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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

REPORT OF UNIDO FIS MISSION
TO MADAGASCAR

To investigate the market of nitrogen fertilizers there and in East Africa

PART A: MARKET STUDIES

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The consultant wishes to express his gratitude to the Government officials, particularly to Mr. C. Ramonason, General Director of the Office of the Industrial Promotion and Miss. C. Rabevazaha, Chief of Department of the Ministry of Planning, the Representatives of trade and industry, and the international personnel in Chana who gave their time and extended much assistance and advice to facilitate his mission. The assistance of Mr. de Selys Longchamp, UN Resident Representative in Madagascar, was particularly valuable. He contributed a great deal to the arrangement of useful visits and participated with many constructive suggestions in the high level meetings.

CURRENCY EQUIVALENTS

1 Malagasy Franc (FMG)	= US $ 0,00405
1 US $ 1,00	= FMG 247
FMG 1 million	= US $ 4,050.-

THE MALAGASY REPUBLIC

I - BASIC DATA

Area: 590,000 square kilometers

Population (1 July 1966): 6,3 million

Rate of growth 2,6 %

Average density (per sq. km) 11

Political Status: Independent since June 1960

Gross domestic product at constant prices, 1966: FMG 174,6 billion

Rate of growth (long term 1953-66): 3 %

1966 : 5 %

Percapita GDP : US $ 112.5

Gross domestic product at market prices (1966): FMG 174.6 billion

of which, in percent, agriculture : 35 %

mining and manufacturing : 10 %

services : 55 %

Percent of GDP at Market Prices

	1966	1960-66
Gross investment	10.3 %	10 %
Gross national savings	7 %	5 %
Balance of payments current account deficit	5.8 %	5 %
Factor income payments	6 %	7 %
Government current revenues	19 %	17 %
Resource Gap as % of Investment	36 %	50 %

Money and Credit

Relation to large monetary or customs area: Member of Franc Zone

	end 1966	Rate of Increase 1962-66
Total money supply	FMG 29.8 billion	5.6 %
Time and Savings Deposit 1/	FMG 4.2 billion	13.9 %
Commercial Bank Credit and Development Bank Lending to Private Sector	FMG 32.6 billion	4.3 %
Rate of change in prices		4.0 %

Public Sector Operation 2/

	1966	Rate of Increase 1960-66
Public Sector Current Receipts	FMG 38.0 billion	9.2 %
Public Sector Current Expenditures 3/	FMG 34.7 billion	8.5 %
Surplus	FMG 3.3 billion	
Public Investment Expenditures	FMG 10.0 billion	5.6 %
Total External Assistance to Public Sector 4/	FMG 5.3 billion	

1/ Including Postal Checking Accounts.

2/ Central and Provincial Governments and State Enterprises.

3/ Excluding Amortisation of debt.

4/ Excluding Technical Assistance of about FMG 5 billion in 1966.

External Public Debt: (in US $)

	1 December 1966
Total Debt (incl. undisbursed)	89.1 million
Total annual debt service (1967)	3.7 million
Debt service ratio	2.5 %

Balance of Payments (in US $):

	1966	Rate of Change 1960-66
Total Exports, FOB	97.3	+ 4.6 %
Total Imports, CIF	142.0	+ 4.0 %
Net Services	+ 27	+ 43.0 %
Factor Income Payments	- 38	+ 5.2 %
Current Transfers	+ 29	+ 1.2 %
Net Current Account Balance	- 43.4	- 3.8 %

	Average 1960-66	1966
Commodity concentration of exports (coffee)	30 %	30 %
Gross foreign exchange reserves	n.a.	49.0 million

I M F Position

Quota	US $ 19 million
Drawings	nil

External Financial Assistance (in $ million): 1/

	Past Averages 1960-66		1967	
	Commitments	Disbursement	Commitments	Disbursement
Total				
Soft Assistance	26	16	34	16
Hard Assistance	3	2	5	5
Major Donors				
France	7	n.a.	4	n.a.
EEC	13	n.a.	30	n.a.

1/ Excluding technical assistance averaging about US $ 14 million in recent years from France.

II. INTRODUCTION

The Ministry of Industry and Mines in Madagascar requested in April 1967 through UNDP Resident Representative the UNIDO-UNDP assistance to investigate the market for nitrogen fertilizers (particularly urea) in Madagascar and East Africa. The aim of these investigations was to determine the possibilities of Madagascar to export nitrogen fertilizers to the surrounding area, to propose the final capacity of the urea plant and establish whether a market for nitrogen salts exists in the area.

The original request was supplemented by the letter of UNDP Resident Representative dated [illegible] December 1967 in which the following further information is required by Malagasy counterpart:

- Whether the ammonia manufacturing plant based on oil refinery off-gases and fuel oil, should be established and/or anhydrous ammonia imported;
- Process description and flowsheet of urea plant;
- Estimated capital investment costs;
- Utilities and raw materials consumption;
- Staffing of the project;
- Economic evaluation.

Consequently the one man-month SIS (Special Industrial Services) mission 19 January to 19 February 1968 was effected to East Africa the objective of which was two-fold:

- To evaluate the fertilizer marketing possibilities in Madagascar and East Africa region;
- To review the technical and economic aspects of the respective manufacturing facility for urea production.

The former subject will be dealt with in "Part A" of this report and the latter subject in "Part B".

The briefing for this mission took place in Vienna with UNIDO and in Addis Ababa with ECA (Economic Commission for Africa).

The necessary basic factfindings and subsequent assessment of the situation was guided by the following objectives:

(a) The feasible market in East Africa for Madagascar urea has to be established by reviewing the planned fertiliser production with estimated fertilizer consumption in each East African country;

(b) The potential market for nitrogenous fertilisers in Madagascar has to be projected, based on "big agricultural operations" presently

[illegible]

(c) [illegible]

(d) [illegible]

(e) Madagascar [illegible]

(f) [illegible] African countries [illegible] co-operation;

(g) To the maximum possible extent [illegible] infrastructure should be [illegible] and technical set up of the urea plant;

(h) The urea plant [illegible];

(i) The construction of urea plant, if any, should be [illegible] way as to come into existence at a time when the target [illegible] increased fertilizer consumption in Madagascar is achieved;

(j) The urea plant is expected to have its multiplying effect on further expansion of fertilizer industry in Madagascar and in the region, on the promotion of urea use as fertilizers and cattle feed, introduction of new industry in the country, saving of foreign exchange spent presently on the imports of nitrogenous fertilisers, training of engineers and skilled labour etc.

The comprehensive report to this effect is contained in subsequent pages of this document.

III. THE FERTILIZER PRODUCTION AND USE IN EAST AFRICA

The most important consumers of fertilizers are big plantations producing commercial crops although farmers cultivating commercial and subsistance crops are fairly well informed about the results with fertilizer application. This is mainly due to the research experiment and demonstration work performed in the past by well established agricultural institutes in different East African countries. In addition to that, the governments in the East African sub-region take positive measures to expand the use of fertilizers and consequently this area is more advanced in fertilizer consumption than the other sub-regions of tropical Africa. It does not mean that the fertilizer use should be considered as satisfactory because the consumption of fertilizers is still at the very low level of about 3,2 kg per hectare. Consumption varies significantly in different countries, from practically none in Ethiopia, Somalia, Burundi and Rwanda, to high in Mauritius, Réunion and Rhodesia.

The growth of the population is very rapid (about 2,5 % annually) and it is expected that before 1980 the population will exceed 110 million. It may be said by sure, that the additional population will not find enough food for itself with the present methods of land cultivation, not speaking about the necessity to improve under-nourishment and malnutrition especially as far as animal origin proteins are concerned. To achieve this target, it would be necessary to increase gradually the output of grain [1] by 18.4 million tons until 1980. Taking into account the results of the trials and demonstrations carried out many years in the East African sub-region, fertilizers seem to offer the best possibility of a substantial increase in agricultural production. The other technical inputs in agriculture probably cannot be brought into action fast enough on a sufficiently massive basis to play a major role.

Substantial contribution in the campaign for fertilizer use are extending national agricultural Research Institutes which continue to carry out a very comprehensive investigation in order to determine kinds and quantities of fertilisers mostly suited for given conditions.

The projection of future fertiliser consumption in East Africa has been under by Economic Commission for Africa and several public and private institutions. Coming back to the figure of needed grain mentioned

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[1] (maise, wheat, teff, rice, barley etc.)

above, and taking into consideration the experience of Japan, India and Taiwan, it can be assumed that 50 % of the 18.4 million tons of grain required, or 9.2 million tons, can be obtained by increased fertilizer consumption. To project how much fertilizer would be needed to this effect, it is necessary to make use of proper coefficient of the yield of 1 Kg of plant nutrient. It seems that a realistic proportion 1 to 10 (for balanced use N and P_2O_5) could be applied based on the experience gained in the sub-region, which means that in 1980 it would be necessary to use about 670 thousand tons of fertilizer in the East African sub-region in order to obtain enough food for the additional population (40 million people) and another 250 thousand for the nutrition improvement of the existing population, or 920 million tons of plant nutrients all together.

So far the requirement of fertilizer for subsistance crops were discussed. Additional amounts of fertilizer will be necessary for the expansion of cash crops for export. If assumed that cash crops alone will require double the present over-all fertilizer consumption, 240 thousand tons of plant nutrients will be required. Computed together with calculations outlined above, the potential demand for fertilizer will be about 1,160 thousand tons of pure plant nutrients consisting of about 460 thousand tons of N, about 460 thousand tons of P_2O_5 and about 230 thousand tons of K_2O.

Table 1

Potential Demand of Fertilizers in East Africa in 1980

'000 ton of pure nutrients

Specification	Nitrogen N	Phosphorus P_2O_5	Potash K_2O	Total
Food crops				920
Cash crops				230
Total	460	460	230	1,150

It should be remembered that this potential demand could be achieved only under especially favourable conditions. ECA and this report projections of fertilizer consumption are less ambitious and again usually higher than the figures ensuing from the continuity of actual yearly increment.

Further discussion will, therefore, be concentrated on fertilizer use projections with special endeavour on projections of fertilizer demand in

Madagascar, Mauritius and Réunion

Illustrative presentation is contained in Figure 1: East African Fertilizer Consumption. The projection figures resulting from this report are mentioned separately from the estimates made by ECA in 1965. The projections are based on the data collected in countries concerned or in neighbouring countries and reflect the past fertilizer consumption and the views of fertilizer importers, private entrepeneurs and government officials. It should be noted here, that future fertilizer consumption depends largely on the government appreciation in each country. It starts with assistance in fertilizer distribution, availability of easy credit for farmers wishing to buy fertilizers, government subsidy of fertilizer prices, ready market for additional crops resulting from fertilizer use - summing up, the cultivators must be convinced that fertilizer use is to their benefit. In Madagascar, for example, the Government takes all possible measures to increase the rice crops by using the nitrogenous fertilizers. Field trials and demonstrations are carried out by agricultural Research Institute, the distribution and storing of fertiliser is well organised by the Government which gives also adequate subsidies on CIF fertilizer prices etc. Such a policy would bring about a soon "break through" in fertilizer consumption.

The actual fertilizer use is very uneven in different East African countries. Curiously enough by far the largest pure nutrient fertilizer consumption per ha of arable land is in countries with smallest total area as in Mauritius (233 Kg), and Réunion (105 Kg). The third largest fertilizer consumer is Rhodesia (33 Kg) and then Kenya (13 Kg). In further succession come Zambia (18 Kg), Malawi (1,5 Kg), Madagascar (2,5 Kg), Uganda (1,3 Kg), Tanzania (0,9 Kg). Consumptions of fertilizer per ha of arable land are negligeable in Ethiopia, Somalia, Burundi and Rwanda. The above said figures are based on fertilizer consumption in 1966 and 1967.

The most popular nitrogenous fertilizer is still ammonium sulphate which accounts for about 40 % of total N-fertilizer consumption in East Africa. Second in demand is urea with about 10 % consumption, ammonium sulphate nitrate with about 6 %, the balance being taken predominantly by complex fertilisers.

The prevailing demand for urea was in Somalia (85 % out of N-fertiliser, mixed fertilizers not included), Zambia (41 %) and Rhodesia (16 %). It is

believed that the consumption of urea will increase on detriment of ammonium sulphate in the future. Certain limitation to this trend is the tradition of ammonium sulphate use and the quality of East African soil which is in general deficient in sulphur. This is, at the same time, the reason for the high use of single superphosphate in the region. On the other hand, it is obvious, that in so far it will be possible to use urea and triple superphosphate, these fertilizers will be preferred due to their high N and P_2O_5 content which reduces cost of transportation, handling and storing per ton of fertilizer nutrient.

Interesting subject offers the comparison of future projections of fertilizers demand with existing and proposed manufacturing facilities mentioned in Figure 1: Present and Future Consumption and Production of N and P_2O_5 in East Africa. From this Figure, it is apparent that in 1970 the manufacture of nitrogenous fertilizer is estimated to be by 25,000 tons lower than the actual demand in East Africa. The same applies to the manufacture of P_2O_5 expected to be shorter by 20,000 tons. If the projections made in this report will materialize, East Africa will be selfsufficient in P_2O_5 production and there will be about 30,000 tons of unutilized nitrogenous fertilizer production capacity in 1975. From the point of view of the ECA report there will be a deficiency of production capacity of about 25,000 tons P_2O_5 and slight excess of N production capacity of about 10.000 tons in 1975.

Further observations will be concerned with the primary objective of this study, i.e. the existence of export outlets in East Africa for urea to be manufactured in Madagascar.

From the review shown above in the Figure 2 and further from Tables 2 and 3, it is apparent that the main fertiliser production facilities will be put on stream in East Africa between 1970 and 1975, i.e. in the period when Madagascar urea plant will be constructed (scheduled operation target 1 July 1972). In spite of a foreseen quantitive excess of N manufacturing capacity during this period in East Africa, it is believed that urea will not be produced in this region except for Madagascar (Tansania plans to produce urea are too vague to be considered seriously). This gives a fair chance to Madagascar to export some of its urea to its East African neighbours whereby two main problems will be encountered:

- prohibitive sea freight for urea exported,
- keen competition of European and Japanese urea exporters.

