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ECONOMIC COMMISSION FOR AFRICA

CHEMICAL INDUSTRY DEVELOPMENT PROGRAMME

REPORT OF THE FIRST ECA/UNIDO CHEMICAL
INDUSTRY DEVELOPMENT PROGRAMME

MISSION*

(May - October 1978)

(for discussion by Intergovernmental Meeting of Experts)

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PREFACE

Attempts at promoting the development of the chemical industry in the region goes as far back as 1963 when the first desk work on the sector was carried out 1/. Subsequent to this, subregional co-ordination missions were undertaken and reports were prepared 2/ during the period 1963-1966. The chemical industry figured among the sectors covered.

The above attempts were followed by the preparation of studies (a number of them on the chemical subsector) and conferences/meetings on industrial co-ordination at the subregional level between 1964 and 1967.3/ For a number of reasons including the fact that most member States were pre-occupied with consolidating their newly acquired independence, their priority stress on development of import substitution industries and the relative ease with which such industries were being established, the above attempts failed to materialize or ended up in the establishment of units of uneconomically small sizes.

During the period 1968-1976, some of the chemical documents were up-dated and new ones prepared with the hope that they could serve as background material for any activities that could subsequently be undertaken.4/ The preparation of some of them, such as those on fertilizers and pharmaceuticals, were motivated by the energy crisis of 1973 and its aftermath.

In the meantime, the need to accord priority to industrial development in developing countries started to gather momentum in early 1970s. It was, as evidenced by a number of General Assembly and Commission resolutions, including the Lima Declaration and Plan of Action adopted at the Second Conference of UNIDO in 1975, recognized by the international community. According to the Declaration, Africa is expected to increase its share in world industrial production (and by implication, its chemical output) from 0.6 per cent to at least 2 per cent by the year 2000.

Realizing the critical role played by industrial development, the Second Conference of African Ministers of Industry held in 1973, that is, prior to the Lima Declaration, had adopted its own declaration, the Declaration on Industrialization in Africa: Principles and Guidelines for Co-operation and Development. Subsequent meetings of the Conference and its subsidiary organ, the Follow-up Committee on Industrialization in Africa, dealt with the problem and came to the conclusion that there was need for accelerated structural change in industrial production with a view to achieving an increased measure of self-reliance and self-sufficiency. In its third and fourth meetings, the conference, in its agreed conclusions, accorded high priority to the development of basic industries, including the chemical sector.

1/ Document E/CN.14/INR/1, Industrial Growth in Africa, 1963.

2/ Documents E/CN.14/246, 247 and 248.

3/ Conference/meeting reports: E/CN.14/324, 346, 351, 354, 366 and 399.

4/ Documents prepared included:

E/CN.14/206, 212, 217

E/CN.14/EP/49

M69-1867, M70-521 and M76-980

In response to the request of the member States made at the fourth meeting held in Kaduna, Nigeria in November 1977 by which ECA in co-operation with UNIDO and OAU was required to pursue measures leading to the attainment of the above objectives, ECA is in the process of formulating a chemical industry development programme. This programme is intended to serve as a guide for ECA, UNIDO, OAU and other organizations which will render assistance to member States in the chemical sector.

As a first step, a mission comprising a team of three consultants and one staff member visited six representative countries (the United Republic of Tanzania, Gabon, the United Republic of Cameroon, Nigeria, Upper Volta and Egypt) from 20 May to 8 August 1978. During the period to mid-October, the mission prepared country reports and this regional report.

The terms of reference of the mission were to assess the existing situation to identify opportunities for integrated development and formulate sectoral policies, programmes and targets for the chemical sector. These were to be based on the identification of the peculiar characteristics, major problems, critical linkages, training needs and institutional requirements of and modalities for co-operation amongst member States in the chemical sector.

In view of the vast field of the chemical sector, it was, for practical purposes, necessary to limit the coverage to those subsectors which are, under African conditions, considered priority areas. Accordingly, the subsectors dealt with in this report comprise basic chemicals, fertilizers, pesticides, petrochemicals and pharmaceuticals.

The report is divided into four chapters. The first, the Summary, highlights the main findings and recommendations. It was purposely made detailed so that those readers who may not have the time to read the whole report could have a fair preview of the report.

In the remaining chapters, each of the subsector mentioned above is dealt with separately. It was felt that this subsectoral approach could facilitate in bringing out the peculiar characteristics of each subsector and thereby highlight the specific problems and prerequisites related to the development of the subsectors. It should be noted that, as many of the observations made in the basic chemicals, fertilizers and pesticides chapter, particularly those related to policies and strategies for development, are applicable to petrochemicals and pharmaceuticals, the coverage of the latter two was biased in favour of the project opportunity identification aspect of the report.

It is earnestly hoped that this Document, and in particular, the specific developmental possibilities highlighted in it, would be of interest to the Governments concerned and would serve as the basis for further studies and actions on their part and other concerned organizations.

Composition of the team:

- | | |
|---|-----------------|
| 1. Mr. Autar K. Bhatnagar, specialist in basic chemicals, fertilizers and pesticides, | Team Leader |
| 2. Dr. Hussein A. El-Sharawy, specialist in petrochemicals, | Member |
| 3. Dr. Edward H. Zawada, specialist in pharmaceuticals, | " |
| 4. Mr. Makonnen Alemayehu, ECA staff member | Project Officer |

CHAPTER I: SUMMARY

FERTILIZERS, BASIC CHEMICALS AND PESTICIDES

World and regional survey

1. In the field of chemicals, basic chemicals are perhaps the earliest to have been in use. The use of chemical fertilizers and pesticides came in, at a later stage, in order to increase agricultural production for meeting the growing requirements of food in the world. However, as a result of their successful application in agriculture, fertilizer and pesticide usage has been rapidly increasing and so also their production all over the world.

2. The total world production of all fertilizers ($N + P_2O_5 + K_2O$) in the year 1975/1976 was 92.2 million tons. Out of this 47.6 million tons (51.7 per cent) was produced by developed countries, 7.9 million tons (8.64 per cent) by developing countries and 36.5 million tons (39.66 per cent) by countries with centrally planned economies. The production of fertilizers in Asia during the same year was 13.0 million tons (14.13 per cent) and in Africa 1.77 million tons (1.96 per cent) of world production.

3. The total world consumption of all fertilizers ($N + P_2O_5 + K_2O$) in 1975/1976 was 88.58 million tons. Out of this the consumption of developed countries was 41.83 million tons (47.17 per cent), developing countries 13.11 million tons (14.78 per cent) and that of countries with centrally planned economies 33.78 million tons (38.05 per cent). The total consumption of all fertilizers in Asia was 15.80 million tons (18.17 per cent) and in Africa 2.40 million tons (3.05 per cent) of world consumption during the same year.

4. The per capita consumption of fertilizers during 1975 in different regions of the world was: developed countries 55.2 kg., developing countries 6.8 kg., Africa 6.0 kg., centrally planned countries 26.2 kg. As the developed countries have reached almost the point of maximum fertilizer application, the scope for increased fertilizer usage in agriculture mainly exists in the developing countries and specially in Africa. Therefore the future development of fertilizer production is likely to be concentrated in the developing countries of the world.

