplies, financial resources, and training of professionals are the tasks that the UN agencies are expected to contribute. Following the successful training, exploration, and evaluation on implementation of results, the national capability is believed to be promoted to undertake such activities on their own.

6. Special consideration

It is important to note that the transfer of know how, including training, are practical and effective.

7. Co-ordination arrangements

The EIGS Project Manager will report directly to the UNIDO representative through the intermediary of UNDP in Addis Ababa and the General Manager of EIGS. No further co-ordination is necessary.

8. Counterpart support capacity

The Government should provide a project counterpart, preferably a well experienced geologist in phosphate exploration.

C. DEVELOPMENT OBJECTIVES

The main development objective is to utilize the deposit thus studied and evaluated to substitute for imported phosphate rock for the fertilizer plant being considered soon.

D. IMMEDIATE OBJECTIVES OUTPUTS AND ACTIVITIES

1. Immediate objectives and activities

- Prospecting for igneous and sedimentary phosphate in Sidamo, Wellega, Bale, East Hararge Administrative regions and Ogaden Autonomus region at a scale 9 1:250000
- Geological mapping on 300 km² at a scale of 1:10000
- Core drilling of 4000 linear meters
- Chemical analyses of 2000 samples
- Characterization of phosphate ore-10 bulk samples
- Training of Ethiopian project personnel

2. Immediate objective 2

- Evaluation of the phosphate potential and complete pre-feasibility

studies on selected deposits.

-Mining planning and design

-Studying alternative uses for resources evaluated

3. Immediate objective 3

-Utilization of the domestic raw material in fertilizer manufacture

4. Immediate objective 4

-Survey of micronutrients in Ethiopia, such as: Zn, Bo, Mn, Fe, Co, Mo, Cu

E. INPUTS

(a) Ethiopian Government

-Project coordinator	-36 man/month	Birr	54,000
-Geologists	-360 man/month	"	255,000
-Drivers	-180 " "	"	63,000
-Drilling crew	-288 " "	"	207,000
-Casual labour	- - -	"	90,000
-Camping equipment	-12 sets	"	48,000
-Vehicle	-4 toyotas	"	200,000
-Project running cost fuel & lubricants maintenance	- - -	"	700,000
-Insurance	- - -	"	260,000
-Tax	- - -	"	500,000
-Chemical analysis	- - -	"	<u>200,000</u>
	Total		<u>2,577,960</u>

(b) UN Agencies

-Consultant	36 man/months	Birr	200,000
-Lab. equipment and consumables	-	"	300,000
-Drilling accessories	-	"	1,000,000
-Vehicle	4 toyotas	"	200,000
-Truck	1	"	200,000
-Spares	-	"	150,000
-Training (Misc.)	24-48 m/m	"	<u>160,000</u>
	Total		<u>2,010,000</u>

Figure: Target areas for phosphate and sulphur exploration

Figure: Map

Figure: Map

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PROJECT OF THE GOVERNMENT OF ETHIOPIA

Title: The package of training programmes in distribution of fertilizers to strengthen managerial and operational capability of AISCO

Number:

Estimated Duration: 12 months

Proposed sources of funds: RB

Estimated UNDP contribution: US\$300,000

Estimated Government cost-sharing: US\$50,000

Estimated Government input: 100,000 Birr

A. DEVELOPMENT PROBLEM TO BE ADDRESSED BY THE PROPOSED PROJECT

1. Development problem at (sub-)sectoral (macro) level

Agriculture is the mainstay of the Ethiopian economy. Fertilizers are recognized to be the most important input to agricultural production increase for domestic use and for export. At the present time Ethiopia imports about 150,000 MT of fertilizers per annum, mostly DAP and Urea. The only company/parastatal/ involved in the whole chain of imports, handling, transport, distribution and marketing of fertilizers in Ethiopia is AISCO (Agricultural Input Supply Corporation).

2. Problem addressed by the project

Imports of fertilizers in Ethiopia is a substantial burden to the domestic economy, therefore the efficient use of both the financial means to buy fertilizers at reasonable prices and their proper distribution to minimize the overall cost of this input, is of great importance to agricultural output increase in Ethiopia, all the more so that the demand for fertilizers by 2000 is characterized by substantial growth rate.

B. CONCERNED PARTIES AND TARGET BENEFICIARIES

1. Problem identification

In order to strengthen managerial and operational capability of AISCO, there is a need to organize training programmes for its management, regional agents and operational staff in:

- procurement, contracting and trading imported fertilizers (3 persons)
- logistic storage, transport and distribution of fertilizers (30 persons)
- operation and maintenance of mobile fertilizer bagging units (3 persons)

Training programmes shall be organized in Ethiopia and abroad.

2. Target beneficiaries

The preparation and organization of training programmes for 36 AISCO employees will contribute to:

- foreign exchange savings for the Ethiopian economy through improvement of procurement and contracting of fertilizers at more competitive prices.
- more efficient handling, distribution and use of fertilizers delivered to farmers in proper qualities and at the proper time.
- proper utilization of the 3 mobile fertilizer bagging units (to be purchased from the World Bank funds) in order to decrease port handling costs and fertilizer losses, improve handling flexibility in fertilizer warehouses during peak loads or during breakdowns for fertilizer to be re-packed.