To remedy at least partly the above mentioned limiting factors facing Madagascar export of urea, it will be useful to consider the charter arrangement which might reduce the sea freight considerably. This again, would bring about the necessity of larger lots of urea to be exported and utilization of the boat capacity on its way back to Madagascar to import what is needed there.

Three principal methods of sale of fertilizer in the export market ought to be mentioned. In some countries the importation of fertilizers is concentrated in one or several agencies (governmental, semigovernmental or private) which carry out the purchase on an international bid basis. The second method is to sell to the general importers in competition with other fertilizer exporters. The third method is to appoint agents who purchase and distribute fertilizer on semi-exclusive or exclusive basis. There might be a chance for Madagascar to enter into preliminary discussion with its neighbouring countries with the aim to establish mutual trading in fertilizers on larger commodity basis. Setting-up the production of urea in Madagascar solves only one fertilizer nutrient problem. Madagascar will continue to import phosphetic and potassic fertilisers, some P-K, N-P-K or ammonium sulphate.

Such situation opens the door for fruitful bilateral co-operation with e.g. Tanzania which plans the development of phosphate industry at Dar-Es-Salaam, Uganda with its Tororo single superphosphate plant, Ethiopia planning the development of potassic industry, Mauritius which will have its N-P-K production etc.

The second and third method still emphasises the factor of price, but has certain advantages. The seller is usually well informed on the competitive market, price development, buyer's requirements etc. The best solution is the synthesis of government's support opening the preferential trade basis for the export-import implementation to be entrusted to effective channels mentioned as second and third alternative.

1. Fertilizer Production Facilities in East Africa

(a) Mauritius

It was reported to me in Mauritius that a Company-Mauritius Chemical & Fertilizer Industry Limited (MCFI) - was created to undertake the construction, operation and management of a chemical fertilizer complex at Port Louis.

Arthur D. Little Inc. was hired to asses the potentials and feasibility of this project by Development Bank of Mauritius which will have equity participation in the above mentioned company.

In the proposed plant, imported anhydrous ammonia will be used to make nitric acid with additional ammonia used to neutralize the nitric acid and to neutralize phosphoric acid to be mixed with potassium muriate to produce several formulations of complex fertilizers. Total production will be about 100,000 tons of fertilizers per year. The principal market should be Mauritius, but considerable part of produced fertilizers should be exported to achieve capacity operation. The equity participation in the MCFI will be the following:

	Mauritius Rupees
Blyth Bros & Co. Ltd.	532,400
Currinjee Jeevanjee & Co. Ltd.	169,800
Doger de Spéville & Co. Ltd.	193,900
Ibrahim Davood Ltd.	175,500
Ireland Fraser & Co. Ltd.	266,200
Haral Mallac & Co. Ltd.	532,400
Roger Tayd'herbe & Co. Ltd.	192,800
Rogers & Co. Ltd. and Scott & Co. Ltd.	332,800
The Anglo Ceylon & General Estates Ltd.	266,200
Total private importers	2,662,000
Development Bank of Mauritius	5,038,000
IDI (International Development & Investment)	7,700,000
Medium term loan finance from C & I/Girdler and Suppliers (This loan will be repayable in 10 equal yearly instalments)	36,520,000
Grand Total	51,920,000

The preliminary engineering plans were made by C & I/Girdler that is presently progressing with detailed engineering and will assume the job of

main contractor on turn-key basis. It seems that the whole scheme is in a final stage of discussion and soon is to be expected the final agreement to be signed between MCFI and Mauritus Government. The representative of IDI expressed a firm view that the plant would be in operation by 1 July 1969.

The production programme is reported to be the following:

Formulation:	Tons/year:
26-0-0	11.500
22-11-11	10.300
20-10-20	25.000
17-17-17	42.240
21- 0-21	6.290
0 - 0-60	4.670
Total:	100,000 tons per year

A. D. Little Inc. suggest the current technology with a little risk of near-term obsolescene. It believes, if most economic raw materials are used, the plant would be capable of producing wide range of products of high quality.

It has estimated the plant cost to be $ 7.53 with an additional $ 466,000 (exclusive of capitalsed interest and credit insurance, making the total fixed investment $ 8.0 million. Working capital requirements, including spare parts and catalyst, are estimated to be $ 2.94 million.

It is expected that the discounted cash flow rate of return on total capital employed will be from 15 % to 17 % over a 15 year period.

As already mentioned before, the agreement is expected to be signed soon between Mauritius Government and MCFI. In this agreement MCFI will oblige itself to produce high-quality, homogenous, granulated fertilizer in given quantities and at proper timings. The Government in turn will guarantee the protection of the new plant against competition from outside imports of fertilizer, building-up of a quay where ammonia and phosphoric acid tankers will be recieved and the supply of necessary utilities at agreed constant rates. The biggest risk involved in this venture is the disposal of some 40,000 to 50,000 tons/year of complex fertilisers which will be in excess in 1969 when plant is reported to be commissioned and operated at the design capacity. Messrs. IDI, in their capacity of

industrial promoters, offered their obligation in finding the export outlets for the above mentioned quantity of final products in excess for about 3 years after the plant would have been put on stream.

During my stay in Mauritius, IDI representative showed keen interest in Madagascar market for complex fertilizers to be produced in Mauritius. To make his ideas more attractive for Madagascar, he made this proposal:

To supply stock solutions of slurry from Mauritius by granulating this slurry and bagging where necessary or distributing as bulk. He suggested that about $ 1,000,000 would cover the fixed capital costs of such plant as the expensive conversion equipment would be already erected in Mauritius as well as the most of the offsite facilities.

He estimated the cost of the various slurries produced in Mauritius supplied CIF Madagascar to be the following for different formulations:

22-11-22	$ 61.30
20-10-20	$ 63.09
17-17-17	$ 68.80
21- 0-21	$ 52.33

The freight from FOB Mauritius to CIF Madagascar was estimated at $ 7/ton which might allow for some reduction depending upon the amount of material used.

The evaluation of this proposal will be contained in the part "B" of this report.

(b) Réunion

Réunion does not produce fertilizers and so far the demand has been met by imports. The most popular are complex fertilisers (N-P-K) of similar formulation as those to be produced in Mauritius. No wonder that Mauritius expects to export part of NCPI fertiliser production there. This will be rather difficult because besides the fact that Mauritius and Réunion are close to each other, Réunion has no particular reason to buy Mauritius' fertilisers. In addition to that, shipments of fertilisers from Mauritius to Réunion will suffer a 6 % duty and this fact makes it more difficult to compete with European suppliers from common market countries supplying fertilisers duty free. In D. A. Little report it is maintained that PEC (biggest fertiliser importer to Réunion) offered to suggest to its Réunion affiliate to purchase one half of its fertili-

zer requirements from Mauritius. It was reported in Réunion that nothing has been agreed upon so far and therefore it is difficult to predict the quantity of fertilizers which may be exported to Réunion from Mauritius. To my opinion, unless some special arrangements are done, this quantity will not exceed 5,000 tons/year.

Another thing would be if at least finishing steps in fertilizer production could be made in Réunion. This idea offered to Madagascar, might work better for Réunion, i.e. to import N-P-K slurries from Mauritius, stock them in Réunion and make granulated fertilizers there. Unlike to Mauritius it can't be expected any protection against competition from European fertilizer importers and consequently very meticulous investigation of this proposal should be carried out before any decision is taken.

(c) Kenya

Kenya is the only more important fertilizer consumer which imported in 1966 about 70,000 tons of finished fertilizers. The major N-straight fertilizer has been, until recently, ammonium sulphate, which in 1966 was distinctly replaced by complex fertilizers. The only longer ago established manufacturing fertilizer plant is a sodium phosphate factory at Turbo. The raw materials required for manufacture are obtained locally, i.e. phosphate from Sukulu and soda-ash from lake Magadi. The plant is operated by East African Fertilizer Co. Ltd. producing about 4,000 tons/year of sodium phosphate (24 % P_2O_5).

The prospects for the increased consumption of fertilizers in Kenya originated the plans to start the local nitrogenous fertiliser industry. Also there were deliberations to produce complex fertilisers at a first stage, it was finally decided to produce calcium ammonium nitrate (27% N). A new company was created under the name of "Triangle Fertilisers Co." to carry out the construction, operation and management of a new factory as well as the distribution of the final products.

The Covenant Industries Ltd.", an associate of ICI and Albatros Superfosfaatfabriken NV of Utrecht, Netherlands, will each have an equity of 40 % in the new company. The remaining 20 % of equity capital will be provided by Kenya Government through Development Finance Company of Kenya.

The original plant capacity should have been about 107,000 tons/year of ammonium calcium nitrate but later the production target was increased up to 130,000 tons annually.

The required anhydrous ammonia as a primary raw material source will be imported from Gulf area. Lime will come from the area of Bamburi Cement Factory which is situated about 1 mile from the site of the future ammonium calcium nitrate plant at Mombassa.

The receiving anhydrous ammonia storage capacity is expected to be 10,000 tons. From imported ammonia, nitric acid and ammonium nitrate will be produced. The total fixed investment is reported to be about $ 15 million out of which a considerable amount would be spent on the infrastructure including the quay facilities, roads, storage of final products and provision of utilities. The plant is expected to start commercial operation by 1970-1971. It is obvious that the designed plant capacity is much higher than the actual needs of Kenya by about 50 - 70,000 tons annually. It is therefore, expected that at least until 1975, it will be necessary to export substantial part of its production. The logical market is thought to be neighbouring Uganda and Tanzania.

The collaboration with Uganda is prospective because Uganda Tororo superphosphate plant could supply Kenya with P_2O_5 as it is done presently. It was reported that there are some plans for the future to combine the efforts of these two countries and start manufacture of compl. fertilizer later on. The pertaining approaches are likely to be made directly between the Triangle Co. and Tororo factory. This step would possibly be co-ordinated with the bulk blending plant that was recently been put into operation by Messrs. Windmill & Co. in Nakuru, Kenya. This plant is performing the physical mixing of fertilizer raw materials coming from Europe and Uganda in bags or in bulk. Advantage of this plant is low investment and production cost as well as the flexibility of operation. It operates at a capacity when there is seasonal demand for fertilisers and can afford, due to low depreciation and other production cost, to decrease substantially its capacity or shut-down, if necessary.

(d) Uganda

There is a phosphatic industry in existence in Uganda. Messrs. Tororo Industrial Chemical and Fertiliser Company produce a single superphosphate of a concentration of 21 % of water soluble P_2O_5. The plant is

located at Tororo near the Kenya border and is managed by ICI. Phosphate rock is supplied from Sukulu mines and sulphur needed for the manufacture of sulphuric acid is imported. The plant has a rated capacity of 25,000 tons/year of single superphosphate. It is planned to expand this capacity by 75,000 tons/year in 1970/71. Final decision has not been taken as yet whether the above said production target will include the manufacture of triple superphosphate as well. Whatever decision is taken, it is quite sure that, to some extent, the manufacture of single superphosphate will be continued with respect to the high sulphur requirement of the East African soil. As soon as the capacity of the Tororo plant is expanded to about 100,000 tons/year of phosphatic fertilizer, this plant will be able to supply the East African market. In 1966 only Kenya imported about 18,000 tons of superphosphate from this plant.

As it has already been mentioned when dealing with Kenya fertilizer production facilities, the plant in Tororo has supplied in the recent past the fertilizer bending plant in Nakuru, Kenya, with phosphate fertilizer and may enter into collaboration with the "The Triangle Fertilizers" for manufacture of liquid mixed fertilisers in the future. As regards the nitrogenous fertilizer ECA recommended the production of 190,000 tons per year of ammonium sulphate based on Kivu methan gas if this could be economically used for this purpose.

(e) Tanzania

Tanzania has no fertilizer manufacturing facility so far. Several studies were undertaken in the past indicating some recommendations what kind of fertilizer should be produced in the future. A cursory report has also been presented to this effect by the Industrial Studies and Development Centre (set up under the aegis of generally recognised, very successful Special Fund Project). For all that there are some contradictory recommendations ensuing from submitted reports as to what should be done. The brief report of JCI (Japan Consulting Institute) prefers the manufacture of double superphosphate to nitrogenous fertilisers. Industrial Studies and Development Centre recommends in line with Messrs. Humbolt report production of ammonium sulphate. There are rumors that neither phosphetic nor nitrogenous fertilisers should be produced in Dar-Es-Salam, but the liquid complex fertilisers. Whatever will be the outcome in the future, I think it will serve the pur-

pose to mention some basic facts of nitrogenous and phosphatic industry in Tansania.

The raw materials for manufacture of nitrogenous fertilizer would be naphtha and off-gases of the oil refinery in Dar-Es-Salaam (capacity 600.000 tons of processed crued/year). Industrial studies and Development Centre considers the fertiliser complex composed out of ammonia production to be used for manufacture of 11,000 tons/year of urea and 108,000 tons/year of ammonium sulphate. It is further recommended to use the locally available pyrites for production of sulphur and sulphuric acid. It estimates that at the capacity mentioned above, urea could be produced at a price loco factory $ 84/ton, ammonium sulphate $ 55/ton with the provision of 10 % return on capital investment. (Imported prices for large lots were about $ 90/ton for urea and $ 60/ton for ammonium sulphate). The investment costs are estimated at about $ 13 million. JCI fears the decreasing trend of nitrogenous fertiliser prices and stresses the reverse-increasing trend of phosphatic fertiliser prices. Consequently JCI recommends the production of triple superphosphate. The triple superphosphate was chosen because of transport costs saving and further due to the fact that the tobacco requires high content of P_2O_5 in compound fertiliser which is not possible to achieve if the mixing component is normal superphosphate.