5. The total import of all chemicals in Africa in the year 1977 was 4.8 billion U.S. dollars. This represented a five-fold increase (including the effect of inflation) from 1968 when the imports were hardly 1 billion US dollars. The 1977 imports for different African regions were: North Africa \$1.81 billion, West Africa \$1.54 billion, Central Africa \$0.35 billion, East Africa \$0.56 billion, and other developing Africa \$0.60 billion.

6. At present, there is comparatively little production of basic chemicals in Africa, because the industries which consume basic chemicals are not fully developed. Whatever production of basic chemicals, like sulphuric acid or chloro-alkalies is there, is intended mainly for the captive use of plants for fertilizer manufacture or pulp and paper production or for mineral extraction. As the consuming industries are fast developing, the basic chemicals manufacture is also likely to grow with the increased demand for their consumption.

7. The total world imports of pesticides in the year 1975 were 2.1 billion US dollars. Out of this the developed countries imported pesticides worth US\$950 million, developing countries US\$813 million and countries with centrally planned economies US\$355 million. Total imports of African countries were US\$281 million and Asian countries US\$340 million. While the imports of Africa and Asia may vary nearly represent actual consumption, the figures for the developed world must be supplemented with internal production data to make them represent total consumption. The import figures for Africa and Asia for pesticides, again indicate great potential for development in this sub-sector.

8. Having examined the world position in respect of the three sub-sectors of chemical industry and also the African position, it is intended to briefly discuss here certain aspects of the development of chemical industry in developing countries such as the pre-requisites for its development, its characteristics, etc.

9. The necessary pre-requisites for the successful development of chemical industry in a developing country are an adequate sized market for the products of the industry which could sustain the minimum economic size chemical plants; availability of raw materials at an economic price; availability of infrastructural services such as electricity, water, effluent disposal facilities etc.; availability of trained and qualified manpower; and finance at reasonable terms.

10. The development of chemical industry initially takes a set pattern. To begin with the first generation industries come up to manufacture consumer products from imported intermediates. Next, the second generation industries develop to manufacture intermediates and then the third generation industries are set up to manufacture the basic chemical inputs.

11. Chemical industry has certain special characteristics of its own which are: high capital intensity, low labour intensity, complex technology calling for a high degree of professional operational skills, high sensitivity to economies of scale, high risk of process obsolescence, need for integrated product planning; need for economic selection of process routes out of several alternatives, high temperature and pressure processes calling for precise monitoring and control, high risk of process accidents calling for high priority for industrial plant safety practices etc. Therefore, while planning chemical industries, those characteristics of the industry must be kept in view.

12. While the details of the mission's findings and recommendations are contained in the individual country reports, a summary report on the countries visited is given in the general report.

13. Tanzania has practically covered the first stage of development of first generation chemical industries and is now entering the second stage developments. A fertilizer plant for manufacturing phosphate fertilizers and ammonium sulphate is already in operation in the country and plans are in hand for the establishment of a natural gas based ammonia plant to meet the country's nitrogenous fertilizer needs. In the field of basic chemicals, there is sulphuric acid manufacture for the captive use of the phosphate fertilizer plant and a small caustic soda/chlorine plant is also in production. Tanzania is also looking into the possibility of soda ash manufacture based on its Lake Natron deposit. In the field of pesticides, although there are several pesticide formulation plants in the country, the manufacture of basic active materials is not undertaken so far. The country has

undoubtedly potential for the further development of fertilizers, basic chemicals and pesticides sub-sectors. Trained and qualified national manpower is a serious problem in the country, and it would be well for the Government of Tanzania to pay attention to the development of this important resource.

14. Gabon's economy has mainly been supported on its oil resources in the past. However, the Government has lately been engaged in efforts to diversify the industry in order to broaden its economic base. In the areas of fertilizers an attempt made at setting up an export-oriented ammonia plant in the country had to be shelved half way because of drop in world ammonia prices. Of course, there is little domestic consumption of fertilizers, as agriculture is not very developed in the country. Gabon is planning to set up large-scale pulp plants, which would generate the demand for caustic soda and chlorine and this could justify setting up capacity for the manufacture of these basic chemicals. In the field of pesticides again, there is no manufacturing activity at present, but potential exists for setting up a formulation plant.

15. Gabon's efforts to broaden its economic base are certainly well directed. There is particularly need for encouraging agricultural production to meet the country's heavy food import bill. With the development of agriculture, the need for agricultural inputs like fertilizers and pesticides will also go up. Current planning for production in these sub-sectors could be based essentially on the subregional UDEAC market.

16. Cameroon's economy is mainly agriculture based; the country has already a phosphate fertilizer plant which is also capable of producing ammonium sulphate and mixed fertilizers. The plant is presently closed on account of certain financial problems, which it is expected would get sorted out with World Bank assistance. In the field of basic chemicals, the country has sulphuric acid manufacture for the captive use of the fertilizer plant. There is a sizable market for caustic soda but inadequate chlorine demand is the main constraint in developing local production of this chemical. As Cameroon imports yearly 4 million US dollars worth of pesticides, this is indicative of a potential for the establishment of a pesticides formulation plant in the country. The availability of trained manpower is not a serious constraint in development in Cameroon.

17. Nigeria has been passing through a buoyant phase of economic activity in the past, as a result of the oil boom. However, while the country has planned major investments in the directly productive sectors of industry, enough attention does not appear to have been paid to the development of infrastructures. As a consequence, serious bottlenecks and constraints have resulted due to the infrastructure problems, which are seriously affecting the productive sectors of industry. The country has one phosphate fertilizer plant and is planning to set up a large ammonia and urea plant. Except for sulphuric acid production for the captive use of the phosphate fertilizer plant, there is no other major production of basic chemicals in the country. There is however good potential for the development of caustic soda/chlorine to meet the requirements of three pulp and paper plants which Nigeria is planning to set up. In the field of pesticides, there is one formulation plant in the country at present. However, the total market for pesticides can justify more formulation plants as well as manufacture of basic active materials. The main area which needs the urgent attention of the government is that of strengthening of infrastructures in the country, without which investment in productive sectors will not be fruitful.

18. Upper Volta is mainly an agriculture based country, and is going through the development of first generation industries in the chemical field. The requirements of fertilizers, basic chemicals and pesticides in the country at present are very small and do not call for planning for local production. The country has recently started a project for mining and grinding of natural phosphate fertilizers and it is expected that this will help to improve agricultural production. The country has potential for the development of agricultural based chemical industries and also metallurgical industries in view of its agricultural and mineral resources, and studies to explore these potential areas are suggested with the help of an institute for industrial studies being set up by UNIDO in Upper Volta.

19. Egypt's level of development of chemical industry is quite impressive. Egypt is practically self-sufficient in its production of phosphate fertilizers, and meets part of its requirements of nitrogenous fertilizers from local production. After completion of two major nitrogenous fertilizer plants, which are under construction at present, the country hopes to achieve self-sufficiency in respect of nitrogenous fertilizers too. In the area of basic chemicals, the country produces, sulphuric acid, nitric acid, hydrochloric acid, caustic soda, chloride, soda ash etc. However existing manufacturing capacity can meet only part of the market needs and the rest has to be met by imports. Presently, expansion of capacity for each of the chemical mentioned above is planned. Egypt has a very large market for pesticides (about US\$60 million) although there is only one formulation plant which supplies a small percentage of the large demand from local production. There is definitely a potential for the development of both formulation as well as active material manufacture in the field of pesticides.