C. PRE-PROJECT AND END-OF-PROJECT STATUS

1. The pre-project situation

At the present time AISCO is totally responsible for purchasing, handling distribution and marketing of all fertilizers imported to Ethiopia at the cost of about US\$50 million per annum. Growing demand for fertilizers will result in year-by-year increased cost of imported fertilizers, before domestic fertilizer industry is built. This implies the necessity of strengthening managerial and operational capability of AISCO in order to reduce the fertilizer farm-gate price, all the more so that the unit cost of fertilizer transport and distribution from the port in Assab to the farmer's gate is as high as US\$150/ton.

2. End-of-project status

The package of training programmes for AISCO will contribute to the institutional strengthening of this corporation. After project execution AISCO will be better prepared to competitive procurement and contracting of imported fertilizers, will gain additional knowledge of the fertilizer distribution system and its logistics in Ethiopia. This, in turn, will contribute to fertilizer consumption growth and to more efficient fertilizer use.

D. SPECIAL CONSIDERATIONS

1. Special considerations

Special attention should be given to arrangements related to training programmes organized abroad in order to assure that all AISCO specialist/agents trained abroad shall return afterwards to their duties in AISCO in Ethiopia. Egypt and India are considered to be the countries properly experienced to organize training programmes for Ethiopian specialists/fertilizer distribution agents.

2. Potential negative effects

No negative effects are expected apart from potential losses of funds used for trainees not returning to their duties with AISCO.

E. RELATED TECHNICAL ASSISTANCE ACTIVITIES

Pre-feasibility study on the viability of the establishment of PE/PP fertilizer packing unit in Assab. This project should indicate whether purchasing of fertilizers in bulk to be subsequently packed in Assab is an attractive option. If it were the case, the accent should be put in AISCO training programmes on procurement, handling, storing and packing fertilizers in bulk.

F. DEVELOPMENT OBJECTIVE

Through its training programmes, project aims at the development of major components relating to storage, transport, distribution, consumption, demand and policies in Fertilizer Industrial System in Ethiopia.

G. MAJOR ELEMENTS

Immediate objective 1

The immediate objective of the project will be strengthening of AISCO in order to prepare its managements and regional agents/mobile packing specialists to cope with increased amount of fertilizer to be purchased and distributed at the farm-gate level.

Responsible party: AISCO/UNIDO

Output 1.1

Activities 1.1.1

Training objectives and training schedule for each of the programmes will be prepared by AISCO together with specific conditions relating to training abroad.

Activities 1.1.2

UNIDO, cooperating with AISCO shall negotiate the possibilities and conditions of training abroad in the countries selected for the execution of the project (Egypt and India - tentatively)

Output 1.2

Activities 1.2.1

Detailed reports will be prepared by AISCO, after each of the training components is executed, indicating benefits and experience derived from the training programmes.

H. PROJECT STRATEGY

1. Direct recipients

The package of training programmes would strengthen managerial and operational capabilities of AISCO at the level of its headquarter in Addis Ababa and at the regional level /AISCO agents/specialists at Selling/Distribution Centres and Service Cooperatives/.

2. How will the benefits reach the target beneficiaries?

Through increased knowledge of AISCO managers/agents/specialists, the whole chain of operations beginning with imports/production/ of fertilizers till their application at the peasant level. At the present time bagged fertilizers imported through port in Assab are directed to warehouses in Nazarett and Addis Ababa from where they are sent to 750 Selling Distribution Centers linked with 4,000 Service Cooperatives supplying fertilizers to about 7 million of peasants.

3. Implementation arrangements

Specific training objectives, training schedules and lists of participants in each of the training programmes should be prepared by AISCO

and approved by Ministry of Agriculture before they are sent to UNDP in Addis Ababa. UNIDO-Vienna/UNDP Addis Ababa should initiate arrangements on training programmes in Ethiopia and abroad.

4. Alternative strategies considered

The execution of the whole training programme package entirely in Ethiopia may also be considered by means of sending to AISCO trainers highly specialised in procurement, contracting, marketing and logistics in fertilizer distribution. It is recognized, however, that the optimum training programmes should include not only training in Ethiopia but also training abroad. AISCO should justify proposed split of training programmes for local and foreign components.

I. HOST COUNTRY COMMITMENT

1. Government commitment

Any UNIDO action relating to the package of the above mentioned training programmes for AISCO, should be preceded by the commitment of the Ethiopian Government.

2. Legal arrangements

Legal arrangements may be necessary with countries/tentatively Egypt, India/organizing training programmes for the Ethiopian staff.

H. RISKS

The following are significant risks which could seriously delay or prevent the achievement by the project of its outputs and objectives.

Estimated likelihood of occurrence
(high, medium, low)

1. Major risks

Emigration of trainees from Ethiopia through host training country, or their not returning to their duties in AISCO after being trained abroad.

Medium

2. Risks to be monitored

Number of the Ethiopian trainees sent abroad and number of trainees returning to their duties in AISCO.

K. INPUTS

1. Skeleton budget: Provide a summary estimate of total costs by major budget category.

	<u>National inputs</u> (specify currency)	<u>External inputs</u> (US dollars)
Personnel	<u>100,000 Birr</u>	_____
Sub-contracts (specify types of goods or services)	_____	_____
Training	<u>50,000 Birr</u>	<u>US\$300,000</u>
Equipment	_____	_____
Miscellaneous	_____	_____
Totals Indicatively	<u>200,000 Birr</u>	<u>US\$300,000</u>

UN exchange rate: \$1.00 = 2.07 Birr

2. Comment on any proposed inputs which may raise policy issues on which Headquarters guidance is sought.

No comments.