JCI suggests the capacity of 97,000 tons/year of double superphosphate, out of which 75,000 tons would be for domestic consumption and the balance for export. For the manufacture the locally available phosphate rock should be used but it must be beneficiated before. The available reserves are estimated to be 9,000,000 tons of average grade 20 % P_2O_5 which could be enriched to 30 % P_2O_5. According to JCI it is uneconomical to use the local Semena pyrite deposits in Geita area. The Schneider group report estimates that the cost of yellow sulphur (99.6 % S) produced from aforementioned pyrites would be in the range of $ 65/ton which compares unfavourably with yellow sulphur imported CIF Dar-Es-Salam. JCI estimates the battery limits plant cost to be about $ 2,0 million with ex factory price $ 56/ton ECA recommended the production capacity of 160,000 tons/year of single superphosphate using locally available phosphate deposits and imported sulphur.

For the sake of comparison the following were the fertiliser prices:

Ammonium sulphate CIF Dar-Es-Salam		Normal superphosphate for MSMZA
1965	$ 69/ton	$ 46
1966	$ 65/ton	$ 52

(f) Ethiopia

Ethiopia does not produce chemical fertilizers. There are the plans and private initiative to open and utilise the sylvinite deposits in the vicinity of Dallol for production of potassic fertilisers. The party involved are Messrs. Ralph M. Parsons & Co. and the production target was set up to 300,000 tons/year of potassium muriate (60 % K_2O) practically hundred percently for export. Such a target corresponds as well to the recommended capacity by ECA. It seems that this scheme is now stalemate, the reason of which may be the decreasing price of these fertilisers in the world market due to their growing supply from Canada where enormous deposits of potassium minerals are available.

There are, at the same time, very vague considerations to utilise the excess refinery products for nitrogenous fertiliser manufacture in Ethiopia. The Kassab oil refinery has the capacity of 500,000 tons/year of processed crude and it is believed that if refinery off gases and naphtha are used for the manufacture of fertiliser, the foreign exchange could be saved. To my opinion all this thinking is rather premature because the consumption of fertiliser is close to none at present and there will be some underutilised fertiliser manufacturing capacities in East Africa in a near future which could supply Ethiopia's needs.

(g) Somalia

Fertilisers are not produced in Somalia and French Somalia. The fertiliser requirements mainly in urea and superphosphate were met by importa

(h) Zambia

Fertiliser production is not introduced in this country. There are plans to build an ammonia and nitrogen fertiliser complex at Livingston using cheap hydroelectric power from Victoria Falls or from Kariba Dam and coal from the Wankie coal fields as raw material for the Ammonia production at a capacity of about 40,000 tons/year was considered jointly with Japanese Kobe Steel to be used for the manufacture of nitric acid and ammonium nitrate including explosives. It is still questionable whether the production cost of such a plant could compete economically with straight nitrogenous fertilisers imported, the price of which was decreasing steadily ever since.

(i) Rhodesia

In Rhodesia phosphatic industry is well established. African Explosives & Chemical Industries (Rhodesia) Ltd. operates a single and triple superphosphate plant in Salisbury. The production capacity is 55,000 tons/year of each single and triple superphosphate. This capacity was not able to cope with Rhodesia and Zambia demand and therefore, it is presently expanded by another 45,000 tons/year. This plant is fed by locally available phosphate concentrate from Dorowa deposits beneficiating 150,000 tons/year. Pyrites for manufacture sulphuric acid will be supplemented by imported sulphur.

Besides straight phosphatic fertilizer, Messrs African Explosives Chemical Industries as well as Fisons and Windmill are operating fertilizers mixing plants around Salisbury. These companies are also envisaging to put up an ammonia plant to get straight fertilizers and other most important fertilizer nutrient for their mixing plants. ECA proposed the setting up of a plant producing 190,000 tons/year of ammonium sulphate and 80,000 tons/year of ammonium nitrate based on petroleum feed stock.

2. Export Markets in East Africa

(a) Réunion

Similarly as in Mauritius and other East African countries, ammonium sulphate has been until 1960 the prime source of nitrogen fertilisers constituting some (illegible) of the total nitrogen requirement. Since that time the situation changed substantially and in 1966 out of 4,400 tons Nitrogen applied to the soil, 3,180 tons came in the form of NPK and 1,120 tons as ammonium sulphate. It may be assumed that this tendency will continue further in the future and more NPK on detriment of ammonium sulphate will be imported.

The most favoured formulations were:

14 : 14 : 14
15 : 15 : 15
16 : 8 : 16
15 : 7 : 15
17 : 17 : 17 and
20 : 10 : 10

Use of urea has got a distinct disadvantage because it is believed there that the nitrogen component tends to volatilise and be lost to the atmosphere unless the urea is mixed with the soil. Unfortunately urea has not been used in recent years and only very limited trials have been carried out with this fertilizer until now. It would take time and efforts to get a conclusive evidence on urea suitability for sugar plantation in Reunion. Under such circumstances, when mixed fertilisers are getting more and more popular in Réunion and there is limited experience with urea, little chance persists to replace partly the diminishing quantities of imported ammonium sulphate by urea in the future.

The shipments of urea from Madagascar to Réunion would not suffer a duty similarly as from the Common Market countries. On the other hand, it will certainly be difficult to compete with European or Japanese producers in this market since these producers have similar or probably lower production costs, better shipping arrangements, and more efficient existing marketing channels.

Table 4 presents a history of Réunion's fertilisers imports and projection of different fertilizer nutrients use in 1970, 1975 and 1980.

The total imports were less than 28,000 tons in 1966, the lowest imports since 1962. On the other hand, imports of complex fertilisers, of

20,500 tons were the highest in [illegible] or over two-thirds of the total. As in Mauritius, fertiliser consumption is expected to remain fairly static, [illegible] fertilisers on 1965 basis was taken into consideration for projections until 1975. Since that time, this percentage has decreased to [illegible]. On the whole, the fertiliser consumption will fluctuate in [illegible] with the respective prices of sugar, the fertiliser consumption is also influenced by natural disasters like cyclones.

Average [illegible] CIF prices of [illegible] fertilisers [illegible] in the past few years, which [illegible] increased use. Primarily [illegible] in 19[illegible], [illegible] importance, [illegible] P[illegible]. The [illegible] price to Reunion producers is on the increase, and fertiliser prices are on the decline. These two factors are expected to increase the use of fertilisers. It has been estimated that by 1970, 5,700 tons of nitrogen nutrient will be used.

(b) Mauritius

Projected Fertiliser Consumption

Fertiliser consumption in 1966 was 7,477 tons nitrogen, 3,[illegible]5 tons phosphate, and 9,004 tons potash. Table 5 shows the Present and Projected Nutrient Use in Mauritius. The MSIRI and the Department of Agriculture estimates indicate that by 1974 consumption should be about 10,000 tons N, 4,000 tons P_2O_5, and 9,600 tons K_2O. As imports alone exceeded these quantities (in 1964 and 1965 for nitrogen and in 1964 for potash), it may be expected that consumption could be greater than these estimates. Also, local production, if materialised, would encourage a more forceful sales effort, and fertiliser consumption could be expected to increase more rapidly. Bearing this in mind, one might expect consumption to be about 11,000 tons N, 5,000 tons P_2O_5 (in addition to guano), and 10,500 tons K_2O by 1975.

Table 5 contains the Fertiliser Consumption in 1961, 1965 and 1966 as well as the Projection of Fertiliser Nutrients Consumption in the Future, namely in 1975. The pattern of consumption indicates the growing popularity of N-P-K fertilisers as it is the case in Reunion. Practically all fertilisers imported were used on sugar, the acreage of

sugar prices. If this price situation turns out to be favourable, it may be expected that also small cultivators cropping about half of the sugar area will use more fertilizer on cane. Until now, optimum fertilization was made on large plantations whereas small cultivators often have used fertilizers in negligible quantities. New irrigation schemes under way may bring under plough further acres to be used as well for subsistence crops.

Similarly as in Réunion, ammonium sulphate was the main fertilizer in the past giving up the field to mixed fertilizers presently. The same what was said about urea use in Réunion applies as well as to Mauritius.

It would be therefore recommendable for IRAM to take contacts with MSIRI with the aim to explore the possibilities of urea use on sugar cane in Mauritius. This is supported by the fact that the trend seems to be towards the production of slow release nitrogen fertilizers for areas where leaching losses can be expected. MSIRI itself recommends that experimentation conducted elsewhere at present should be closely followed in order to aim eventually at the application of more efficient nitrogenous fertilizers e.g. urea - formaldehyde derivates etc.

(c) Other East African Countries

The most likely market beside Mauritius and Réunion for Madagascar urea would be East Africa (Kenya, Zambia, Tanzania, Somalia and Rhodesia).

Supporting data for this assumption are contained in Table 6 Present and Future Fertilizer Consumption (Pure nutrient) in East Africa and in Tables 7 and 8 Summary of Present and Future Fertilizer Consumption in East Africa. In these tables two projections of future consumption of fertilizers are presented. Under the heading ECA (Economic Commission for Africa) the estimates computed by Batelle Institue (Federal Republic of Germany) in 1964 to serve the basis for the Conference held in Lusaka in 1965 dealing with hormonisation of the industrial programmes in East Africa, are shown. Under the heading "Report" are contained the estimates resulting from the present mission.

From the above mentioned tables it is apparent that, among the most significant consumer of fertilizers is KENYA, expected to consume 18,000 tons of N in 1970 and 23,000 tons in 1978. On the other hand, it is reported that Kenya will have its own manufacturing plant pre-

ducing about 35,000 tons of N in the form of ammonium calcium nitrate by 1970/71.

It is evident that the manufacturing capacity of this plant will exceed the local market consumption during at least 3 - 4 years to come. The logical outcome will be to export the ammonium calcium nitrate to neighbouring countries, mainly to Uganda and Tanzania. In addition to that, urea was not consumed in larger quantities in Kenya in the past and under such circumstances there are very restricted possibilities to export Madagascar urea to this country.

It is estimated that Zambia will consume 15,200 tons of N in 1970 out of which about 40 percent could be supplied by urea. This fertilizer is well established in Zambia which imported about 4,000 tons in 1965. All depends whether the construction of ammonium nitrate plant at Livingstone will be realized. Such a plant being in existence in the future may preclude the increasing trend of urea use in Zambia and thus diminish the prospect of Madagascar exports to that country. Tansania is considering construction of tis own phosphatic fertilizer industry based on locally available phosphate deposts from Min Jingu Hills. Tansania is expected to consume 5,500 tons of N in 1970 and 9,500 tons in 1975. As Madagascar will continually need to import large quantities of phosphatic fertilizers a fruitful collaboration could be developod comprising the exchange of Madagascar urea for Tansania superphosphate. The same might apply on much larger scale with Rhodesia which is expanding its phosphatic industry and consumes large quantities of urea.

Another market possibility offers Somalia which covered about 85 % of its N requirements by importation of urea (about 700 tons in 1966) used mainly for bananas and sugar cane plantations. It is recommended to explore further the existing trade relations between Madagascar and Somalia to find out some workable solution for the problem of Madagascar urea expert.

Summing up the East African market's opportunities, it seems that it would not be easy but, by no means, impossible for Madagascar to export by 1972 about 7000 tons of urea to reach the break-even point of its plant's production cost provided that the projected local urea consumption will be achieved by that time. The more discomforting fact presents the keen competition from future large scale urea manufacturing

plants to be built in different favourably placed countries. World production capacity of urea increased from about 120,000 metric tons of nitrogen in 1955 to nearly 5 million tons of urea in 1966. Future estimates indicate production capacity of 11 million tons of urea by 1971. It goes without saying that such a development in urea production will bring down the market price of urea in the future. How far this will go is difficult to visualize. But certainly the CIF Tamatave price for 1 ton bagged, prilled urea will be less than US $ 90 per ton which was the lowest offer received by the Madagascar Government in 1968 as response to its international calls for bids. The shrinking margin of profit due to lower international urea prices will be, however, partly made up by lower future CIF prices of imported ammonia being important component of urea production cost.

IV. IMPORTANCE OF AGRICULTURE FOR MADAGASCAR ECONOMY

1. General

The agricultural production (including livestock, forestry and fishing) accounts for 35 % of the value added to the GDP, half of which is made up by paddy output. Consequently, the low rate of growth in the paddy output in the past influenced substantially low total annual GDP increase of 2 % in agricultural sector. This was partly due to a poor growing weather in the 1960's and to extremely severe cyclone which occured in 1965 and caused a dropping of agricultural output as a whole by 10 %in that year alone. That is why the Government takes serious measures to achieve 3 % annual increase of the value added to GDP by the agricultural sector in the five years from 1966-71. Subsistance crops, which make about half of the value added by this sector are projected to increase by 4 - 5 %. All this is dependent on continued successful efforts of the government to carry out launched programme to increase the output of paddy. The principal target is to step up paddy production by 400,000 tons at the 1971/72 harvest, i.e. about 30 % increase over average production in recent years. It is expected that such a programme will cost almost FMG 13 billion and is being financed with the help of French and EEC aid. The otuput should be raised by bringing new land under plough and by an improvement in productivity in existing cultivated areas mainly by promotion of fertilizer use. If the paddy production target is met by 1971/72 there will be enough population growth, and about 20 - 25,000 tons of the deluxe rice varieties for export. Similar efforts are devoted to the output increase of other subsistance crops (mainly manioc, corn and sweet potatoes) which has to follow the population rate of growth.

The government assigns, at the same time, a great importance to the cash crops and crops grown primarily for export. The main cashcrops are sugarcane and groundnuts that are cultivated for both domestic and export markets. The importance of sugarcane and groundnuts in terms of value added by the agricultural sector is very limited. The cultivation of sugarcane in the future will be almost confined to the supply of local demand. Production of groundnuts is expected to grow for export and to be converted into edible oil for local consumption.

The main crops grown primarily for export are coffee, vanilla, cloves, pepper, sisal, tobacco, bananas and cocoa. Export volume of this group

is expected to increase by 30 % which might not be achieved, due to feared decline in export prices, except vanilla and cocoa. Consequently, the total value of these exports will not exceed FMG 14,6 billion by 1971 as it is obvious from Table 8.

Coffee exports account for 35 % of all merchandise exports, and if not for substantial decrease of world prices, they are expected to reach 51.000/year in 1971 totaling nearly FMG 8 billion in 1971, within the frame of Madagascar's long term quota under the International Coffee Agreement. The review of Madagascar agricultural production is comprised in Table 10.