20. In view of the fairly good level of development of chemical industry in Egypt, it is suggested that the country goes in for the establishment of design engineering and construction services for the chemical industry, and also manufacture of process equipment to meet the growing needs of the chemical sector.

Development problems in Africa

21. During the missions tour of African countries, several typical problems of industry were either reported or came to the attention of the mission. These are summarized below with suggested solutions.

22. Inadequate size of the domestic market to support an economic size chemical plant is a problem common to all smaller African countries. The only solution of the problem is subregional integration of markets and setting up of economic sized chemical and fertilizer plants with financial participation of member countries, to meet subregional market requirements. This approach must be adopted with the fullest support of all the member States.

23. Lack of experience in project planning and contract negotiation is another area of difficulty in most African countries, and accounts for serious problems which have arisen in some industrial projects in Africa. As a solution, it is suggested that ECA/UNIDO organize seminars and workshops on 'Technology Transfer and Contract Negotiation' in different African subregions to disseminate information on this specialized field. In addition, the inclusion of a technology transfer division in the proposed fertilizer and pesticides development centre is suggested for providing technical assistance to African countries. Till these facilities become available,

it is recommended that African countries associate experienced U.N. experts with their project planning and contract negotiating teams for various chemical projects.

24. Exploitation by unscrupulous foreign companies, who have taken undue advantage of the prevailing situation in African countries, to sell used plant/equipment which eventually does not operate, or enter into contracts which are never fulfilled, has created difficulties in a number of countries. African countries are generally advised to be on their guard against unscrupulous organizations and it is recommended that they deal with only reputable organizations.

25. Exploitation by unscrupulous Banks and foreign financing institutions is another one of the problems reported to the mission. This involved extension of foreign credit to African countries at highly unfavourable terms and conditions. It is suggested that African countries first approach financing institutions in the World Bank Group for financing their projects and only if their financial requirements are not fully met by them, then go to private investment sources. They should also take the expert advice of ECA/UNIDO/WORLD BANK before finalizing financial credit agreements.

26. Instances of lack of co-operation between national fertilizer plant managements and government purchasing agencies, were also reported to the mission, which involved either long delays or refusal of purchasing agencies (usually government agricultural departments) to purchase finished fertilizer stocks from national factories, eventually forcing either a slow down or stoppage of plant operations. In the greater interests of the countries, it is suggested that both the producers and purchasers of fertilizers should co-operate very closely in order to avoid problems for both.

27. Instances of lack of proper communications and exchange of information between government organizations was also noticed in certain countries. These obviously call for better contacts and information exchange at different levels.

28. Lack of operation and maintenance experience of chemical plants, seems to be one of the factors responsible for frequent plant breakdowns and loss of production in a number of fertilizer plants in African countries. The solution of course is, training of plant personnel, and setting up of preventive maintenance systems in the plants. For process problems, establishment of process development departments in the factories should be arranged.

29. High cost of expatriate technical/management personnel seemed to be the cause of serious financial problems in some of the plants. The suggested remedy lies in engaging expatriate personnel only for short periods and replacing them quickly with suitably trained nationals.

30. Inadequately developed infrastructures seemed to be the basic cause of low capacity utilization and overall loss of efficiency in industrial and commercial operations in a country. This points to the need for balanced sectoral development in countries, in order to prevent bottlenecks, which might make productive sector investments unfruitful.

31. The management pattern of national companies, where the governments did not have a controlling interest, seemed to cause problems in some of the countries. It is therefore recommended that governments should normally acquire the controlling financial interest in national enterprises and should also actively participate in the management of the ventures.

32. Inappropriate import duty structures were found to be responsible for discouraging local manufacture and encouraging imports in certain countries. African countries are advised to periodically check the tax and duty structures to ensure that they are in line with development policies.

33. Non-availability of national qualified manpower seemed to be a typical problem in most African countries. This could act as a serious constraint in their future development programmes. African countries should pay special attention to this problem and develop a cadre of national manpower, suitably qualified and trained in important technical fields.

Planning and development strategy

34. As a result of the experiences of other developing countries, a planning and development strategy with emphasis on the implementational phase of development projects has evolved.

35. This development strategy calls for a well organized institutional framework for planning and implementing development projects. The institutional framework normally consists of organizations like, the economic planning bodies, industrial studies institutes, industrial promotion organizations, designs, engineering and construction organizations, project executing and operating organizations and project monitoring organizations.

36. The functional role of economic planning bodies is to formulate development programmes, the industrial study institutes to undertake identification and feasibility evaluation of projects, for industrial promotion organizations (Industrial Development Corporations) to organize implementation of projects through project planning and contract supervision, for design and engineering institutes to do actual design, engineering, procurement and construction of projects, for project executing and operating organizations to execute the projects and operate chemical plants, and for the monitoring bodies to monitor government projects and report on them to the highest levels of the government.

37. The present development machinery and strategy in African countries, suffers from two main weaknesses which are (i) lack of a well organized institutional framework consisting of institutions as defined above for handling development function and (ii) lack of expertise in respect of activities involved in development planning and specially implementation of projects. It is therefore recommended by the mission that African countries develop the necessary development institutional facilities and also expertise in this field by counterparting their engineering and qualified nationals with U.N. experts and also arranging their direct involvement in national chemical projects alongside expatriate contractor personnel.

38. Another important area in which there is great need for expertise and knowledge in African countries is that of 'Technology transfer and contract negotiations.' Technology transfer has its technicalities such as exclusiveness/non-exclusiveness of technology use, process and engineering guarantees, process patents etc. which call for full familiarity with those matters, and similarly several different types of design-engineering project contracts - turn-key lumpsum, cost reimburseable, semi-turn-key, supply of know-how and engineering - involving also their legal aspects, are currently in practice. A proper knowledge of this specialized field is

very necessary for countries in Africa to enable them to safeguard their interests and purchase technology and technical services on reasonable terms and conditions. For the development of expertise in this area, it is recommended that ECA/UNIDO organize seminars and workshops on Technology Transfer and contract negotiation in the African subregion. It is also suggested that African countries make use of the model forms of contract agreements for construction of fertilizer plants, which UNIDO is presently developing, as guidelines in negotiating and finalizing their project contracts. Further, till such time as expertise is developed in this field in the African region, countries are advised to associate experienced U.N. experts in their contract planning and negotiating teams for chemical projects.

39. The adoption of proper development policy for promoting industrial development is extremely important. Such policies usually include promotional incentives such as, tax-holidays, concessional finance, assistance in marketing, tariff protection against imports, export incentives, etc.

Regional co-operation and development

40. While the need for regional co-operation has been stressed by all international as well as regional organizations in Africa, and even the formation of subregional economic communities like UDEAC and ECOWAS has taken place, yet the real economic integration based on the real spirit of co-operation between member States has still to come.