Person primarily responsible
for this formulation framework:

Signature

Name:

Title:

PROJECT OF THE GOVERNMENT OF ETHIOPIA

Title: Pre-feasibility study on the viability of the establishment of PE/PP fertilizer packaging unit

Number:

Estimated duration: 3 months

Proposed sources of funds:

Estimated UNDP contribution: US\$50,000

Estimated Government cost-sharing:

Estimated Government input: 50,000 Birr

A. DEVELOPMENT PROBLEM TO BE ADDRESSED BY THE PROPOSED PROJECT

1. Development problem at (sub-)sectoral (macro) level

Fertilizers are one of the most valuable, but also most costly input to the Ethiopian agricultural sector/approximately US\$50 million per year/. All the fertilizers consumed in Ethiopia are imported in PE/PP bags. Unit price of bagged DAP and Urea - /the fertilizers predominantly imported in Ethiopia/-is substantially higher than that of fertilizers in bulk. One of the possible option to decrease foreign exchange burden would be the importation of fertilizers in bulk and packing them in Assab in domestically manufactured PE/PP bags.

2. Problem addressed by the project

Present consumption of fertilizers close to 200,000 MTPY and increasing demand for fertilizers estimated for at least 600,000 MT by 2000 is heavily constrained by foreign exchange availability in Ethiopia. With growing imports of fertilizers through port in Assab/or even with planned own DAP/TSP production in Assab/ there is a need to prepare pre-feasibility study in order to analyze the viability of the establishment of PE/PP fertilizer packaging unit in Assab. Manufacturing of PE/PP bags in Assab would have to be based on imported polyethylene and polypropylene.

B. CONCERNED PARTIES AND TARGET BENEFICIARIES

1. Problem identification

The problem has been identified by AISCO (Agricultural Input Supply Corporation) responsible for imports of fertilizers in Ethiopia, and addressed to UNIDO consultant.

Assuming high fertilizer consumption increase /about 18-20% per annum/ and future fertilizer demand AISCO believes that the development of packaging industry in Ethiopia would be justified technically and economically.

2. Target beneficiaries

Ethiopian peasants would be ultimate target beneficiaries of the project. All net savings between imports of fertilizers in bags and bulk (cost of manufacturing PE/PP bags included) would be transferred to the peasants after the reduction of fertilizer selling price. This would stimulate further fertilizer consumption growth through higher incentive of fertilizer use.

C. PRE-PROJECT AND END-OF-PROJECT STATUS

1. The pre-project situation

About 200,000 MTPY of fertilizers are imported in PE/PP bags at the present time. This equals to the importation of about 4 million double layered PE/PP bags. When fertilizer demand 2000 is taken into consideration, as much as about 12 million of PE/PP bags would have to be imported, even assuming local production of fertilizer for which PE/PP bags are necessary as

well. Such an amount of imported PE/PP bags justifies elaboration of the pre-feasibility study on the viability of establishment of PE/PP fertilizer packaging unit.

2. End-of-project status

After establishment of the domestic PE/PP manufacturing unit at Assab, two different options are possible:

- (a) all fertilizers are still imported and the capacity of PE/PP manufacturing unit would be about 12 million bags to meet NPK demand 2000.
- (b) A domestic fertilizer industry is to be built in near future, implying the analysis of optimum PE/PP bags manufacturing units either in Assab where DAP/TSP plant is expected to be built or in Assab and another location selected for the domestic nitrogen fertilizer complex (Ammonia/Urea). Optimum solutions should be aimed at, depending on FERTIS development scenarios.

D. SPECIAL CONSIDERATIONS

1. Special considerations

There are several special considerations related to the project, namely:

- (a) NCC - planning the construction of DAP/TSP plant in Assab does not intend to invest into PE/PP bags manufacturing facilities, assuming that all bags would be delivered from imports. This strategy will, most probably, be maintained when construction of ammonia/urea complex is considered. Therefore, NCC approach is quite different from that of AISCO, and at least preliminary agreement on basic ideas should be reached before pre-feasibility study is launched.
- (b) Ethiopia does not produce polyethylene or polypropylene. Refinery in Assab is too small to derive from it any of olefins for the production of polymers: PE and PP. Thus, all polymers (PE + PP) for the manufacturing of PE and PP bags would have to be imported.

2. Potential negative effects

No potential negative effects of the preparation of the analyzed pre-feasibility study are expected.

E. RELATED TECHNICAL ASSISTANCE ACTIVITIES

The five technical assistance projects are directly related to the present project and may influence its final targets. These are:

- (a) Techno-economic appraisal of the viability of ammonia-urea plant,
- (b) Training services related to DAP/TSP complex in Assab,
- (c) The package of training programmes to strengthen AISCO management,

- (d) Seminar on fertilizer demand by 2000 and optimum types of fertilizers,
- (e) Stand-by project related to potash exploration in Dallol/depending on whether at least part of output from the potassium salts mine is to be packed in PE/PP bags for export deliveries,

See List of Technical Assistance Projects Documents for FERTIS in Ethiopia.

F. DEVELOPMENT OBJECTIVE

Taking into account fertilizer demand by 2000, it is assumed that the construction of facilities for the manufacturing of 12 million inner PE bags and 12 million outer PP bags should be considered. Approximate demand for raw materials-polymers to be imported to Ethiopia would be about 1,200 tons of high density polyethylene HDPE and about 1,200 tons of polypropylene per annum.

If the construction of the facilities for the manufacturing of PE/PP bags based on imported polymers will prove to be economically viable, there is a room for investment project in order to save foreign exchange Ethiopia spends at present for the importation of PE/PP bags manufactured elsewhere. The price difference in between bulk/bagged fertilizers are expected to bring the highest foreign exchange savings.