Madagascar as world largest supplier of vanilla, succeeded in entering into agreements with its principal importers from USA which stabilized the fluctuating prices in the past. If these arrangements continue, about FMG 2,1 billion could be earned.

Exports of bananas recently developed have risen rapidly and are expected to maintain the level of FMG 0,4 billion in 1971.

Growing of bananas recently developed has risen rapidly and is expected to maintain the level of FMG 0,4 billion in 1971.

Growing of cocoa a good prospects due to excellent quality of this crop and its export is limited by supply potential only. It is reported that 3000 tons could be achieved by 1971 increasing thus earnings from cocoa five times to about FMG 0,5 billion.

Tobacco exports should increase in value by FMG 0,2 billion, provided that replanting efforts currently under way are successful.

The export value of cloves, oil of cloves and pepper will most probably remain stabile (FMG 1,3) but sisal exports are believed to drop from its present value of FMG 1,3 billion, a result of the recent fall in price.

Future difficulties to keep earnings from sugar exports are due to outlets problem and not to production possibilities. The first blow came when France took in 1965 half of the sugar quantities purchased in earlier years. Excessive piled stocks had to be marketed below the cost of production. Whatever is the result of getting sugar export quota with EEC it cannot be assumed that more than 35,000 tons could be exported in 1971 which makes at a price of 4 cents a pound FMG 0,8 billion.

As further foreign exchange earners manioc and tapioca, raphia and beans could be considered.

Importance is gaining cotton which after supplying the local textile industry may be eligible for export. The surplus quantity of first class quality cotton is believed to reach about 2,000 tons by 1971 earning about FMG 0,3 billion.

The Government is further thriving for increased output of livestock products, which accounts for about 20 % of value added by the agricultural sector and is considered as a potential foreign exchange earner. Outlined targets of big operations are aimed at improvements of pasturage, cattle breeding and construction of government owned slaughterhouses. Value added by livestock production could increase by 4,5 % a year over the next several years.

Here again a principle role of urea could be noticed, not only as a fertiliser, the application of which may improve the available pasturage, but as a cattle feed which can replace ordinary fodder up-to the third of the total protein intake.

2. Economic aspects of fertiliser use in Madagascar

The significance of agriculture for Madagascar's economy was discussed above. The application of fertiliser is one of the most important inputs conducive to the development of this sector of economy. On the otherhand, it is the farmer who must be convinced how fertiliser are beneficial for his crops. If profit expectations are sufficiently favourable, farmers may be induced to invest their labour and scarce capital in fertiliser. It is usually expected that the returns from an investment in fertiliser may have to be at least FMG 2 per 1 FMG invested.

IRRAM (Institut de Recherches Agronomiques Malgaches) undertook many trials and demonstrations with fertiliser use on paddy crops with the following conclusions from the Tananarive district:

(1) When applied separately

The response to 1 kg of N was additional 31,1 kg of paddy;
The response to 1 kg of P_2O_5 was additional 12,3 kg of paddy;
The response to 1 kg of K_2O was additional 15,9 kg of paddy;

(2) known applied N-P-K

The response to 1 kg of - N - (comparison NPK-NK) was additional [illegible] kg of paddy;

The response to 1 kg of P_2O_5 (comparison NPK-NK) was additional 14,3 kg of paddy;

The response to 1 kg of K_2O (comparison NPK-NK) was additional 15,4 kg of paddy.

The average 1968 prices of fertilizers in Tananarive district were the following:

Ammonium sulphate (21 % N)	FMG 22,000/ton (US$ 88,-)
Superphosphate (25-28 % P_2O_5)	FMG 18,000/ton (US$ 72,-)
Potassium muriate (50 % K_2O)	FMG 23,000/ton (US$ 92,-)

The recommended fertilizer application per ha for this district is:

Ammonium sulphate 21 % N	150 kg
Superphosphate 25 - 28 % P_2O_5	250 kg
Muriate of potassium 50 % K_2O	75 kg

The aforementioned fertilizer treatment costs per hectare FMG 9525 (US $ 38,-) and the obtained additional paddy yield was FMG 18,884 (US $ 75,25) at price of paddy FMG 10 (US $ 0,04/kg), i.e. the level of reckoned on returns was attained. The return for the farmer would be higher if the lower 1966 CIF fertilizer prices and government subsidy were [illegible] as a basis.

The [illegible] from fertilizer use on cash crops will be still higher but in its overall volume less important because of all fertilisers used in the future about 65 % will be consumed by paddy crops.

3, Mixed contra single nutrient fertilisers

From the observations made in Madagascar and especially Réunion and Mauritius it is obvious that the liquid high analysis fertilisers show the increasing trend of popularity.

In Madagascar in 1965 2035 tons and in 1967 3900 tons of N-P-K fertiliser were used. In Réunion, in 1961 15,611 tons and in 1966 30,500 tons of N-P-K fertiliser were used etc.

To my opinion, in a country without long established fertiliser use tradition single nutrient fertiliser application may have certain advantages in spite of the fact that additional labour is required for

fertiliser application. As different formulations are frequently required for different crops, there may be considerable confusion which formulation should be chosen under given specific conditions. The necessary restriction of the number of different mixtures requires previous extensive research and practical work entailing tedious tests and trials in the fields.

At present, Madagascar is consuming about 3,900 tons of N-P-K, 2,250 tons of ammonium sulphate, 3,100 tons of urea, 250 tons of ammonium nitrate, 2,160 tons of single, triple super and bone phosphate and 1,200 tons of Potassium muriate. Bone phosphate is manufactured from cattle bones purchase from slaughterhouses by Messrs. Prochimad. The manufacture is limited by the supply of bones which may increase as soon as planned new slaughterhouses are constructed. Presently, 6,000 tons/year of bones are treated yielding about 3,600 tons/year of finely ground, bagged phosphate fertilizer containing 25 - 28 % P_2O_5 and 4,5 % N. Due to relatively high price of bones the price of bone phosphate loco factory Tananarive exceeds the CIF price of imported phosphatic fertilizers with similar or better P_2O_5 content. Value added, however, accrues hundred porcently in Madagascar.

Manufacture of bone phosphate will be soon complemented by production of dry mixed fertilizers. A separate Company was instituted called "Madagascar Engrais" or "Madengrais" having social capital FMG 5 million located at Svanierona near Tananarive. Principal share holders of this Company are the following:

- SEPCM (Société d'Engrais et de Produits Chimiques de Madagascar)
- Prochimad (Produit Chimiques de Madagascar)
- COMOI (Le Comptoir de Commercialisation et de Représentation de L'Ocean Indien)
- SNI (La Société Nationale d'Investissement)

The company intends to invest about FMG 9,700,000 (US $ 39,000) in civil engineering works, machinery and equipment, preinvestment expenses and working capital. The initial manufacturing capacity envisaged is about 3000/tons/year of blended N-P-K. The company is ready to erect another similar unit at Tamatave if the nitrogenous fertilisers are produced there.

The simple mixing plant will use phosphate of bones produced by Messrs. Prochimad and dolomite fabricated by Messrs. SONADEX. Within

the battery unit of this plant the bagging unit will be included.

At a later stage an organic nitrogen will be produced obtained from treatment of cattle leather, hoofs and horns.

The mixing and bagging of fertilizers will be for the account of Messrs. SEPCM and COROI, i.e. the latter will buy or import straight fertilizers. This will preclude the occurence of double taxation of 2 % on transactions effected. The necessary storages will be maintained and financed by participating companies SEPCM and COROI. The site of location will be rented from the proprietor Messrs. COROI.

The above said information about Messrs. Prochimad, Somadex and Madengrais fertilizer activities and plans is essential for drawing up congruous Madagascar future approach to setting-up of a fertilizer industry.

If urea is produced in Madagascar, this will not interfere with the actual production of bone phosphate and mixed fertilizers. On the contrary, the blending plant will turn out the P-K binary and possibly N-P-K ternary with urea if P_2O_5 mixing component is selected properly -(for example ammoniated triple superphosphate).

V. PRESENT AND FUTURE CONSUMPTION OF FERTILIZERS IN MADAGASCAR

Fertilizer consumption is still relatively small in Madagascar but it is expected to grow in the future mainly due to "big agricultural operations" sponsored by the Government initiative. The most favoured fertilizer was in the past ammonium sulphate, which is gradually being replaced by urea and liquid base mixed fertilizers (N-P-K). Madagascar m Institute of Agricultural Research (IRAM) initiated and is continuously carrying out many trials and demonstrations with fertilizers on paddy fields with positive results. IRAM recommends expanded urea use due to its small wash-away loss, loosening of the bond of ammonia-state nitrogen available in the soil and high nitrogen content. The nitrogen content of ammonium nitrate is also high (35 % N-half of which is nitrate form) but IRAM believes that it is inferior to ammoniacal nitrogen and subject to leaching. That is why the use of ammonium nitrate is not recommended by IRAM for paddy cultivations in Madagascar and urea strongly preferred.

Consequently, I had to abandon my original idea to produce the nitric acid and ammonium nitrate from imported anhydrous ammonia and produce binary and ternary fertilizers in Madagascar.

After long discussions with the representatives of the ministry of agriculture and IRAM, it was concluded that due to future leading role of paddy in Madagascar agriculture, urea will be the most favoured fertiliser.

Further step was to make the inventory of fertiliser use in Madagascar. Valuable information to this effect was made available by the Ministry of Agriculture which prepared for the year 1965 a synthetic table of fertiliser use specifying the kind of fertilizer consumed, for which crops and in which regions. The figures contained therein were used as a basis for projections of future consumption in Madagascar.

By that time, the most important consumers of fertilisers were sugar plantations with total fertiliser consumption four times bigger than rice fields. The majority of fertilisers was consumed in the regions of S. Diego, Majunga and Tamatave which will continue to be preponderate users also in the future.

Taking into account the programme of optimum fertilisation of rice crops and the plans for future extension of palm trees, cotton, coffee,

banana and other cultivations, the projections of future fertilizer consumption were carried out in close collaboration with the government officials and private fertilizers importers. The fertilizer consumption of the year 1968 and 1969 were based on figures contained in the government calls for international tenders for bulk supplies of fertilizers for rice plantations covering the estimated needs of Madagascar in these aforementioned years as follows:

Kind of fertilizer	Quantity in metric tons	Price CIF Tamatave in FMG/ton	Equivalent in US $ / ton
Ammonium Sulphate	3,900	12,400	52,37
Urea	1,980	22,250	90,14
N-P-K (11-22-16)	17,200	18,950	75,91
P-K (21-16)	15,700	14,215	57,71
Potassium Muriate	1,560	15,150	62,32

Note: in jute bag reinforced by plastic

It has to be observed here that according to the opinion of one of the biggest importers of fertilizers to Madagascar, Messrs. SIPCM (La Société d'Engrais et de Produits Chimiques de Madagascar) representing Les Potasses d'Alsace, L'Office National Industriel de l'Azote, the figures shown above are much higher than the respective past consumption in 1965, 1966 and 1967 and it will require to step up efforts especially by Government in order to achieve them.

If we consider three phases of fertilizers use, namely,

- the take-off phase which requires considerable efforts and shows relatively small results;
- the full swing development phase, starting with a certain breakthrough marked with steeper consumption of fertilizers from year to year.
- the consolidation phase with moderate yearly increases,

Madagascar might be considered at present to be about at the end of the take-off phase, mainly due to the increase of rice cultivation programme, and the ambitious figures contained in the government calls for tenders have to be considered as a start up of a following development phase or a break-through of fertiliser use. For illustrative presentation of a break-through period including the present and future estimated fertilizer consumption, see Figure 3, Consumption of Nitrogen

P_2O_5 and K_2O in Madagascar.

The growing government's initiative in promotion of rice plantations is the reason for which it is advisable to divide the future fertilizer consumption estimates into two groups:

- cultivation of rice,
- cultivation of other crops.

For better guidance such estimates have to be subdivided according to kind of fertilizer to be used, mentioning the tonnage of fertilizer as well as its pure nutrient content.

Attached to this report is Table II showing the past, present and estimated future consumption of N, P_2O_5 and K_2O till 1975 and 1980. The principle interest of this report is concentrated on Table II/1 in which the estimates of N consumption are shown. In case of rice cultivation the future estimated consumption was arrived at by increasing the target consumption in 1969, comprised in government calls for tender, by 20 % each year. The feasibility of such an increase was discussed with the representatives of the Ministry of Agriculture and private importers and was found to be quite a realistic one. The arithmetical estimated increase of 20 % annually in fertilizer consumption for paddy fields was cross-checked by the total area expected to be cultivated in the future, taking into consideration the recommended fertilizer doses. It is, therefore, hoped that by 1970 the consolidation period of fertilizer consumption will start.

Somehow different is the situation as regards other cultures covering mainly the cash crops. It is believed that here the consolidation period has started already in 1968 and consequently, the annual 20 % increase is based on estimated 1967 fertilizer consumption. The rate of 20 % increase in fertiliser use reflects the future plans to step up the production especially of cash crops.

From the trend show in Table II it is apparent the following changing percent ratio between N consumption for rice cultivations and other cultures based on the total N consumed and estimated to be consumed.

	1965	1970	1975	1980
rice	9 %	59 %	62,3 %	65 %
other cultures	91 %	41 %	37,7 %	36 %

It means that the rice growing will occupy the dominant position in Madagascar's agriculture in the future.

Similar principles were applied when preparing the future P_2O_5 consumption projections.

Concerning the potassic fertilizers' future consumption projection, the rate of growth of 2 % was also applied, based on estimated 1969 consumption target ensuing from government calls for tenders. The quantities of 350 tons for 1968 and 600 tons for 1969 of K_2O will be imported to be mixed with locally produced phosphate of bones (the commercial production of phosphate of bones started in 1967).

A little different approach was chosen for the laying of trend, of potassium muriate consumption for other cultures. It seems correct to consider only 5 % increase of K_2O consumption based on annual estimated K_2O consumption in 1967. Other necessary K_2O will come from the growing use of N-P-K fertilizers.

Coming back to the projected consumption of N in 1975 it is obvious that if there were not for urea manufacturing plant in Madagascar, the main quantity of N would be supplied by N-P-K fertilizers and ammonium sulphate.