41. In order to achieve this objective, co-operation must be organized at four different levels (i) the political level through OAU, (ii) the subregional level through organizations such as UDEAC and ECOWAS, (iii) the country level through member States and (iv) the United Nations level through U.N. agencies such as ECA, UNIDO and UNDP. Co-operation on a subregional basis must be stressed at all these levels and the organizations concerned must play their role with sincerity of purpose to bring about the success of the subregional economic communities in Africa.

42. In addition, there is imperative need for the development of an institutional framework for co-operation for different economic activities in the subregions, and the subregional secretariats must undertake this important activity. For instance, an institutional framework must be developed for joint industrial ventures, in which each member State can have its financial participation and also proportional representation at the management level of the enterprise. Similarly institutional mechanisms for co-operation for other economic activities should also be developed as precursors to the actual establishment of these organizations.

43. A number of industrial possibilities have been identified by the mission for regional development in the fields of fertilizers, basic chemicals and pesticides, and these are being listed below. It is recommended that detailed studies be undertaken on the identified projects and then based on the findings and recommendations of the studies, implementation action should be taken.

- (a) Ammonia project for East African countries;
- (b) Pesticides manufacturing project for East African countries;
- (c) Ammonia project for the UDEAC countries;
- (d) Caustic soda and chlorine project for the UDEAC countries;
- (e) Phosphate fertilizer project for the UDEAC countries;

- (f) Pesticides manufacturing project for the UDEAC countries;
- (g) Pesticides manufacturing project for the ECOWAS countries;
- (h) Fertilizer project for the ECOWAS countries; and
- (i) Design-Engineering and Project Construction Organization for North African countries.

44. In the context of the implementation of the projects identified above and even generally for co-operative development, African countries can undertake several industrial activities on a co-operative basis such as: joint marketing and distribution arrangements, standardization and quality control, joint acquisition of technology, bulk purchase of materials, joint exploitation of natural resources, joint development of infrastructural facilities, joint programmes for manpower development, etc.

45. To facilitate co-operation in the broad spectrum of activities identified, it is felt that besides contacts at the subregional secretariat level, African countries should have additional opportunities for contacts at:

- (a) Meetings of intergovernment experts;
- (b) Consultation meetings between governments; and
- (c) Meetings of plenipotentiaries.

46. Further, the development of regional and subregional institutes suggested below will also help in the integrated development of the areas:

- (a) Subregional industrial consultancy institutes;
- (b) Subregional executing agencies such as African Multinational Corporations;
- (c) Fertilizer and pesticides development centre; and
- (d) Chemical Technology Transfer Centre.

Role of ECA/UNIDO/OAU in implementation of the programme

47. The United Nations Organization will have to play a very active role in the development of the African region mainly through its principal agencies like ECA, UNIDO and UNDP. United Nations programmes will also have to be co-ordinated with OAU policies and programmes in Africa.

48. In order to provide expertise for the satisfactory development of fertilizer, basic chemicals and pesticide industries, the following regional institutes must be set up with ECA/UNIDO assistance:

- (a) Fertilizer and Pesticides Development Centre, and
- (b) Chemical Technology Transfer Centre.

49. In addition, it is recommended that national institutes for industrial studies be established in different African countries to explore and evaluate potential industries. They would need assistance from ECA/UNIDO for their establishment and further development.

50. During the missions tour of six African countries, several industrial possibilities have been identified in the fields of fertilizer, basic chemicals and pesticides. It is recommended that ECA/UNIDO provide expert assistance to conduct more detailed

studies on these national projects. In addition, for projects that have been identified by the mission for development at the subregional level as stated in paragraph 43 expert assistance is also recommended to be provided.

51. Besides providing technical expert assistance on projects in Africa, it is recommended that World Bank/UNIDO Division, at UNIDO Headquarters should provide part or whole financing of bankable projects in Africa. It should also provide guidance to African governments on matters such as the type of financial agreements to be entered into etc.

52. For the implementation of the technical assistance programmes at the national as well as subregional and regional levels during 1979-1983 in Africa, the estimated manpower requirements for ECA/UNIDO are: one Industrial Development Adviser (fertilizers, basic chemicals and pesticides) P.4/P.5 (60 m/m), Consultants for subregional programmes (66 m/m) and Consultants for country programmes (39 m/m).

PETROCHEMICALS

Conclusions

53. The petrochemical industry comprises the production and/or recovery of the primary or basic petrochemicals from petroleum feedstocks and natural gas, followed by the manufacture of intermediates which in turn undergo a series of successive conversions to end-products before they are made available to other consuming or processing industries which utilize them as inputs for many consumer and capital goods. In view of these linkages, its development is of great importance to African countries.

54. The main pre-requisites for the establishment and development of the petrochemicals industry are: existence and development of a market; availability of hydrocarbon raw materials (petroleum and/or natural gas); existence of a large-scale refining industry; availability of manpower; access to means of financing the high investments required; and the existence of a processing industry.

55. These pre-requisites exist, at present, in Algeria, Libya, Egypt and Nigeria as well as in South Africa. However, in the not too distant a future, some other African countries, namely, Morocco, Tunisia, Gabon, Congo, Zaire, Angola, Tanzania, and Kenya would also have equipped themselves with these pre-requisites in varying dimensions.

56. The distribution of petroleum and natural gas is uneven in the region, North and, to some extent, West Africa are better-endowed; the South is relatively poor and the East is the least-endowed. The producer countries of petroleum and/or natural gas in Africa are: Algeria, Libya, Tunisia, Egypt, Morocco, Nigeria, Gabon, Cameroon, Congo, Zaire and Angola. Tanzania and possibly Benin are expected to join the ranks of producer countries in the region.

57. The present and near future situation of petrochemical industry in Africa is summarized as follows:

Africa's demand (including South Africa) for the main basic petrochemicals (excluding ammonia) in 1985 compared with the World demand as estimated by UNIDO's International Centre for Industrial Studies (ICIS) is shown hereunder:

	(1000 Tons)			
	<u>Ethylene</u>	<u>Propylene</u>	<u>Butadiene</u>	<u>Benzene</u>
North Africa	661	245	97	296
West Africa	356	121	75	173
East Africa	300	87	70	121
Central Africa	181	51	23.6	56
South Africa	440	268	56.6	307
Total Africa	1,938	772	322.2	947
Total World	72,936	36,638	9,563.2	32,834

58. Of the above four basic petrochemicals, only ethylene is currently being produced by one African country, namely, Algeria. However, Libya is constructing an ethylene plant which will come on stream by 1981. Also, Nigeria and Egypt will have their ethylene plants by 1982 and 1984 respectively. Algeria is also constructing a 600,000 tons BTX unit which will probably be able to provide about 300,000 tons of benzene by 1982/83. In regard to propylene and butadiene there are, at the moment, no plans in African countries for the construction of production capacities for these basic petrochemicals.

59. Existing and planned production capacities of ethylene and benzene by 1985 in Africa compare with World production as follows:

	<u>Ethylene Capacity</u>	<u>Benzene Capacity</u>
	(1000 Tons)	
Africa	1400 <u>a/</u>	300 <u>a/</u>
World	85,800 <u>b/</u>	38,900 <u>b/</u>
African share	1.63%	0.77%

a/ Information obtained during the field mission and from international publications.

b/ UNIDO's ICIS estimates.