G. MAJOR ELEMENTS

Immediate objective 1

The immediate objective of the project would be to analyze the viability of the manufacturing PE/PP bags on the basis of imported polymers.

Responsible party: AISCO + NCC + UNIDO

Output 1.1

Activities 1.1.1

Pre-feasibility report study on the viability of the manufacturing of 12 million PE/PP bags in Assab will be prepared.

Activities 1.1.2

Techno-economic analysis will parallelly be carried-out on the coordination of engineering activities for DAP/TSP facilities/ fertilizer stores in Assab with the planned investment for the manufacturing of PE/PP bags.

Output 1.2

Activities 1.2.1

Alternative options of the construction of the facilities producing only PE or sisal or jute bags will be analyzed.

Activities 1.2.2

Coordination between all potential options regarding fertilizer importation/domestic production and manufacturing of different types of bags /PE/PP; PE; sical; jute/ would have to be assured including the preparation of an overall complex schedule for these activities.

Immediate objective 2

The immediate objective 2 of the project would be to select an optimum locations and capacities of the facilities manufacturing bags, taking into account 0 among other factors - such as: capacities of DAP/TSP complex in Assab, Ammonia/Urea complex and potential supplementary import of fertilizers.

H. PROJECT STRATEGY

1. Direct recipients

The Technical Assistance Project discussed here would provide the background for the coordination of activities among AISCO, NCC and other companies involved in the chain of importing, producing, packing, transporting and distributing fertilizers.

2. How will the benefits reach the target beneficiaries?

Availability of domestic supply of PE/PP; PE; sical; jute bags will benefit in foreign exchange savings for the national economy. At the same time farmers will be able to purchase fertilizers at a lower price. Packaging industry development will create job opportunities and allow to give AISCO more freedom and flexibility in purchasing fertilizers in bulk.

3. Implementation arrangements

In order to prepare a sound pre-feasibility study, a very careful analysis and comparison of prices between ready-made bags and raw materials to manufacture bags, as well as DAP/TSP/Urea prices in bulk and bagged should be carried-out.

4. Alternative strategies considered

Alternative strategy to be considered, but only for Assab, is to analyze imports of fertilizer in bulk, separate imports of bags and packing fertilizer in Assab port/fertilizer terminal, utilizing Ethiopian labour force and fertilizer packaging facilities.

It is believed, however, that the reasonable and complex programme of manufacturing bags (using imported and domestic raw materials) and packaging fertilizers in Ethiopia is a more justified option than imports of bagged fertilizers.

I. HOST COUNTRY COMMITMENT

1. Government commitment

It would for sure be worthwhile to have agreed basic idea of this project between AISCO and NCC before Ministry of Agriculture and Ministry of Industry shall support the project.

2. Legal arrangements

The responsibility and competence of AISCO and NCC in the preparation and implementation of this project should be determined before pre-feasibility study is launched.

J. RISKS

The following are significant risks which could seriously delay or prevent the achievement by the project of its outputs and objectives.

Estimated likelihood of occurrence
(high, medium, low)

1. Major risk

The potential lack of the proper coordination of actions in this project between AISCO and NCC is the major risk, however, likelihood of its occurrence is low.

2. Risks to be monitored

No risks need to be monitored.

K. INPUTS

1. Skeleton budget: Provide a summary estimate of total costs by major budget category.

	<u>National inputs</u> (specify currency)	<u>External inputs</u> (US Dollars)
Personnel	_____	_____
Sub-contracts (specify types of goods or services)	_____	_____
Training	_____	_____
Equipment	_____	_____
Miscellaneous	_____	_____
Totals Indicatively	<u>50,000 Birr</u>	<u>US\$50,000</u>

UN exchange rate: \$1.00 - 2.07 Birr

2. Comment on any proposed inputs which may raise policy issues on which Headquarters guidance is sought.

Pricing policy related to domestic raw materials to manufacture bags and long-term agreements on the profitable purchasing of PE/PP polymers are recommended to be preliminarily arranged with potential suppliers.

Person primarily responsible
for this formulation framework:

_____ Signature

Name:

Title:

PROJECT OF THE GOVERNMENT OF ETHIOPIA

Title: Seminar on fertilizer demand by 2000, optimum N:P:K ratios and fertilizer types, fertilizer affinity to the local soils and crops

Number:

Estimated duration: 2 months

Proposed source(s) of funds: UNIDO/FAO

Estimated UNDP contribution: US\$50,000

Estimated Government cost-sharing: US\$10,000

Estimated Government input: 60,000 Birr

A. DEVELOPMENT PROBLEM TO BE ADDRESSED BY THE PROPOSED PROJECT

1. Development problem at (sub-)sectoral (macro) level

Ethiopia, with a per capita GNP in 1986 of US\$120, is one of the poorest countries in the world. The almost total reliance on agricultural exports, accounting for over 90% of foreign exchange earnings, imposes to increase the agricultural productivity by appropriate technological change and increased efficiency and use of inputs such as fertilizer, improved crops varieties as well as some acreage expansion. The rapid growth of agricultural exports is critical to financing essential capital goods for development.

2. Problem addressed by the project

The Ethiopian Government is to decide on investment programme in the domestic fertilizer industry by the year 2000. The creation of the national fertilizer industry is a pre-condition to increase the agricultural exports and to save valuable foreign exchange used for imports of fertilizers. Both demand for fertilizers and investment in the fertilizer subsector are heavily constrained by decisions in the long-term programme of development of the country. This Technical Assistance project aims therefore at organizing a seminar in order to define and specify more precisely the future objectives and targets in FERTIS development in Ethiopia.