To achieve the economy of scale of urea manufacturing plant in Madagascar it would be imperative to substitute urea nearly hundred percently for all other N containing fertilizers stated in Table 11. This important point was raised with the Director General of IRAM who does not see any major difficulties from the agronomic point of view. It means that no N-P-K should be imported in the future, and P-K and N in the form of urea should be applied separately. In such a case additional labour is required and when fertilizers are broadcast by hand, extra care must be taken to ensure even distribution of each fertilizer. But this should not be a major obstacle. By contrast, no particular difficulty should offer substitution of urea for ammonium sulphate, both being straight fertilizers. Agronomically looked upon, urea is totally assimilated in the soil and hence it is acceptable to practically all varieties of soils and crops.

If the above mentioned postulate is fulfilled, about 11,000 tons of nitrogen i.e. 25,000 tons of urea is expected to be consumed in 1975. Such a quantity would enable the establishment of a small size urea

plant at full-time turning out area at an acceptable production cost from the national economy point of view. Details on this subject will be presented in part "B" of this Report.

VI. SUMMARY ON MADAGASCAR UREA EXPORT POSSIBILITIES

The Madagascar market for urea from the plant to be established at Tamatave is expected to total about 18,720 tons in 1972 and 25,200 tons in 1975 which leaves in 1972 about 6,360 tons for exportation at break even point annual capacity or about 14,280 tons at a designed capacity.

Export sales of urea will not be easy to obtain in spite of the fact that in the East African region there is no urea plant in existence at present and no firm plans of its establishment for the future. There are some vague considerations to establish one (see Table 2) in Tanzania but it seems that if anything is constructed there, it will be preferably the plant producing single or triple superphosphate.

The major factor counted with, is to export urea at reasonable prices. Madagascar has to import ammonia and use its fuel oil to produce carbondioxide to make urea. The production costs at a manufacturing capacity recommended are much higher as compared with those countries having natural gas available for production of ammonia and urea in large scale plants. The only advantage of Madagascar should be the shorter distance to their neighbours in Réunion, Mauritius, and East African countries which normally would call for reduced freight costs. Unfortunately, this is not the case if regular line rates are taken into consideration. These rates are extremely high and close to those for shipping of fertilizers from Europe, Gulf area, etc. Better solution might be to take into account a charter arrangement which is feasible if the quantity to be shipped is not too small. The maximum economy could be achieved if on its way back to Madagascar chartered boat could be loaded with goods needed there.

The second problem Madagascar will be faced with, is the system of marketing of its excess urea production. Due to the fact that the quantities involved are rather on a lower side and will have decreasing tendency with the growing of the domestic market in the future, it may not be feasible to appoint agents for purchase and distribution of Madagascar Urea on an exclusive or semi-exclusive basis in countries of interest. Madagascar, however, may be able to use its purchasing power to establish itself in fertiliser markets of neighbouring East African countries. It may work the idea to enter into agreements with

these East African countries that either produce or will produce the phosphatic and potassic fertilizers required by Madagascar in order to exchange these products for urea which Madagascar will be anxious to sell.

All depends on future equity capital structure of urea plant in Madagascar. If the government secures the major equity participation in the plant the way how to export excessive urea to neighbouring countries, shown above, may help. If the plant is a joint venture with prevailing equity participation of private companies, preferably specialised in fertilizers' international business, the agreement mentioned above could be made within the frame of their established channels with possible administrative support of the governments involved.

Coming back to the problem of the maritime freight rates raised above, it would mean a lot if a chartered boat carrying Madagascar's urea to some of East African countries could be used for shipment of phosphatic fertilisers from there to Madagascar. In such a case the average freight cost of about $ 10 - 12/ton for shipments within the East African area could be brought down by aforementioned charter arrangement to about $ 5 - 6/ton. This would help to safeguard the economic interests of urea manufacturing plant in Madagascar which could not afford to sell urea below its manufacturing cost price.

To my opinion, the East African market should be considered as a logical outlet for Madagascar urea surplus production in the years to come after the plant is commissioned. Due to smaller quantities of urea entailed, it is not worth of considering further outlets in Asia and Oceania, where strong international competition and prohibitive freight rates would make it extremely difficult to expect any export results at economically acceptable urea price FOB Tamatave.

If urea production plant is established in Madagascar, its physical presence in the country will promote the urea at a quicker pace not only as fertiliser but also as an excellent cattle feed, narrowing thus the gap between the economic rate of production and visualised local consumption.

I hope that if consumption targets of nitrogen mentioned in Table 11 in the form of urea are achieved, the plant in Madagascar could be put in-

to operation in 1972 and the necessary surplus urea tonnage exported within the region provided that the aforementioned shipping and marketing arrangements are made well in advance of this date.

VII. CONCLUSIONS AND RECOMMENDATIONS

The agricultural sector is the most important part of the Madagascar economy. The value added to GDP by agricultural production (including livestock and finishing) was 35 % of the total and increased in real terms by less than 2 % a year in the past. It was largely perquisite to a similar low rate of growth in paddy output which made a little more than half of the value added by the agricultural sector. That is why the government attaches great importance to the development of the agricultural production from 1966-71. Subsistance crops, (mainly paddy, manioc, corn and sweet potatoes) which account for about half of the value added by this sector, are projected to increase by 4-5 % annually. Among the subsistance crops paddy is occupying the foremost place. Its production should increase by around 400,000 tons by the 1971/72 harvest, i.e. the paddy output should be by 30 % higher over average production in recent years. This output should be sufficient to meet by 1971/72 the expanded domestic demand for ordinary rice, due to population increase and leave some 20-25,000 tons of the de luxe paddy varieties for export. Such a rate of growth of paddy and other subsistance crops output is expected to be attained both by an improvement in productivity in existing cultivated areas and by an expansion of the area under cultivation.

The fertility of the soil requires, however, considerable improvement. As the use of organic manures cannot contribute very much to this target, the major approach is the increasing introduction of industrial fertilisers. On the other hand, it has to be realized thatthe introduction of fertilisers is a complex problem with multiple aspects. First of all, a large number of farmers has to see the usefulness of fertilisers resulting in their own benefits. This again requires an extensive and intensive propaganda campaign among them. These efforts have to be followed by the system of efficient distribution of fertilisers to individual farmers at a time when they need them. The supply of fertilisers brings along the necessity of extending subsidies and credits to the farmers to enable them to buy the fertilisers at reasonable prices and repay the credits after they cash the respective crops. In this respect, a strong and continued initiative of the government is essential.

Out of this brief enumeration of different and essential aspects and prerequisites for increased fertilizer use, it is apparent that the setting up of fertilizer industry in the country is only a very specific issue.

The specific character of the establishment of the fertilizer industry comprises the necessity of an adequate market for fertiliser produced, based on which such a manufacturing facility, by its very existence in the country, could in turn, contribute substantially to the more rapid fertiliser use in the future. At the same time, the type of industry must be carefully selected and located in conformity with the possibilities prevailing in the country as, for instance, is the availibility of raw materials for fertilizer manufacture, existing infrastructure, industrial development etc. Consequently, the following conclusions and recommendations are given below:

(1) Government of Madagascar has embarked on ambitious programme of so-called "big operations" among them the foremost place is assigned to the development of agriculture. A very elaborated, regional and central organization was set up to carry out practically all kind of agricultural promotion and extension service. Farmers are being taught how to avail themselves of progressive agricultural methods including the use of fertilizers, field trials and demonstrations with fertilizers are performed, subsidies at a rate of 30 percent Tamatave CIF prices are granted (chiefly paying for the inland transport cost), advantageous credits for the purchase of fertilizers are available to the farmers, extensive fertiliser distribution network including the storage facilities is prepared to response to the farmers needs in fertilisers etc. All this is organized with the help of French and EEC aid and is reported to cost almost FMG 13 billion ($ 52 million) in 1968 and 1969. It is essential to extend the period of "big operations" regarding the agriculture by at least subsequent 3 years to 1972 to establish firmly the results and gains derived from these operations. It is, therefore, strongly recommended to the Government to take the respective measures well ahead of the year 1969.

(2) Based on the results of the tests and trials with fertilisers mostly suited for paddy cultivations and in line with the recommendations of IRAM (Madagascar Institute for Agricultural Research) urea (46 % N) has been chosen as a production target in Madagascar. Due to a lack of natural resources like natural gas and naphta, it is econo-

mically inevitable to start the manufacture of urea based on the imported ammonia and locally produced carbon di xide. Relatively low and even decreasing CIF Tana anarive prices of imported ammonia from huge export plants do not substantiate the establishment of ammonia based fertilizer industry in the country and imports of refrigerated ammonia were taken into consideration for the purpose of this study.

(3) The recommended design capacity of the urea plant was fixed at a 33,000 metric tons of urea in 330 stream days/year. It has to be noted that the manufacture of fertilizers in Madagascar is destined predominantly for local use. Consequently, the setting up of the urea plant should be considered 3 years ahead of such a time when the whole atmosphere and trend of the fertilizer consumption mentioned in Table 11, marked as a break-through in fertilizer use, gives the prospects that some 5,500 tons of N nutrient could be locally marketed in the year 1969 and thus projections till 1975 reasonably achieved. The further prerequisites to this effect are the following:

a) The government's present endeavour and policies to develop the agricultural production of subsistance crops are to be maintained in the future, i.e. after the year 1969;
b) The projected nitrogen consumption is fully met by the urea, i.e. urea will substitute all other straight or complex fertilizer containing N nutrient in the future;
c) The plant will be guaranteed of a monopoly position in Madagascar as long as its production costs are competitive with world prices seen from the national economy point of view;

(4) The mentioned market outlets for Madagascar excessive urea in East African countries should be further explored with the aim to reach later pertaining agreements either on government or private basis within the frame of mutual trade by exchange of one kind (phosphatic) fertilizer produced there for urea produced at Tamatave etc. Special attention should be paid to charter arrangements for shipping of Madagascar urea to East African countries and reciprocal utilisation of the respective boats for shipping commodities imported to Madagascar including fertilisers.

(5) Full advantage should be taken from the existing agricultural research facilities in Madagascar giving them further task to explore to which extent urea as a feedstuff could replace ordinary fodder in-

take by cattle.

Further recommendations and conclusions pertaining to the setting up of the urea plant in Madagascar are contained in the part "B" of the present Report.

VIII. LIST OF VISITS

MADAGASCAR:	Mr. G. Ramenason	General Director of the Office of of the Industrial Promotion.
	Mr. de Selys Longchamp	Resident Representative UNDP
	Mr. Tal	Deputy Resident Representative UNDP
	Mr. G. Laurent	UNDP/FAO
	Miss. C. Rabevazaha	Ministry of Planning
	Mr. Piquemal	Presidential Office
	Mr. Vernhet	CFDT
	Mr. Fournier	Ministry of Agriculture
	Mr. Gregoire	Ministry of Agriculture
	Mr. Ratsimbozofy	Ministry of Agriculture
	Mr. Randriamasy	Ministry of Agriculture
	Mr. Deshayes	Ministry of Planning
	Mr. Vaurs	Ministry of Planning
	Mr. Reynier	Ministry of Industry and Mines
	Mr. Fouche	Ministry of Industry and Mines
	Mr. Roche	Institute of Agricultural Research
	Mr. I. Velly	Institute of Agricultural Research
	Mr. J. Celton	Institute of Agricultural Research
	Mr. R. du Fournet	Institute of Agricultural Research
	Mr. Nibelle	Messrs. Davum, Importer of Fertilizers
	Mr. Rabearisoa	Principal Secretary of the Ministry of Agriculture
	Mr. V. Vachier	Oil Refinery Tamatave
	Mr. Croselle	Oil Refinery Tamatave
	Mr. Zafimahova	Director General Mines and Energy
	Mr. Rasafindratanvah	Adjoint Director General Mines and Energy
	Mr. Contant	National Bank of Madagascar
	Mr. Riaux	Prochimad (manufacturer of potassic fertilizers)
	Mr. Carré	Prochimad
	Mr. Noitakis	Messrs. Corvi (Importers of Fertilisers)
	Mr. Bohl	Messrs. Sepch and Madengrais (Importers and manufacturers of fertilisers)

	Mr. Chirra	Office of the Industrial Promotion
	Mr. Randriamanga	Office of the Industrial Promotion
	Mr. Treuil	Office of the Industrial Promotion
	Mr. Potier	Office of the Industrial Promotion
	Mr. Humefre	Centre of Economic Research
	Mr. Poudoulec	Rice Crops Operations
	Mr. Champenois	Director General of Shell Company
	Mr. V. Milner	Ministry of Agriculture
	Mr. Fauval	Technical Adviser Tamatave Port
	Mr. Gillan	Ureer - Ministry of Agriculture
	Mr. H. Huguet	Economic Adviser to the President's Office
	Mr. Hazeltine	Economic Adviser to the President's Office
MAURITIUS:	Hon. L. Rangoolan	Prime Minister
	Hon. L. Jugnauth	Minister of State Development
	Hon. B. Jomadar	Minister of Commerce and Industry
	Mr. Bumenohbay	Permanent Secretary
	Mr. J. Y. Gnany	Prime Minister's Office
	Mr. R. F. Benner	Economic Planning Unit
	Mr. M. D. Kingston	Director of Economic Planning Unit
	Miss J. M. King	Economic Planning Unit
	Mr. B. Arouff	Secretary for Industrial Development Ministry of Commerce and Industry
	Mr. D. S. Patterson	Vicepresident, International Development and Investment Company
	Mr. A. Harel	Harel Malke Co. Ltd.
	Mr. André Carles	Technical Advisor to European Fertilizer Importers
REUNION:	Mr. M. Chevance	Deputy Préfet for Economic Affairs
	Mr. A. Tirard	Office for Industrial Promotion
	Mr. Lefèbre-Dibon	Office for Industrial Promotion
	Mr. Barau	President of the Sugar Syndicat