60. Accordingly, the share of Africa in World production of ethylene by 1985 will be approaching the target of 2% in the year 2000, where as those of benzene and the other main basic petrochemicals will be far below the target. Similarly, the existing and planned production capacities of plastics and other main end-product petrochemicals (synthetic fibres and rubbers) are as follows:

	Plastics Capacity	Synthetic Fibres Capacity	(1000 Tons) Synthetic Rubbers Capacity
Africa	669 _{a/}	89 _{a/}	
World	99,980 _{b/}	20,000 _{b/}	11,820
African share in World production	0.67%	0.45%	

a/ Information obtained during the field mission and from international publications.

b/ UNIDO's ICIS estimates.

61. From the above data, it is apparent that the African share in the World production of these end-product petrochemicals is far below the target. Consequently, the subregional demands for petrochemical were compared with the production capacities in 1985, and the subregional deficits/surpluses of basic and end-product petrochemicals were identified. Multinational or subregional production capacities were accordingly suggested (as outlined under recommendations of this Summary) to meet the subregional deficit in the different petrochemical products and also to bring Africa's share in world production closer to the Lima Declaration target of 2%.

62. Thus, assuming that the African subregions would implement the suggested new project capacities, the total African production capacities and percentage share in World production will be as follows:

	(Suggested) Africa's Production in 1985 (1000 Tons)	Per cent Share in World Production
(a) <u>Basic Petrochemicals</u>		
Ethylene	1,498	1.75%
Propylene	504	
Butadiene	266	
Benzene	640	1.65%
(b) <u>Plastics</u>	2,450	2.45%
(c) <u>Other End-product Petrochemicals</u>		
Synthetic fibres	542	2.71%
Synthetic rubber	355	3.00%
Synthetic detergents	540	

Recommendations

Programme of Action on the Integrated Development of the Petrochemical Industry Sub-sector at Multinational, Subregional and Regional Levels

63. The development of the petrochemical industry in Africa has, up to now, been characterized by an orientation to national policies and strategies without regard to multinational, subregional or regional planning. It is strongly recommended that African countries should adopt a policy of setting up multinational or subregional petrochemical industries by combining their markets as well as their capital, human and raw material resources. Even in the case of North African countries, where national petrochemical industry development have been undertaken without subregional or regional co-operation, the policy of setting up multinational or subregional industries should be adopted in respect of new petrochemical opportunities to be set up or planned in the future.

64. Based on economic interdependence, comparative advantages, specialization, complementarity and demand/supply of African subregions, the following programme of action on the integrated development of the petrochemical industry sub-sector is suggested for the period 1985-1990.

North Africa

(a) Basic Petrochemicals

- (i) Two united of 100,000 and 150,000 tons/annum of propylene costing about 180 and 270 million dollars respectively, and
- (ii) Two units each of 50,000 tons/annum of butadiene, each costing about 75 million dollars.

(b) Plastics

Additional production capacity of about 700,000 tons to be produced by setting up plants in more than one country of the subregion. It is not possible at this stage to estimate the capacities of the different types of plastics or resins which would come under this total of 700,000 tons. This would require a market survey of North African countries as well as of export opportunities.

(c) Other End-product Petrochemicals

- (i) A 220,000 tons/annum synthetic fibres to be produced in four plants;
- (ii) A 130,000 tons/annum synthetic rubbers to be produced in two plants of about 65,000 tons each; and
- (iii) A 290,000 tons/annum synthetic detergents to be produced in several units.

As in the case of plastics, it is not possible, at this stage, to attempt a breakdown of the above capacities by type and quantity before a market survey of the countries of the subregion is made.

West and Central Africa

(a) Basic Petrochemicals

- (i) A 180,000 tons/annum ethylene unit costing about 530 million dollars;^{1/}
- (ii) A 170,000 tons/annum propylene unit costing about 320 million dollars;^{2/}
- (iii) A 100,000 tons/annum butadiene unit at a cost of about 160 million dollars; and
- (iv) A BTX unit capable of producing 230,000 tons of benzene costing about 110 million dollars.

(b) Plastics

- (i) Additional 300,000 tons/annum of plastics to be produced in different units in West African countries; and
- (ii) Additional 250,000 tons/annum of plastics to be produced in Central African countries. Market surveys should be carried out to identify the type and quantity of the plastics required in both subregions.

(c) Other End-product Petrochemicals

- (i) Two units of combined capacity of 135,000 tons/annum of synthetic fibres in West Africa;
- (ii) A 30,000 tons/annum synthetic fibres unit in Central Africa;
- (iii) One unit of 130,000 tons/annum or, two units of 65,000 tons/annum each of synthetic rubbers in West Africa to serve the markets of both subregions;
- (iv) Combined capacity of 110,000 tons/annum detergents to be produced in more than one unit in West Africa; and
- (v) Combined capacity of 50,000 tons/annum detergents to be produced in more than one unit in Central Africa.

East Africa

(a) Basic Petrochemicals

- (i) A 300,000 tons/annum ethylene unit based on naphtha from refineries in the subregion at an estimated cost of about 830 million dollars.^{3/}
- (ii) A 90,000 tons/annum propylene unit at an estimated cost of about 170 million dollars.^{4/}

^{1/} This investment includes downstream ethylene consuming plant which normally forms part of a petrochemical complex.

^{2/} This investment includes downstream propylene consuming plant which normally forms part of a petrochemical complex.

^{3/} Ibid. see footnote ^{1/}.

^{4/} Ibid. see footnote ^{2/}.

- (iii) A 70,000 tons/annum butadiene unit at a cost of about 110 million dollars.
- (iv) A BTX unit capable of producing 120,000 tons/annum of benzene (possibly incorporated to one of the large refineries in the subregion) and costing about 90 million dollars.

(b) Plastics

A 480,000 tons/annum plastics to be produced in more than one plant. The different quantities and types of plastics to be produced could only be estimated after a market survey of the countries of the subregion is carried out.

(c) Other End-product Petrochemicals

- (i) A 75,000 tons/annum synthetic fibres capacity to be produced in more than one unit;
- (ii) A 95,000 tons/annum synthetic rubber plant or two of 45,000-50,000 tons/annum each; and
- (iii) A combined capacity of 90,000 tons/annum synthetic detergents to be produced in more than one unit. A market survey will also be needed to determine the different types and quantities of detergents required.

Organizational structure and institutional mechanisms required to follow-up and implement the programme

65. Apart from exchange of information on transfer of technology, and exchange of experts and trainees among member countries at the subregional and regional levels, the following organizational structure and intergovernmental institutional mechanisms are recommended:

- (a) Periodic regional and subregional meetings of planning, finance and technology experts from member countries and ECA, OAU, UNIDO and advisory consultants.

The objectives of these meetings would be: to study specific aspects of the petrochemical industry; to harmonize investment, fiscal, custom and other policies of African governments; and to carry out the necessary preparations and mobilize the financing of petrochemical projects.

- (b) National committees for the development of the petrochemical industry in each country with pre-requisites for the development of the industry. The committees should be composed of planning, finance and technology experts as well as others (legal etc.). The main objectives of the committees would be to carry out the preparatory work for the regional and subregional periodic meetings; and to take the necessary follow-up actions or measures at the national level as a result of decisions taken at the regional or subregional meetings.