B. CONCERNED PARTIES AND TARGET BENEFICIARIES

1. Problem identification

The fertilizer consumption growth and the fertilizer demand 2000 justify to create domestic fertilizer industry in Ethiopia. There are, however, too large differences in opinions among the organizations responsible for setting development targets on fertilizer demand, optimum nutrients ratio and types of fertilizers needed in Ethiopia, to justify at the present time any concrete investment actions to be undertaken, before the most important questions relating to the strategy of FERTIS development in Ethiopia are cleared up at the planned seminar and agreed among the organizations involved in this development process.

2. Target beneficiaries

Ethiopia, with its weak economy and civil conflict in the country, draining valuable foreign exchange from agricultural exports, cannot afford for taking any investment decisions in the development of the domestic fertilizer industry but optimum ones. Therefore, the whole nation will benefit from the conclusions worked-out at the planned seminar. The sooner the seminar is organized, the quicker the coordination of objectives in fertilizer demand, capacities needed in the domestic fertilizer industry and actions connected with the exploration of domestic raw materials related to FERTIS. National Chemical Corporation, Ministry of Industry, Ministry of Agriculture, AISCO, Ministry of Energy and Mines and others will benefit from the planned seminar.

C. PRE-PROJECT AND END-OF-PROJECT STATUS

1. The pre-project situation

It appeared, during field work of UNIDO consultant on FERTIS strategy in Africa, that differences in setting the principal objectives for development of FERTIS in Ethiopia are substantial and too big to be accepted if UNIDO is to enter into any Technical Assistance/Investment Projects related to FERTIS. Demand for fertilizers by 2000, derived from different data and scenarios available, varies in the range of 330,000 MT up to 1,400,000 MT, while N:P ratio varies from about 1:1.5 to 1:0.5 depending on the source of data (NCC, FAO, AISCO, MOA, IAR), this indicating the necessity of agreement and coordination of targets before investment decision are undertaken.

2. End-of-project status

It is assumed that after the planned seminar all the major issues and questions related to FERTIS development in Ethiopia will be answered, in particular as far as problem identification and objectives related to agriculture (fertilizer demand, nutrient ratios, fertilizer types) are concerned. It is assumed that the seminar would also lay-down the frame for the strategies relating to FERTIS development in Ethiopia, such as: optimum location and capacities of fertilizer plants and complexes, logistics and infrastructure and phase-wise schedule of investment actions in order to gain the highest efficiency and financial viability of the overall programme.

D. SPECIAL CONSIDERATIONS

1. Special considerations

It is important that in the planned seminar should take part representatives of all the organizations involved in the whole chain of activities related to FERTIS development in Ethiopia: Agricultural Input Supply Corporation (AISCO), Ministry of Agriculture (MOA), Ministry of Coffee and Tea (MCT), Ministry of State Farm Development (MSFD), Institute of Agricultural Research (IAR), FAO, National Chemical Corporation (NCC), Ministry of Industry (MOI), Ethiopian Institute of Geological Surveys (EIGS), Ministry of Energy and Mines (MOEM), Ministry of Transport and Communication (MTC), Agro-industrial Development Bank (ADB), and others - according to the suggestions of the Government of Ethiopia and UNDP in Addis Ababa. It is suggested that a joint FAO/UNIDO seminar opening paper should be prepared and agreed with the Ethiopian Government before the seminar.

2. Potential negative effects

No potential negative effects are expected from organizing coordinative seminar on FERTIS development in Ethiopia.

E. RELATED TECHNICAL ASSISTANCE ACTIVITIES

All Technical Assistance projects discussed in the package of UNIDO actions connected with FERTIS development in Ethiopia are, to different extent, related to this Technical Assistance project. Technical Assistance projects connected with the construction of Ammonia/Urea mini-fertilizer plant

and/or nitrogen fertilizer complex, as well as project connected with the DAP/TSP complex in Assab seem to be the most important to the present Technical Assistance project, as the seminar may bring together opinions of decision-makers from the Ethiopian Government and in the process speed up FERTIS development programme.

F. DEVELOPMENT OBJECTIVE

The aim of the Technical Assistance project is to organize a seminar in order to define and specify more precisely the future objectives and targets in FERTIS development so as to reach full agreement and coordination of objectives in fertilizer demand, domestic production of fertilizers and exploration of the domestic raw materials related to FERTIS.

After a seminar a UNIDO/FAO study may follow-up at a later stage.

Apart from the topics related to import substitution strategy in nitrogen and phosphate fertilizers (mostly DAP and Urea), there is also a room at the seminar for the discussion of export-oriented potash project in Ethiopia set for delivery of muriate of potash (MOP) and sulphate of potash (SOP) to East African and Indian Ocean countries.

G. MAJOR ELEMENTS

Immediate objective 1

Preparation of the frame of the Seminar related to FERTIS development in Ethiopia in order to work-out valuable conclusions regarding investment strategies in the domestic fertilizer industry.

Responsible party: NCC/AISCO + UNIDO/FAO

Output 1.1

Activities 1.1.1

Agree with the Ethiopian Government the time, programme and the list of participants of the seminar and prepare the final budget for this Technical Assistance project.

Activities 1.1.2

Elaborate in cooperation with FAO a techno-economic paper opening the seminar and agree it with the Ethiopian Government.

Output 1.2

Activities 1.2.1

Prepare summary-conclusions from the seminar and work-out the framework for the strategy of FERTIS development in Ethiopia.