	Mr. Rivière	President of Sugermills and Plantation Development Corporation
	Mr. Tholet	Chamber of Agriculture
	Mr. Pre	Society of Regional Development
TANZANIA:	Mr. Mattsson	Resident Representative of UN
	Mr. Tonnyson	Deputy Resident Representative of UN
	Miss Logie	Officer in the Office of the Resident Representative of UN
	Mr. Iyer	Centre of Industrial Studies
	Mr. Rusk	Project Manager of the Centre for Industrial Studies
KENYA:	Mr. Savosnik	Ministry of Planning and Development
	Mr. Volk	Triangle Company
	Miss Davis	Assistant to the Resident Representative of UN
	Mr. Litfenberger	INTEMA Mercantile and Trading Establishment
ETHIOPIA: Addis Ababa	Mr. Y. S. Pandit	ECA, Director, Industry and Housing Division
	Mr. Ato Makkonen Alemayu	ECA, Industry and Housing Division
	Mr. H. Trzanski	ECA, Industry and Housing Division
	Mr. A. Bloomeris	ECA, Technical Assistance Co-ordination Unit
	Mr. H. S. Belay	ECA, Agriculture Development Division
	Mr. Anker Kloppenborg-Skrumsager	FAO, Soil Fertilizer Expert
	Mr. W. J. Habashi	ECA - FAO, Joing Agricultural Development Division
	Mr. H. K. Rahim	ECA, Technical Assistance Co-ordination Unit

TABLE 2 **Page 1**

EXISTING FERTILIZER PLANTS

Producer and Location	Product	Output (tons/year)	Plant Expansion	Raw Materials
UGANDA - Tororo Industrial Chemical and Fertilizer Company	Single Superphosphate (21 % P_2O_5)	[illegible] • [illegible]	[illegible] to [illegible] [illegible] to [illegible]	Phosphate from Sukulu [illegible] Sulphur
KENYA - Turbo Sodium Phosphate Plant	Sodium Phosphate (2[illegible] % P_2O_5)	4,[illegible] 1,[illegible]	[illegible]	Phosphate [illegible] Soda Ash [illegible] Lake Magadi
RHODESIA - Salisbury African Explosives and Chemical Industries Ltd.	Single Superphosphate (19 % P_2O_5) Triple Superphosphate (44 % P_2O_5)	[illegible] 10,4[illegible] [illegible],000 24,200	1[illegible],000 to add 1,[illegible] to add 1[illegible] to add [illegible] to add	Phosphate [illegible] Dorowa Pyrite and Imported Sulphur
RHODESIA African Explosives, Fisons, Windmill	Bulk blending	100,000		Local and Imported P_2O_5, Imported N and K_2O

PROPOSED FERTILIZER PLANTS

Producer and Location	Product	Output (tons/year)	Plant Expansion	Raw Materials
RHODESIA - Umtoli Nitrogenous Fertiliser Plant	Ammonium Sulphur (21,5 % N) Ammonium Nitrate (27 % N)	190,000 • 41,[illegible] [illegible]0,000 • 27,000	- - - -	Petroleum Feedstock
KENYA Triangle Fertilisers and Co.	Ammonium Calcium Nitrate (27 % N)	130,000 35,000	- -	Ammonia imported Lime from Bamburi

TABLE 3 **Page 2**

Producer and Location	Product	Output (tons/year)	Plant Expansion	Raw Materials
ETHIOPIA Ralph M. Parson and Co.	Potassium Muriate (60 % K_2O)	[illegible] 540,[illegible]	- -	Dallol [illegible] Deposits
MAURITIUS, Port Luis Chemical and Fertilizer Industry Limited.	N-P-K Various Formulations	[illegible]	-	Imported Ammonia, P_2O_5 and K_2O
TANZANIA, Dar-El-Salaam	Single Superphosphate (19 % P_2O_5) Triple Superphosphate (42 % P_2O_5)	1[illegible]* 30,[illegible] 7,[illegible] 21,[illegible]	- - -	[illegible] Minjingu [illegible], Imported Sulphur
TANZANIA, Dar-El-Salaam	Ammonium Sulphate (21 % N) Urea (46 % N)	1[illegible]** [illegible] [illegible] [illegible]	- - - -	Petroleum Feedstock, Local Pyrites
MADAGASCAR, Tamatave	Urea (46 % N)	[illegible] 1[illegible]	- -	Imported Ammonia [illegible] Fuel [illegible]
UGANDA, at Lake Kivu a/	Ammonium Sulphate (21 % N)	1[illegible] • [illegible]	-	Methane [illegible] Lake Kivu

a/ This location may be shifted to [illegible] provided that methane from Lake Kivu could not be used economically in [illegible].

TABLE 2 Page 3

Producer and Location	Product	Unit (tons/year)	Last Expansion	Raw Materials
ZAMCIA, Livingstone	Ammonium Nitrate and Explosives (34 % N)	50,000 21,000	-	Electricity - Coal for Steam

• - Proposed by CA.

•• - Proposed by Centre for Industrial Studies.

Table 3

Fertiliser Production Facilities in East Africa
Summary

Country	N Existing	N 1970	N 1975	P_2O_5 Existing	P_2O_5 1970	P_2O_5 1975
Uganda	-	-	40,000	5,250	15,750	-
Kenya	-	-	35,000	1,000	1,300	-
Rhodesia	-	68,000	-	34,650	8,450	-
Mauritius	-	20,000	-	-	11,000	-
Tanzania	-	-	-	-	-	41,000
Madagascar	-	-	15,500			
Zambia	-		21,000			
Total	-	88,000	111,500	40,900	36,200	41,000
			88,000		40,900	77,100
			199,500		77,100	118,100

Note - Tanzania ammonium sulphate and Urea production not included because of little chance of materialisation before 1975.

Mauritius N-P-K included only under N and P_2O_5

Decisive for incorporation under 1970 or 1975 is expected date of putting on stream of the respective production facility

TABLE 4

CONSUMPTION OF FERTILIZER IN REUNION (in metric tons)

N - FERTILIZER

KIND OF FERTILIZER		1961	1965	1966
Ammonia Sulphate (21 % N)	F	10,508	10,008	5,190
	N	2,207	2,102	1,090
Other Nitrogenous Fertilizers (35 %)	F	460	352	136
	N	161	123	65
TOTAL	F	10,963	10,360	5,376
	N	2,368	2,225	1,155

P_2O_5 - FERTILIZER

Triple Superphosphate (45 % P_2O_5)	F	-	280	315
	P	-	126	142
Rock-Phosphates (20 %)	F	1,630	396	795
	P	326	179	159
Dicalcium Phosphates (38 % P_2O_5)	F	1,050	294	110
	P	399	112	42
TOTAL	F	2,680	1,470	1,220
	P	725	417	343

K_2O FERTILIZER

Muriate of Potash (60 % K_2O)	F	2,270	1,203	700			
	K	1,362	722	420			
N-P-K 14:14:14 15:15:15 17:17:17 16: 8:16 15: 7:15 20:10:10	F	15,611	18,620	20,500			
	N	2,378	2,957	3,184			
	P	1,932	2,303	2,482			
	K	2,144	2,677	2,883			
					1970	1975	1980
TOTAL OF PURE NUTRIENT CONSUMPTION	F	31,549	31,653	27,796			
	N	4,746	5,182	4,439	5,700	6,465	7,111
	P	2,657	2,720	2,845	3,101	3,332	3,665
	K	3,506	3,399	3,303	3,633	4,164	4,580
TOTAL NUTRIENT		10,899	11,301	10,467	12,440	13,961	15,356

F = Fertilizer; N = Nitrogen; P = P_2O_5; K = K_2O.

TABLE 5

CONSUMPTION OF FERTILIZERS IN MALTA (in metric tons)

N - FERTILIZERS

KIND OF FERTILIZER		1961	1965	1966	1967	1968	1969	1970	1975	1980
Ammonium Sulphate (21% N)	F	35,100	17,200	14,480						
	N	7,380	3,612	3,020						
Ammonium Nitrate (33 % N)	F	60	55	90						
	N	20	18	17						
Sodium Nitrate (16 % N)	F	223	160	145						
	N	36	26	23						
Ammonia Phosphate and other fertilizers	F	3,500	-	-						
	N	560	-	-						
TOTAL	F	38,883	17,415	14,575						
	N	7,996	3,656	3,060						

P - FERTILIZERS

Ammonium Phosphate (16 N - 20 P_2O_5)	F	4,310	220	200						
	P	862	44	40						
Superphosphate + triple (20 % P_2O_5)	F	2,130	460	400						
	P	382	92	80						
Ammo Phosphate (20 % P_2O_5)	F	15,810	700	600						
	P	3,162	140	120						
Other phosphatic Fertilisers 22 % P_2O_5)	F	1,726	220	200						
	P	556	48	44						
TOTAL	F	24,176	2,084	1,400						
	P	5,162	324	288						

K - FERTILIZER

Muriate of Potassium	F	8,270	9,230	8,626						
	K	4,961	5,538	5,176						

N - P - K FERTILIZERS

	F	-	29,271	27,040						
	N	-	4,681	4,325						
	P	-	3,622	3,347						
	K	-	4,207	3,868						
IN TOTAL	F	68,020	58,091	51,641					88,000	
	N	7,996	8,337	7,417					11,000	Budgeted
	P	5,162	3,946	3,635					5,000	
	K	4,961	9,745	9,044					10,500	
TOTAL NUTRIENT		18,119	22,020	20,116					26,500	

3 % increase based on Consumption in 1965

KEY: F = Fertiliser
N = Nitrogen
P = P_2O_5
K = K_2O

Table 6 Page 1

PRESENT AND FUTURE FERTILIZER CONSUMPTION (Pure Nutrient) in EAST AFRICA

	1963	1967	1970		197		Country targets
ETHIOPIA			ECA	Report	ECA	Report	
N	217	700	2,100	1,400	8,9[illegible]	4,100	
P_2O_5	200	505	600	800	2,55[illegible]	1,500	
	417	1,205	2,700	2,200	11,450	5,600	
SOMALIA	1963						
			ECA	Report	ECA	Report	
N	3,300		5,600	4,[illegible]00	10,800	5,4[illegible]0	
P_2O_5	-		400	350	[illegible]50	550	
	3,300		6,000	5,150	11,550	8,25[illegible]	
KENYA	1964	1966					
			ECA	Report	ECA	Report	
N	8,600	14,600	13,600	18,000	20,000	23,000	24,000
P_2O_5	6,000	8,000	8,000	10,000	13,500	15,000	37,500
	14,600	22,600	21,000	28,000	33,500	38,000	
UGANDA			ECA	Report	ECA	Report	
N	2,200	2,100	6,500 a)	3,100	17,000	7,000	27,500
P_2O_5	1,200	1,050	12,000 a)	5,200	13,400	8,000	
	3,400	3,150	18,500	8,300	30,400	15,000	
			a) if subdivided				
TANZANIA							
N	4,000	3,800	8,100	5,510	14,600	9,500	17,500
P_2O_5	600	500	10,600	2,500	18,500	6,000	22,500
	4,600	4,300	18,700	8,010	33,100	15,500	
RWANDA							
N		100	2,100		3,200		
P_2O_5		50	800		1,700		
		150	3,000		4,900		

Table 6 Page 2

		1963	196	1970		1975		Country
				IDA	Report	IDA	Report	
	N	30		[illegible]		[illegible]		
	P_2O_5	30		1,100		2,200		
		60		3,500		5,350		
MADAGASCAR		1965						
	N	1,896	2,338	3,700	6,627	7,600	11,585	
	P_2O_5	1,294	1,441	5,200	7,170	12,200	12,132	
		3,190	3,781	8,900	13,797	19,800	23,717	
MAURITIUS								
	N	8,357		12,000	9,500	12,450	11,000	
	P_2O_5	3,926		10,000	4,300	12,000	5,066	
		12,283		22,000	13,800	24,450	16,066	
MOROCCO		1963	1966					
	N	5,600	4,339	4,700	5,[illegible]	[illegible]	6,465	
	P_2O_5	2,100	2,825	2,300	3,[illegible]	4,600	3,132	
		7,700	7,164	7,000	8,[illegible]	12,300	9,[illegible]	
ZAMBIA		1964						
	N	6,500		17,700	15,200	31,850	22,700	
	P_2O_5	3,500		8,100	7,100	14,600	10,600	
		9,500		25,800	22,300	46,450	33,300	
RHODESIA								
	N	21,000		43,000	52,000	55,300	64,300	47,000
	P_2O_5	30,000		39,000	50,000	49,500	61,200	48,000
		51,500		82,000	102,000	104,500	125,500	(pl. Zambia pl. Malawi)
MALAWI								
	N	2,000		3,800	3,200	6,800	4,700	
	P_2O_5	500		2,500	1,000	4,500	2,500	
		2,500		6,300	4,200	11,300	7,200	

Table 7

Summary of Present and Future Consumption in East Africa (Nitrogen N)

Country	1964	1970		1975	
		ECA	Report	ECA	Report
Ethiopia	217	2,100	1,400	8,900	4,100
Somalia (French)	-	-	-	-	-
Republic of Somalia	3,800	5,600	4,800	10,800	8,100
Kenya	8,600	13,600	18,900	20,600	23,000
Uganda	2,200	6,500	3,100	17,000	9,000
Tanzania	4,000	6,100	5,510	14,600	9,500
Rwanda	-	2,100	2,100	3,200	2,100
Burundi	-	2,400	2,400	1,700	1,700
Madagascar	1,500	3,700	6,627	7,600	11,585
Mauritius	8,500	12,000	9,500	12,450	11,000
Réunion	5,600	4,700	5,700	6,700	6,465
Zambia	6,500	17,700	15,200	31,850	22,700
Rhodesia	51,000	43,000	52,000	55,000	64,000
Malawi	2,000	3,800	3,200	6,800	4,700
-N- East Africa Total	93,917	125,300	129,537	197,600	176,250

Table 8 **Summary of Present and Future Fertilizer Consumption in East Africa (Phosphorus P_2O_5)**