- (c) Centres for the development of the petrochemical industry at the subregional level, especially one for West and Central Africa and another for East Africa. These centres should be staffed by a group of highly qualified local and international experts and equipped with equipment for research, pilot plants and training facilities. The centres could assist in the following: collection, analysis and dissemination of information; elaboration of short-term and long-term programmes at the regional and subregional levels; preparation of trends of petrochemicals consumption in member countries; preparation of market studies; preparation of feasibility and pre-investment studies; carrying out research related to most recent development in petrochemical industry; standardization of processes, equipment and products as well as quality control; and manpower training and development.

Role of ECA/OAU/UNIDO in the implementation of the programme

66. Assistance for the implementation of programmes in the six countries visited will require 17 consultants/experts and 64 man/months during the period 1979-1981. The corresponding figures for subregional projects are six consultants and 78 man/months. In addition, one senior chemical engineer or industrial chemist will be required from 1979 through 1983 at ECA headquarters to co-ordinate and follow-up the assistance to be provided to African countries and subregions in the implementation of the programmes.

PHARMACEUTICALS

Conclusions

67. The pharmaceutical industry is one of the sub-sectors crucial to the development of African countries. Although, it is not by itself the solution to all the health problems, yet medicines form a major and essential component in the health care and the improvement of standard of living. It is also one of the most promising areas for industrialization, particularly in the small-scale sector and with initial modest capital. The investment costs are not only relatively low but can be quickly recovered with potential for multiplier effect on investment. Even countries with low per capita GNP are therefore in a position to establish the preliminary production units in this field without any serious problem. An indigenous pharmaceutical industry may also facilitate the formulation of health-care policies that are relevant and suitable to the needs of African countries.

68. While health conditions in Africa have greatly improved in recent times, their inadequacy still poses major concern. Life expectancy is much lower and infant mortality much higher than in other developing regions. Many African countries having the lowest per capita income in the world have also the lowest level of health.

69. The most widespread diseases in African countries are those transmitted by human feces. The most common are the intestinal parasitic and infectious diarrheal diseases. The second major disease group consists of air-borne diseases: tuberculosis, pneumonia, diphtheria, bronchitis, whooping cough, meningitis, influenza, measles

and chicken pox. The most widespread of vector-borne diseases are malaria, trypanosomiasis (sleeping sickness), schistosomiasis (bilharzia) and onchocerciasis (river blindness).

70. Poverty, malnutrition, and unsanitary and congested living conditions are at the root of the health problems in most African countries.

71. Actually, 70-80 per cent of the population in Africa does not have access to such base health care services as: protective immunization, assistance to mothers during pregnancy and child birth, pre-natal and post-natal and infant care, safe water supplies, adequate sanitation, health and nutrition education, first and emergency aid while there is great similarity in health conditions in different countries, there are differences between conditions in urban and rural areas. Mortality rates are much higher in the rural areas.

72. Pharmaceutical products play an important role in protecting, maintaining and restoring the health of people. Systematic vaccinations have eradicated, in some African countries, small-pox and also reduced the incidence of cholera and tuberculosis. The use of chloroquin has helped to prevent or combat malaria, and antibiotics have helped to cure infectious diseases. Health campaigns, with progressive augmentation of health services generate a spurt in demand for pharmaceuticals in an environment of growing population.

73. Generally, the pharmaceutical industry in Africa is in an infant stage. While, a few countries have relatively advanced formulation-facilities. Some others have started preliminary manufacture of pharmaceuticals, but almost all of them are importing the bulk pharmaceuticals, ancilliary materials, and even the packing materials. The manufacture of basic bulk pharmaceuticals is not yet undertaken in most African countries, with the exception of Egypt (which produces salicylates and sulphamides).

74. Nor at the present time, has any African country the facilities to manufacture the most commonly used bulk antibiotics: penicillin, streptomycin and tetracycline. Consumption of pharmaceuticals in Africa is also low. In 1975/76 it was only 1.75 per cent of the world consumption, whereas the share of Africa in world population was 9.5 per cent. Of the total consumption of pharmaceuticals (700 million US dollars in 1975/76) more than 70 per cent was imported as medicines in ready to use form, the balance being local formulations from imported bulk materials. In the six African countries visited by the mission, only Egypt was found to be able to cover about 90 per cent of its internal demand from indigenous manufacture or formulations. The share of locally produced pharmaceuticals in Nigeria and Tanzania was about 10 per cent only. In Gabon, Cameroon and Upper Volta 100 per cent of the demand was met by import.

75. The per capita consumption of pharmaceuticals in US dollars in 1977 was, 0.50 in Upper Volta, 1.81 in Tanzania, 2.57 in Cameroon, 3.14 in Nigeria and 10.00 in Gabon. The average per capita consumption in Africa was 1.86 US dollars, and without North African countries 1.21 US dollars, whereas the world per capita consumption was 10 US dollars, and in Western Europe and North America 35 US dollars. The per capita consumption in most African countries is far beyond the minimum level of 12 US dollars, as determined in "Summary of the draft world-wide study of the pharmaceutical industry".^{5/}

76. The situation regarding procurement, supply and provision of medicines to the patents, is presently very inadequate in most African countries. The list of essential drugs, as recommended by WHO and UNID have, so far, not been introduced. In the market, especially in pharmacies there is proliferation of such medicines as are therapeutic equivalents differing only in brand names and prices. The exporting companies, mainly multinationals, have been promoting, in African countries, the same marketing practices as in industrialized countries resulting in the doctors being persuaded or being inclined to prescribe advertised products. It is quite likely that the importing countries are paying more for pharmaceuticals than necessary and are misled into incurring unjustified expenditure. In most countries, the pharmaceutical products are imported simultaneously through public and private channels, involving unnecessarily double expenditure.

77. In some African countries, the patients can obtain needed medicines from irregular sources. Such sources include mobile chemists shops in lorries, boats, baskets and sacks. All of them are supplied from products smuggled from one country to another or are pilfered from the public distribution system. In some cases, there is also the danger of supply of unauthorized or spurious medicines.

78. The administrative supervision on the part of Ministry of Health is usually inadequate. The pharmaceutical administration in most African countries is weak and without necessary means to control and coordinate all the functions of procurement, import and supply of pharmaceuticals.

79. At the present time, no single country in Africa has production of broad range of bulk pharmaceuticals. Only one country (Egypt) has a preliminary and limited production of bulk pharmaceuticals and some ancillary products although it has rather well developed formulations industry, along with five other African countries (Algeria, Ghana, Kenya, Morocco and Tunisia).

80. Only 10 other countries in Africa have preliminary formulations plants (e.g. Angola, Ethiopia, Madagascar, Mali, Nigeria, Senegal, Sudan, Tanzania, Zaire and Zambia). However, most African countries (at least 25 of them) have no pharmaceutical production at all.

81. At the same time, all African countries, despite their low per capita income are attaching relatively high priority to pharmaceutical supplies. Among all the imported chemicals, pharmaceutical products occupy the first place, ahead of fertilizers or plastics.