Activities 1.2.2

Decide on the seminar follow-up actions/studies/appraisals/if needed for

the further strengthening of capabilities of the Ethiopian organizations involved in FERTIS development/.

Immediate objective 2

Monitor the advance of all Technical Assistance projects related to FERTIS development strategies in Ethiopia, and analyze all relevant actions regarding organization, coordination and schedules in order to work out the complex FERTIS development programme assuring the maximum foreign exchange saving for the country (investment programme based on import substitution and export-oriented FERTIS scenarios)

H. PROJECT STRATEGY

1. Direct recipients

The Ethiopian Government and its agencies responsible for agricultural production increase would learn, on the one hand, on the investment possibilities, different scenarios and constraints in FERTIS development, and, on the other hand, the industrial organizations would have confirmed the principal objectives and targets set for domestic fertilizer industry in order to achieve food self-sufficiency in the country by the year 2000.

2. How will the benefits reach the target beneficiaries?

The Government of Ethiopia and its agencies will get, after Seminar, summary-conclusions with a framework of strategy for FERTIS development.

3. Implementation arrangements

It is necessary for UNIDO in Addis Ababa to agree the objectives and the programme of the seminar with the Ethiopian Government. At the same time UNIDO-Vienna should agree the scope of the seminar and seminar opening paper with FAO-Rome.

4. Alternative strategies considered

The preparation of a study related to the issues discussed in the present Technical Assistance project might be considered as an alternative strategy, however, it would take a longer time to prepare such a study. Moreover, it is believed that the planned seminar, through direct contacts of its participants would yield more concrete and properly agreed conclusions on the strategy of FERTIS development in Ethiopia.

I. HOST COUNTRY COMMITMENT

1. Government commitment

Government commitment is a pre-condition of the realization of the present Technical Assistance project.

2. Legal arrangements

No legal arrangements are believed to be necessary.

J. RISKS

The following are significant risks which could seriously delay or prevent the achievement by the project of its outputs and objectives.

Estimated likelihood of occurrence
(high, medium, low)

1. Major risks

The lack of commitment of the Ethiopian Government or the lack of interest of national organization or FAO in organizing the planned seminar is a major risk for this Technical Assistance project.

Low

2. Risks to be monitored

No risks need to be monitored.

K. INPUTS

1. Skeleton budget: Provide a summary estimate of total costs by major budget category.

	<u>National inputs</u> (specify currency)	<u>External inputs</u> (US Dollars)
Personnel	<u>60,000 Birr</u>	<u>US\$50,000</u>
Sub-contracts (specify types of goods or services)	_____	_____
Training	_____	_____
Equipment	_____	_____
Miscellaneous	<u>US\$10,000</u>	_____
Total Tentatively	<u>80,000 Birr</u>	<u>US\$50,000</u>

UN exchange rate: \$1.00 = 2.07 Birr

2. Comment on any proposed inputs which may raise policy issues on which Headquarters guidance is sought.

It is important that the techno-economic paper opening the seminar touched the most important issues, including policy issues, related to the strategy of FERTIS development in Ethiopia.

Person primarily responsible
for this formulation framework: _____

Signature

Name:
Title:

PROJECT OF THE GOVERNMENT OF ETHIOPIA

Title: Stand-by project related to potash exploration in
Dallol in Ethiopia.

Number:

Estimated duration: 3 years

**Proposed sources of
funds:**

**Estimated UNDP
contribution:** US\$2 million

**Estimated Government
cost-sharing:** US\$100,000

**Estimated Government
input:** 2 million Birr

A. DEVELOPMENT PROBLEM TO BE ADDRESSED BY THE PROPOSED PROJECT

1. Development problem at (sub-)sectoral (macro) level

The potash ore deposits occur in the Danakil Depression in Dallol and Musley consisting of sylvinite, carnallite, kieserite, polyhalite and kainite. The potash deposit was discovered in 1911 and was exploited between 1915-1929. Several companies approached deposits with The Ralph M. Parsons Co. of Los Angeles which completed the shaft to the ore body in 1966 and cut underground openings into the sylvinite beds of the Musley deposit. Pilot mining operations were ended when the mine was flooded in 1967. Parsons withdrew from the area though estimated potash reserves ranged from 10 to 18 million tons of recoverable KCl product. In 1983, PEC Engineering was engaged by the Ethio-Libyan Mining Company (ELMICO) and finished Phase 1A study on the potential of potash mining.

2. Problem addressed by the project

Project involves the development of potash deposits in the Danakil Depression in the Tigre area. The growing guerilla activity in the region causes that the project cannot come to fruition, though ELMICO was established in 1981 to supervise the construction of a 1.5 million MTPY open pit mine and beneficiation facilities in order to start mining KCl by about 1990. Clean ore body is one of cleanest in the world and sylvinite reserves in the Musley ore body, estimated for about 13 million tons, represent for less than 1% of those in the whole Danakilan area. After PEC Engineering of France, Kilborn Engineering of Canada has been employed by Economic Commission for Africa to prepare Phase 1A Report Critique. Once again the location was confirmed to be ideal for marketing potash in Africa and Indian Ocean countries. The project should be actively continued and Phase 2 of the Feasibility Study of Dallol Potash Project should follow, however, there is no access to the site (war zone) hence, this is Technical Assistance STAND-BY PROJECT.

B. CONCERNED PARTIES AND TARGET BENEFICIARIES

1. Problem identification

The ten-year plan envisages a ten-fold increase in annual revenue from the mining sector. The biggest share of this revenue is expected to come from the development of the Potash Deposit. In addition, potash mining is expected to contribute significantly to the foreign exchange capacity of the nation.