Country	1964	1970		1975	
		BCA	Report	BCA	Report
Ethiopia	200	600	800	2,550	1,550
Somalia (French)	-	-	-	-	-
Republic of Somalia	-	400	350	750	550
Kenya	6,000	8,000	10,000	13,500	15,000
Uganda	1,200	10,000	5,200	13,400	8,000
Tanzania	600	10,600	2,500	16,500	6,000
Rwanda	-	900	900	1,700	1,700
Burundi	-	1,100	1,100	2,200	2,200
Madagascar	1,400	5,200	7,132	12,200	12,132
Mauritius	4,000	10,000	4,300	12,000	5,000
Réunion	2,300	2,900	3,132	4,600	3,132
Zambia	3,000	8,100	7,100	14,600	10,600
Rhodesia	30,000	39,000	50,000	49,000	61,000
Malawi	500	2,500	1,000	4,500	2,500
-P_2O_5- East Africa Total	49,200	99,300	93,520	150,000	129,514
-N + P_2O_5- East Africa Total	143,117	224,600	223,064	347,600	322,184
Consumption of K_2O	42,900	67,500	66,900	104,400	91,500
-N + P_2O_5 + K_2O- East Africa Total	186,017	292,100	289,964	452,000	327,564

TABLE 9

EXPORT EARNINGS AND OTHER RECEIPTS OF MADAGASCAR
(Million Francs of 1966 - Current Prices)

	Average 1962-66	1970	1971
MERCHANDISE EXPORTS			
Coffee	[illegible]	[illegible]	7.[illegible]
Other commercial export crops (Vanilla, Cloves, Pepper, Sisal, tobacco etc)	[illegible]	[illegible].1	[illegible].1
Rice and other subsistence Crops	2.5	2.2	2.5
Sugar and other Cash Crops	2.2	1.[illegible]	1.[illegible]
Meat and Fish Products	1.7	2.4	4.0
Raphia and Fiber	0.3	0.[illegible]	1.0
Minerals	0.7	0.[illegible]	1.5
Wood Pulp	-	-	0.9
Petroleum Products	-	0.2	0.7
All other	2.1	2.4	3.5
TOTAL MERCHANDISE EXPORTS	22.6	24.3	30.5
INVISIBLE EARNINGS			
Sales to other Governments	3.6	7.5	5.0
All other	4.0	5.7	7.5
TOTAL INVISIBLE EARNINGS	12.6	13.2	12.5
TOTAL CURRENT EARNINGS	35.2	37.5	43.0

TABLE 10

AGRICULTURAL PRODUCTION IN MADAGASCAR
('000 of metric tons)

	1955	1960	1961	1962	1963	1964	1965	[illegible]
Paddy	1,050.0	1,212.0	1,1[illegible]	1,2[illegible]7.0	1,242.0	1,[illegible]	1,240.[illegible]	1,353.[illegible]
Corn	60.0	30.5	92.0	31.0	[illegible]5.[illegible]	[illegible]	1[illegible]0.0	
Manioc	730.0	740.0	[illegible]00.0	[illegible]30.0	[illegible]50.0	[illegible]	36.0	70.00
Sweet potatoes	250.0	[illegible]2.0	[illegible]0.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lima beans	12.	1[illegible].	[illegible]	[illegible]	[illegible]	[illegible]5.0	23.[illegible]	[illegible]
Sugar cane	450.0	[illegible]50.0	[illegible]63.1	1,[illegible]	1,[illegible]	1,[illegible]	1,0[illegible]0.[illegible]	1,[illegible]00.00
Bananas	115.0	1[illegible]	135.[illegible]	1[illegible]7.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Groundnuts	23.7	23.	[illegible]7.1	32.[illegible]	[illegible]	[illegible]	[illegible]	
Cotton (grains)	0.1	2.1	[illegible].4	3.[illegible]	[illegible]	[illegible].03	[illegible]	5.[illegible]
Coffee	53.0	[illegible]	44.5	[illegible]0.[illegible]	1.[illegible]	[illegible]	[illegible]	[illegible]0.00
Vanilla	0.[illegible]	0.[illegible]	0.[illegible]	[illegible]	0.[illegible]	1.[illegible]	0.[illegible]	1.0[illegible]
Cloves	7.3	5.[illegible]	[illegible].0	[illegible]	3.5	[illegible]	[illegible]	0.[illegible]
Pepper	0.7	1.1	1.2	1.1	[illegible].3	[illegible]	[illegible]	1.[illegible]
Tobacco	4.[illegible]	4.0	4.4	4.[illegible]	4.[illegible]	[illegible].12	[illegible]	3.30
Raphia	[illegible]	7.1	7.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	10.[illegible]
Sisal	[illegible]	13.0	13.[illegible]	23.0	[illegible]	[illegible]	[illegible]	[illegible]
Aleurite (grains)	2.	[illegible].3	5.7	3.[illegible]	[illegible]	[illegible]	[illegible]	10.00
Cocoa	0.3	0.[illegible]	0.5	0.[illegible]	0.[illegible]	[illegible].13	0.41	0.[illegible]

Source: Institut National de la Statistique et de la Recherche Economique: Situation Economique au Début de 1[illegible].

TABLE 11 Page 1

CONSUMPTION OF FERTILIZERS IN MADAGASCAR

CONSUMPTION OF N - RICE

		1965	1966	1967	1968	1969	1970	1975	1980
							20 % Increase on 1969		
N-P-K (11:22:16) 20:10:10	F	197	576	2,000	6,400	12,800	15,360	28,160	40,960
	N	22	64	220	704	1,408	1,690	3,098	4,506
Ammonia Sulphate (21 % N)	F	630	1,454	1,000	3,100	6,200	7,430	13,680	19,880
	N	132	305	210	651	1,302	1,571	2,873	4,175
Urea (46 % N)	F	31	200	500	620	1,240	1,488	2,728	3,963
	N	14	92	230	285	570	684	1,255	1,825
TOTAL	N	163	461	660	1,640	3,280	3,945	7,226	10,506
							20 % on 1967 basis		

CONSUMPTION OF N - OTHER CULTURES

N-P-K (11:22:16	F	1,038	536	1,900	2,280	2,660	3,040	4,940	6,840
	N	202	64	210	251	293	334	543	752
Ammonia Sulphate (21 % N)	F	1,949	1,459	1,250	1,500	1,750	2,000	3,250	4,500
	N	409	306	263	315	368	420	683	945
Ammonia Nitrate (22 % N)	F	303	225	250	300	350	400	650	900
	N	67	50	55	66	77	88	143	198
Urea (46 % N)	F	2,233	2,329	2,500	3,000	3,500	4,000	6,500	9,000
	N	1,050	1,491	1,150	1,330	1,472	1,840	2,990	4,140
TOTAL	N	1,728	1,911	1,678	2,012	2,210	2,682	4,359	6,035
TOTAL RICE + OTHER CULTURES	N	1,896	2,375	2,338	3,652	5,490	6,627	11,585	16,541
IN TERMS OF UREA		4,120	5,140	5,080	7,940	11,900	14,400	25,200	35,900

Note: F = quantity of fertiliser
N = quantity of N nutrient
P = quantity of P_2O_5 nutrient
K = quantity of K_2O nutrient
All quantities are given in metric tons.

TABLE 11 Page

[illegible]

KIND OF FERTILIZER	[illegible]								
N-P-K (1:2:2)	[illegible]								
Single-triple Superphosphate and other (20)	[illegible]								
P-K (2:1)	[illegible]								
TOTAL	[illegible]								
	[illegible]								
N-P-K (18)	[illegible]								
Single, triple super and other (20)	[illegible]								
TOTAL	[illegible]								
TOTAL P RICE AND OTHER CULTURES	[illegible]								

Note: P - quantity of fertilizer
N - quantity of N nutrient
P - quantity of P_2O_5 nutrient
K - quantity of K_2O nutrient

All quantities are given in metric tons.

TABLE [illegible]

[illegible] OF K - RICE

KIND OF [illegible]		[illegible]							
N-P-K (11-[illegible])	F	[illegible]							
	K	[illegible]							
K C L (C K_2)	F	-	-	[illegible]					
	K	-	-	[illegible]					
TOTAL	K	[illegible]							

[illegible] on 100 basis

[illegible] - TYPICAL [illegible]

on 100 basis

N-P-K (11-22-13)	F	11, [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3,[illegible]40	4,940	6,[illegible]40
	K	[illegible]31	75	[illegible]47	29[illegible]	34[illegible]	315	642	389
K-C-L (60 % K_2O)	F	1,600	1,[illegible]41	1,[illegible]00	1,260	1,320	1,3[illegible]0	1,630	1,[illegible]90
	K	[illegible]60	[illegible]97	7[illegible]0	756	79[illegible]	423	1,008	1,136
TOTAL	K	1,[illegible]2[illegible]	773	[illegible]67	1,052	1,13[illegible]	1,[illegible]23	1,650	2,077
TOTAL RICE AND OTHER CULTURES	K	1,23[illegible]	367	1,2[illegible]7	2,[illegible]76	3,7[illegible]6	4,401	7,476	10,551

Note : F = quantity of fertiliser
K = quantity of K_2O nutrient

All quantities are given in metric tons.