82. This is the reason that some of the countries are planning the establishment of pharmaceutical industry singly or in co-operation with their neighbours. Actually the most progressive organization in respect of subregional co-operation in pharmaceuticals seems to be the Arab Company for Drug Industries and Medical Appliances (ACDIMA) in Cairo, established in 1975, with the partnership of thirteen Arab States, including four African countries (Egypt, Sudan, Libya and Tunisia). ACDIMA has a capital of about 210 million US dollars, and plans to establish and develop the production of essential bulk pharmaceuticals, a wide range of formulations and ancillary and packing materials. Some of the projects under consideration (antibiotics, hard gelatine capsules, neutral glass for injections and processing of animal by-products) would be established in North African Arab countries.

83. The UDEAC 6/ countries have also decided in 1975 to establish joint pharmaceutical manufacture, in Central African Empire. A UDEAC Pharmaceutical Centre has also been envisaged for carrying out activities of marketing and purchasing, production and quality control, research, development and training for this industry. Practical steps are yet to be taken to implement this project.

84. In 1978 joint action of UNIDO and CEAO 7/ was agreed upon for the establishment of a pharmaceutical production unit and training centre for the CEAO countries. The project, with financial contributions of UNIDO and Belgian Government is expected to be implemented by the end of 1979.

85. There are also individual efforts on the part of some African countries to set up pharmaceutical projects. In Algeria, a new fermentation unit for the manufacture of antibiotics is under construction. In Tanzania, a new pharmaceutical factory would start production early in 1979. Several pharmaceutical proposals have been submitted to the Comoros government.

86. The necessity to establish pharmaceutical industries on the subregional and higher levels has induced the Non-Aligned Countries (Colombo Summit, 1976) to form an inter-disciplinary team with the Guyana Government as the executing agency. The regional and interregional co-operation among developing countries should be institutionalized through the creation of regional co-operative pharmaceutical production and technology centres (COPTECs). The report of the Task Force (after visit of five African countries: Algeria, Chad, Egypt, Ethiopia and Tanzania) would be prepared in October 1979.

87. In 1978 a Swedish consultancy firm "Consultants for Trade and Industry" has been appointed by the African Development Bank in co-operation with WHO to carry out a study and identify specific pharmaceutical projects possibilities which might be financed by the ADB. The report of the consultancy firm whose representatives have already visited Congo, Mozambique, Ghana, Togo, Tunisia and Sudan is expected to be available by the middle of 1979.

88. In most African countries, the majority of population depends upon traditional system of medicine, where the medicinal plants and traditional healers are playing an important role.

89. Several African countries have potential resources of medicinal plants. Some of the countries have for a long time been exporters of crude medicinal plants (e.g. Cameroon) but they are now considering the establishment of their own processing units. In Cameroon, a proposal submitted by a foreign company, to process the Voacanga grains into Tabersomine chlorhydrate is under consideration. In Gabon, the establishment of a medicinal plant processing unit is being considered by the Institute of Traditional Medicine. In some African countries visited by the mission (Tanzania, Cameroon and Gabon) Research Centres have been established with the objective of a detailed evaluation of the natural resources and the integration of the traditional medicine with the modern system.

90. Various international organizations, especially UNIDO and WHO have intensified their efforts to assist African countries in the establishment of indigenous pharmaceutical production. The various development activities are listed in Appendix 5

6/ UDEAC = Union Douanière et Economique de l'Afrique Centrale

7/ CEAO = Communauté économique africaine de l'Ouest

and reveal the inputs in the form of missions, studies, publications, conferences, etc. made in recent years. These actions however, do not seem adequately co-ordinated and well-directed. Only few of them have a concrete, creative character. The role of ECA as a coordinator of industrialization policy for the African countries also seems to be muted and insufficient.

91. The major constraints in the establishment and development of the pharmaceutical industry in Africa are: inability to plan the development, difficulties in obtaining know-how and technical assistance, financial problems and staff shortages.

Recommendations

92. Taking into consideration the above constraints and the present stage of development of the industry, the following recommendations are made for further developments of pharmaceutical industry in African countries.

93. Following steps should be taken by individual countries according to their level of development of the pharmaceutical sub-sector:

(a) Countries with no manufacturing facilities (most countries):

- establish within 3-5 years the preliminary types of production units for repacking of bulk pharmaceuticals (e.g. imported bulk formulations), Intra-Venus fluids and galenic laboratories (inter alia processing of medicinal plants into mixture "medicinal tea", granulates, etc.);

(b) Countries which are already formulating a range of bulk pharmaceuticals or have large enough internal market for formulated pharmaceuticals, (e.g. Algeria, Ethiopia, Ghana, Ivory Coast, Kenya, Mali, Mauritania, Senegal, Sudan, Uganda, Tanzania, Zaire etc.):

- set up new facilities or expand the existing facilities to achieve, within 5-8 years, 80-90 per cent self-sufficiency in ready to use pharmaceutical products;

(c) Countries which have relatively developed formulation facilities (e.g. Ethiopia, Ghana, Kenya, Morocco, Nigeria, Tanzania, Zaire, etc.):

- start up, within the next 3-5 years, simple chemical processing with the objective of producing pharmaceutical products from imported crude products or advanced intermediates;

(d) Countries which have well established formulation manufacture and possess general pre-requisites in the form of manpower, capital, infrastructures, and related sectors of chemical industry (e.g. Algeria, Egypt, Ethiopia, Kenya, Nigeria, Zaire, etc.):

- establish, within 3-8 years, advanced chemical synthesis of essential bulk pharmaceuticals and antibiotics with high degree of backward integration (i.e. starting from basic chemicals and raw materials);

- (e) Countries which have natural resources in the form of medicinal plants (e.g. Algeria, Angola, Comeroon, Ethiopia, Gabon, Kenya, Mali, Mozambique, Madagascar, Morocco, Nigeria, Sudan, Uganda, Tanzania, Tunisia, Zaire, Zambia, etc.):
 - (i) set up units for extraction of active ingredients from medicinal plants which grow wild or are cultivated in the country;
 - (ii) set up units for processing of chemical conversion of extracted substances into intermediates or bulk pharmaceuticals; and
 - (iii) regulate accordingly the export of crude medicinal plants;
- (f) Countries where large quantities of animal resources are available (e.g. Angola, Cameroon, Egypt, Ethiopia, Nigeria, Sudan, Zaire, etc.) should set up centres to utilize slaughter-house animal by-products and waste products to produce active substances or materials (e.g. insulin, extractum hepatis, hormones, catgut, etc.).

94. Transfer of technology should be obtained through:

- (a) ECA/UNIDO technical assistance in the form of experts or technical advisers for planning, preparing or evaluating feasibility studies, for determining the development potential of existing facilities and in setting up and rationalization of various types of pharmaceuticals manufacture;
- (b) ECA/UNIDO assistance in preparing typical projects for intra-venus Fluids production, making possible the adaption of the project for the particular needs of each African country;
- (c) manufacturing under licence in co-operation with a) experienced pharmaceutical producers in relatively advanced industrial countries, b) leading pharmaceutical companies whose facilities could be used to train on production, technology and quality control personnel (Countries which are regularly spending considerable amounts of their foreign exchange for the imports of pharmaceuticals from leading companies, could utilize their position as purchasers to bargain for the know-how for formulation technology, quality control methods, the right to use trade name, training the personnel, free of charge); and
- (d) joint-ventures with foreign pharmaceutical companies or fully owned subsidiaries of foreign firms.