The project is envisaged for a yearly production of 1.5 million tons KCl. Additionally, sulphate of potash can be produced. A gross selling income of US\$120 million could be earned per year.

Other mineral occurrences of the area could be easily explored and developed.

2. Target beneficiaries

The implementation of the Project could create development opportunity of the area. Trained manpower for the mining sector could be developed.

A marketing feasibility study for Ethiopian Potash was prepared for UN Economic Commission for Africa. The study outlined the potential market areas

mainly in Asia (Japan, India, China, Australia, New Zealand) and Eastern and Southern Africa (Zimbabwe, Mauritius, Kenya, Tanzania and Zambia).

Through its foreign exchange earnings, the Project could bring high benefits to the Ethiopian economy and to the nation. Because of the civil war in this area, all the studies, demonstration drillings and works were halted. The Project can therefore be considered as a STAND-BY project.

C. PRE-PROJECT AND END-OF-PROJECT STATUS

1. The pre-project situation

The Ethio-Libyan Joint Mining Company, established for the purpose of mining the natural resources of Ethiopia, has gathered nine groups of reports regarding Dallol Potash Project. The most important of those are: 33 Technical Reports on Ethiopian Potash Project by Ralph M. Parsons Company (1963-68); Market Feasibility Study for Ethiopian Potash by The Fertilizer India Limited (1983); Dallol Potash Project, Phase 1A Report, Volume 1 + 2 by PEC Engineering, 1984; Ethiopian Dallol Potash Project, Phase 1A Report Critique, by Kilborn Engineering, 1985.

Phase 1B, and in particular Phase 2 of the Feasibility Report that deals with finalising of the technical and economic evaluation of the project is yet to be prepared. Phase 2 of the Feasibility Project includes the final reserve estimates and the appropriate mining method. The final phase deals mainly with the engineering aspect.

2. End-of-project status

After the Phases B1 and 2 of the Feasibility Study are prepared, all the major data connected with: geology, mine, potash refinery, off-sites, utilities and infrastructure, port and shipping facilities, market and marketing, project implementation arrangements and schedule, economic and financial study, reseach programme, and final report - will be gathered and examined by ELMICO.

The final target is to establish an open pit solution potash mine yielding muriate of potash, sulphate of potash and possibly other salts. World-scale capacity potash complex in Ethiopia would be an export-oriented project, that could deliver MOP and SOP to Eastern-Southern Africa and Indian Ocean-Pacific region.

Since both, deposits and the quality of potash ores are very promising, the Potash Project should be continued as soon as there is access to the area (at present in guerilla zone).

D. SPECIAL CONSIDERATIONS

1. Special considerations

- (a) Potash is of great importance for balanced FERTIS development in Africa, as this continent is deficient with that nutrient. Potash project in Ethiopia is therefore of great importance for Eastern-Southern Africa (and also Asia). Therefore this Technical Assistance Project should be given special attention and priority in the financement, as soon as the civil war in Ethiopia is over.

- (b) Sulphate of potash, a very valuable and more expensive than muriate of potash, could be produced in Ethiopian potash complex, thus allowing for higher foreign exchange earnings. Special attention should therefore be given to the stage of potash refinery and diversification of production programme.
- (c) The location of the Ethiopian potash deposits has greater advantages over the other deposits, first of all because of the good access and potential bigger share in the marketing of MOP and SOP in African and Asian markets.

2. Potential negative effects

No potential negative effects are connected with the preparation of this STAND-BY TECHNICAL ASSISTANCE PROJECT.

Taking into account potash production in Jordan, that might be the most competitive to potash production in Ethiopia, as well as overall world market for potash fertilizers, it is recommended that the Ethiopian Potash Complex should be developed according to the following scheme:

- Erection of the facilities for the capacity 0.75 million MTFY of KCl and start the operation with such a production level.
- Complete investigations of the ore body in order to increase the quantity of proven reserves up to the level allowing to raise the production to 1.5 million MTFY of KCl.
- Erection of the facilities for the final production level 1.5 million MTFY.

E. RELATED TECHNICAL ASSISTANCE ACTIVITIES

A Seminar on fertilizer demand by 2000..., to be organized mutually by the Ethiopian Government with FAO and UNIDO, is related to the present Technical Assistance Project, as export-oriented scenario of FERTIS development in Ethiopia is one of the topics planned to be discussed at the Seminar.

Potash exploration project in Dallol is set for export as there is a very little demand for potash fertilizers in Ethiopia.

F. DEVELOPMENT OBJECTIVE

The Dallol potash deposits determined till now are:

1. Crescent ore body,
2. Musley ore body.

Musley ore body is more promising. If conventional mining is not possible, the Musley ore body can likely be mined by solution mining and open pit mining. Advantages of solution mining are the relatively simple process requirements and use of solar energy (geothermal energy). Pilot solution mining and evaporation tests should be carried out. The Musley potash deposit is very shallow and parts of the ore body can be mined economically by open pit methods, since kainite bearing members could be mined at low incremental cost to the cost of mining the sylvite member. Kainite could likely be processed separately and converted to potassium sulphate product.

The Musley ore deposit is located near the city of Mersa Fatma on the Red Sea. Marsa Fatma once served as a port for potash shipments. The location is ideal for marketing potash in Africa and India as well as other countries. The strategic location and low transportation costs will likely outweigh the effects of any negative features of the Musley orebody. The Musley potash deposit may potentially be exploited economically and should be actively pursued.