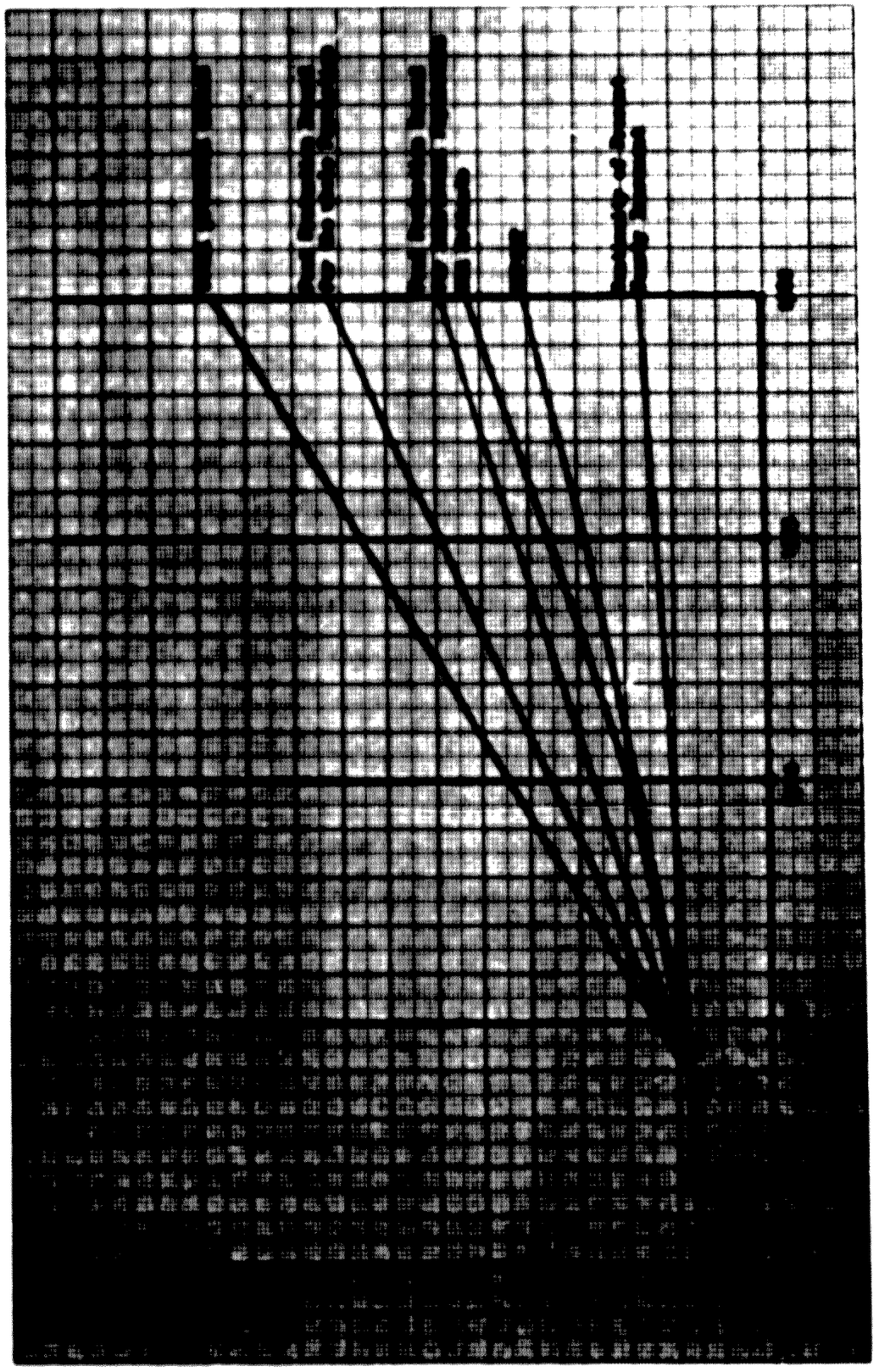
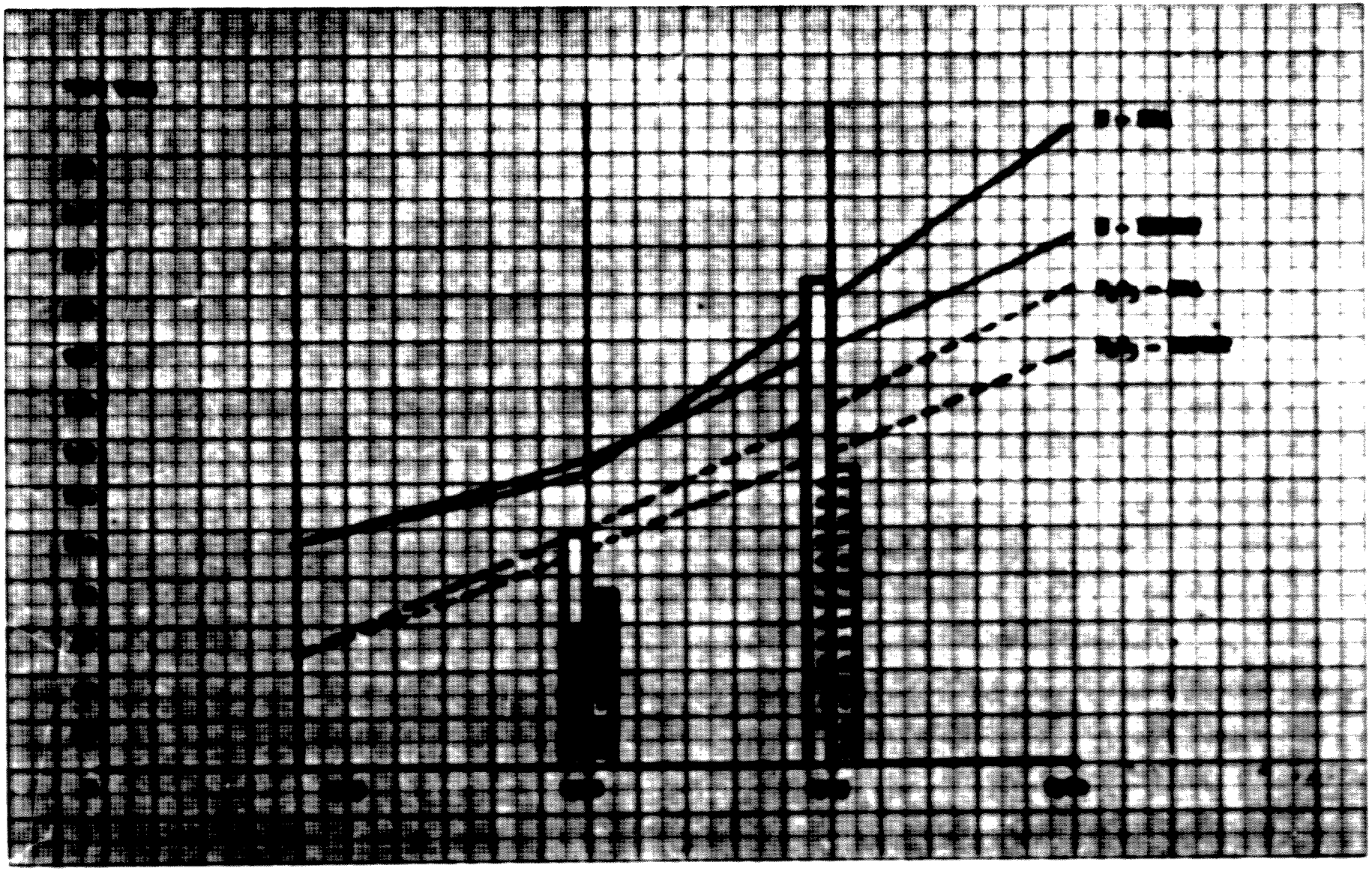
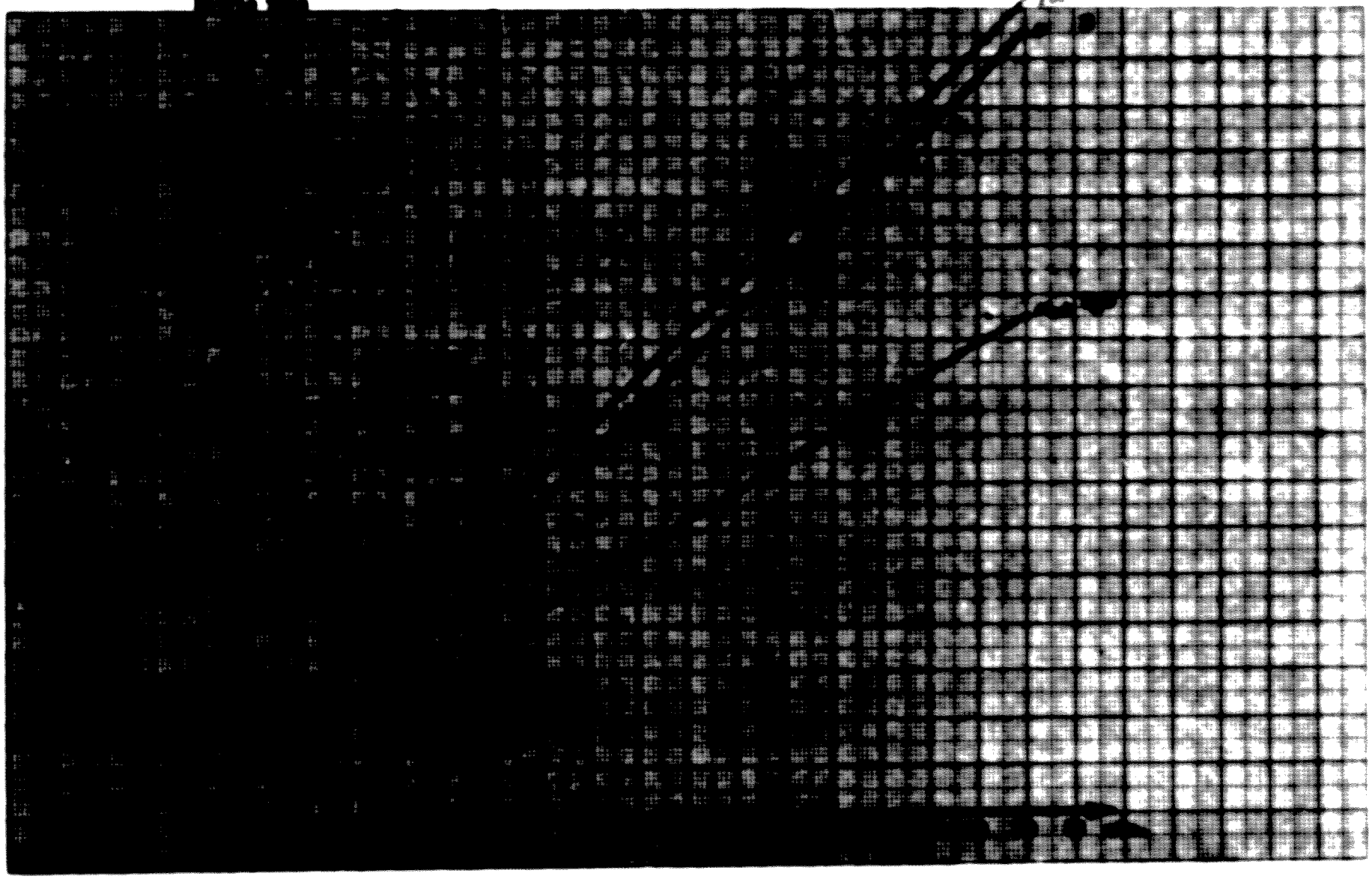


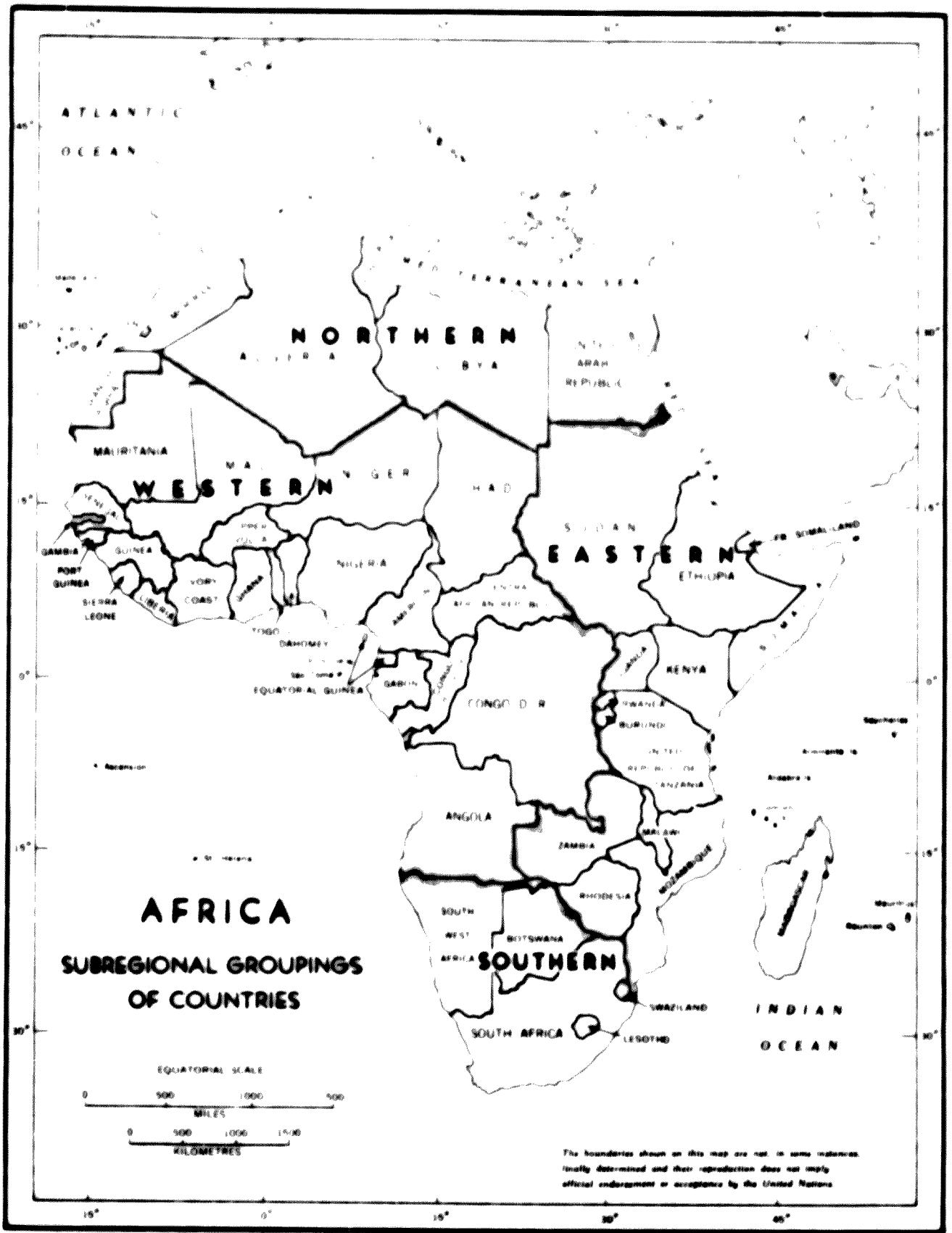
FIGURE 2

PRESENT AND FUTURE CONSUMPTION AND PRODUCTION OF S AND $PM_{2.5}$ IN BAY AREA





Africa: subregional groupings of countries



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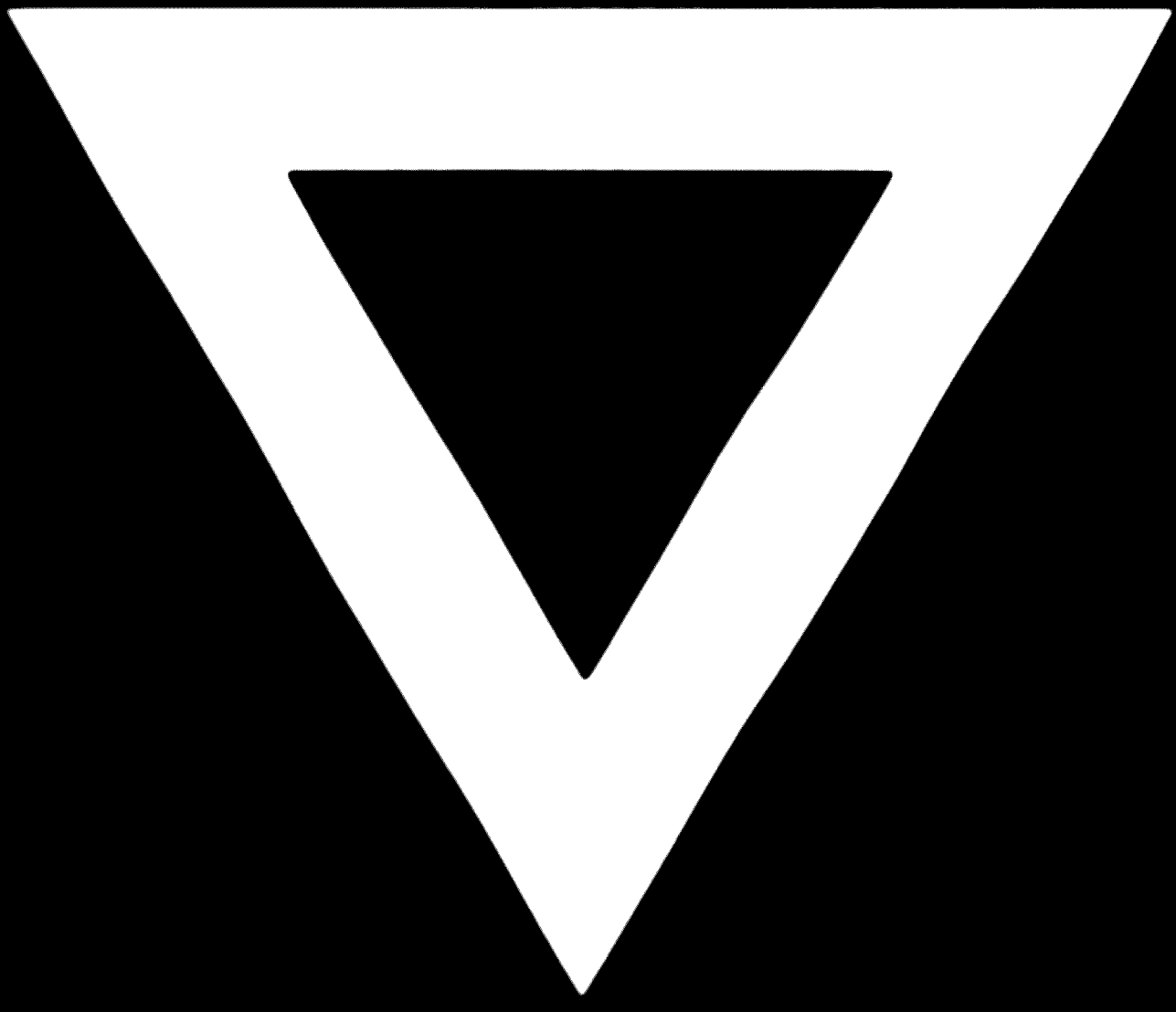

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