G. MAJOR ELEMENTS

Immediate objective 1

Immediate objective of this STAND-BY TECHNICAL ASSISTANCE PROJECT is to complete, as soon as there is an access to the area with potash deposits, project feasibility study - Phase 1B and Phase 2, in order to prepare conclusions allowing the Ethiopian Government to decide on the investment into export-oriented potash complex in Dallol.

Responsible party

Output 1.1

Activities 1.1.1

Secure the local and foreign component of the financemnt for the completion of the project feasibility study to be continued as soon as the potash deposits area is safe enough to carry any activities.

H. PROJECT STRATEGY

1. Direct recipients

ELMICO, the Ethiopian Government and the whole nation would benefit from the implementation of export-oriented potash complex in Dallol.

2. How will the benefits reach the target beneficiaries?

It is estimated that a gross selling income of US\$120 million could be earned from the export-oriented project envisaged for the capacity of 1.5 million MTPY of KCl.

The project would directly and positively influence the foreign exchange net balance in Ethiopia.

3. Implementation arrangements

To be assessed when the civil war in Ethiopia is over, or at least there is safe access to the potash ore bodies.

4. Alternative strategies considered

There is no alternative strategy to be considered for the implementation of the export-oriented potash project in Ethiopia.

The only alternative to the present stand-by technical assistance project could be the total abandoning it until there is an access to the area of the

potash deposits. This, however, is considered to be a strategy not too active enough, given the very promising location and potential efficiency of the exploration of the potash deposits in Ethiopia.

I. HOST COUNTRY COMMITMENT

1. Government commitment

The commitment of the Ethiopian Government to this Technical Assistance Project, to be treated as a STAND-BY PROJECT is essential for UNIDO to secure any financemnt for this project.

2. Legal arrangements

Legal arrangements between Ethiopia and Libya on the establishment of ELMICO and on the purpose of mining the natural resources of Ethiopia should be looked into.

J. RISKS

The following are significant risks which could seriously delay or prevent the achievement by the project of its outputs and objectives.

Estimated likelihood of occurrence
(high, medium, low)

1. Major risks

The major risk of proceeding with the present Technical Assistance Project in Ethiopia is political unstability in the region of potash reserves (the Danakil Depression in the Tigre area of northern Ethiopia).

High

2. Risks to be monitored

No risks need to be monitored until there is a safe access to the potash reserves in Ethiopia.

K. INPUTS

1. Skeleton budget: Provide a summary estimate of total costs by major budget category.

	<u>National inputs</u> (specify currency)	<u>External inputs</u> (US Dollars)
Personnel	_____	_____
Sub-contracts (specify types of goods or services)	_____	_____
Training	_____	_____
Equipment	_____	_____
Miscellaneous	<u>US\$100,000</u>	_____
Totals Tentatively	<u>2.2 million Birr</u>	<u>US\$2 million</u>

UN exchange rate: \$1.00 = 2.07 Birr

2. Comment on any proposed inputs which may raise policy issues on which Headquarters guidance is sought.

No comments.

Person primarily responsible
for this formulation framework: _____
Signature

Name:
Title:

BIBLIOGRAPHY
(main sources)

1. EIU - The Economist Intelligence Unit - Country Profile: ETHIOPIA, Somalia, Djibouti.
2. The Africa Review 1989 - ETHIOPIA.
3. Provisional Military Government of Socialist Ethiopia - Ten-Year Perspective Plan 1984-85 to 1993-94, Addis Ababa 1984.
4. UNIDO-SIDFA Yearly Country Brief on Ethiopia 1988, Addis Ababa 1989.
5. World Development Report 1988 - The World Bank, Washington 1988.
6. The World Bank Annual Report 1987 - Washington 1987.
7. The World Bank - Monthly Operational Summary of Proposed Projects, United Nations 1989 - Development Business No. 282, November 1989.
8. The World Bank Report No. 6859 - ET, 1988- ETHIOPIA - Public Investment Programme Review.
9. The World Bank Report No. 7111 - ET, 1988 - ETHIOPIA - Mineral Sector Review.
10. Mining Annual Review 1985 through 1988 - ETHIOPIA.
11. World Survey of Sulphur Resources, Second Edition, 1974 - The British Sulphur Corporation Limited.
12. World Survey of Potash Resources, Third Edition, 1979 - The British Sulphur Corporation Limited.
13. ELMICO - Dallol Potash Project - Phase 1A Report, 1984 - PEC Engineering Division Mine, France.
14. UN Economic Commission for Africa - Ethiopian Dallol Potash Project Phase 1A Report Critique, 1985 - Kilborn Engineering, Canada.
15. FAO Fertilizer Programme - Ethiopian Agriculture - Crop Yield Response and Fertilizer Policies, July 1989.
16. African Agriculture: the next 25 years - Atlas of African Agriculture, FAO, Rome 1986.
17. Management of Nitrogen and Phosphorous Fertilizers in Sub-Saharan Africa, 1986 - Martinus Nijhoff Publishers (Proceedings of a symposium held in Lome, Togo, March 1985).
18. FAO Fertilizer Yearbook, 1985 through 1988.

19. Agricultural and Industrial Development Bank, Annual Report 1987, Addis Ababa, Ethiopia 1987.
20. Data and information derived from different Ethiopian Organizations (mainly NCC, AISCO, MOA, EIGS, ELMICO, MOCTD, MOME, IAR, MOTC and others), as well as FAO, UN, ECA, UNDP in Addis Ababa - field mission to Ethiopia, Dec. 12-27, 1989.