95. The adoption of any of these approaches depends upon various factors, e.g. the general development in the country, the selected type of pharmaceutical production required, the availability of competitive technology, etc. Countries with low per capita income and without industrial experience should benefit more from the assistance of UN organizations.

96. Countries with advanced chemical and pharmaceutical industry, and with available qualified technical personnel should set up groups or companies for engineering and design work, to reach certain degree of independence in transfer of technology. Such groups are recommendable in Egypt, Algeria and Nigeria, etc.

97. National list of essential drugs as recommended by the report of a WHO Expert Committee (Technical Report Series 615 WHO 1977) should be introduced. Priority for local manufacture should be accorded to products to be selected from such a list. Candidates for this purpose should include those:

- (a) combining as far as possible drugs of equivalent therapeutic action and substituting one medicine for a number of similar products;
- (b) that as a single active substance are capable of being effective for a wide range of disease conditions;
- (c) in maximum demand for severely debilitating or life-threatening conditions;
- (d) which guarantee basic treatment at low cost and easy issue and administration to the patient; and
- (e) specialities with the least complicated production processes and ease of storage preservation and optimum stability under tropical conditions.

98. The indispensable supervision over all aspects of pharmaceutical matters on the part of health authorities in each country should be strengthened by establishing an efficient system of quality control of local production and imported pharmaceuticals in the country. No product should be allowed to be imported or manufactured unless it is registered in the Ministry of Health.

99. The quality of pharmaceuticals should be controlled on the national level through a national quality control laboratory and its field inspectors, who should be authorized to take samples for control from manufactures, central stores, pharmacies, hospitals and dispensaries. To this end, all African countries should have pharmaceutical quality control services within the next five years. ECA/WHO should assist in the establishment of adequate national quality control laboratories in at least some African countries.

100. A Central Import and Procurement Company should be established so as to nationalize the system of procurement, supply and delivery of pharmaceuticals to the patients. This should replace existing duplications (e.g. parallel existing agencies for public, semi-public and private sectors) and eliminate the unauthorized sources of pharmaceutical distribution.

101. A pharmaceutical administration headed by the Chief Pharmacist of the Ministry of Health to supervise territorial health administration, pharmaceutical inspectors, etc. should be set up. In this connexion, although the Health Authorities play the leading role in all problems connected with pharmaceuticals, it is necessary that the promotion of pharmaceutical projects remains under continuous supervision and care of national planning and industrial authorities (e.g. Ministry of Economy, Ministry of Industry, etc.), ensuring the means and impetus for the development of pharmaceutical industry in each country.

102. The following recommendations are made in respect of qualified manpower problems:

- (a) Exploit fully all the possibilities for training, including those resulting from the existing co-operation with leading exporters of pharmaceuticals to the country;

- (b) include in all contracts for pharmaceutical installations or licences, a firm provision for the training of personnel on production technology, maintenance and quality control at the licensor's facilities;
- (c) utilize the possibilities offered by UNIDO in training of specialists for the pharmaceutical industry, e.g. those held at the University of Ghent, Belgium with the co-operation of Belgium Authorities; and
- (d) arrange that at Faculties of Pharmacy which exist in African countries emphasis is made on industrial aspects of pharmaceutical knowledge (e.g. processing technique, science of mechanics, maintenance technique, elements of design work, etc.).

103. International Organizations, especially ECA/UNIDO should intensify their assistance in implementing training programmes, through:

- (a) organization of Training Centres for individual subregions: Training facilities similar to the first training centre being organized jointly by UNIDO and CEAO should be established in East African subregion up to 1980; and
- (b) procurement of qualified lecturers for Training Centres for short term courses, faculties of pharmacy, and research institutes. At least 50 specialists should reinforce the training facilities in Africa within the next 3-5 years.

104. Following the experience of ACDIMA, it is recommended that two multinational African pharmaceutical companies be similarly organized: one for West Africa and one for East Africa, based on capital participation of individual countries. Although the pharmaceutical industry has humanitarian objectives it must be organized on economically sound lines. The pharmaceutical production cannot be treated as a source of profit for private groups or for the State, but it must obtain the necessary support through adequate price subsidy and credit and tax-policy to overcome the financial difficulties, inevitable especially during the gestation period.

CHAPTER II: FERTILIZERS, BASIC CHEMICALS AND PESTICIDES

A. WORLD SURVEY

Introduction

105. Chemicals as such, are perhaps older than mankind, because they existed in their natural state much before Adam and Eve ever set their foot on this glorious planet of ours. It is however only with the growth of civilization and more precisely the progress of the science of chemistry that man learnt about chemicals and how he could use them to make life easier, more comfortable and thus happier for himself. The story of development of fertilizers, pesticides and basic chemicals is no exception to this general process of evolution of chemicals. While basic chemicals like the mineral acids and alkalies were the forerunners of all other chemical products on account of their use and application in "alchemy" in the ancient times, but the use of chemical fertilizers and pesticides in agriculture is a development comparatively of recent historical origin. Early in the present century, there was hardly any application of chemical fertilizers and pesticides, because even without the application of chemical nutrients and protective chemicals, there was enough food production in the world to feed the comparatively smaller population. However, with the population growing in geometric progression, the production of food had to be stepped up with the help of additional nutritional aids over and above what mother earth was capable of providing.

106. Hence came in the fertilizers to provide the booster shot in the aim to agricultural production, and pesticides to protect it from disease and destruction by pests. Once introduced with success, the use of different fertilizers-nitrogenous phosphate and potash based - has been growing very rapidly and today it constitutes one of the biggest and most important chemical industries in the world.

Fertilizers, basic chemicals and pesticides

107. World production of fertilizers: The total world production of all fertilizers in the year 1975/76 in terms of nutrients ($N + P_2O_5 + K_2O$) was 92.2 million tons, out of which 47.6 million tons was produced in the developed parts of the world, 7.9 million tons in the developing world and 36.5 million tons in countries with centrally planned economics. The total world production of fertilizers from the year 1961/62 to 1975/76 and also regional production for the same period are shown in Table II.1

108. As would be seen from Table II.1, of the total world production of fertilizers, Africa produced 1.96%, Asia 14.13%, South America 1.22% and Oceania 1.10%. While Europe's production was 31.88%, North Central America's 27.53% and USSR's 22.26%. As against this production pattern, it would be interesting to consider the consumption pattern of different regions of the world.

Table II.1. World Production of all Fertilizers (N+P₂O₅+K₂O) in tons, 1961/62 to 1975/76

	1961/62 -1965/66	66/67	67/68	68/69	69/70	70/71	71/72	72/73	73/74	74/75	75/76	%
merica	40097445	54107878	58966250	62371715	66285041	71470033	76696486	81682794	87534302	91897177	92224876	100
a	518505	788545	898207	1006008	1175569	1272851	1559225	1761124	1671407	1793233	1770476	1.96
	11531525	16378078	18123011	18593613	20068954	20885344	21980531	22735812	25103479	25224510	25435900	27.53
	429242	389071	389071	400167	420893	498254	657559	733742	817400	13091579	1109972	1.22
	3775781	5522898	6296357	7104599	7799717	8555448	9579660	11053097	11658803	13091579	13003941	14.13
	13135805	22132843	22499128	25251459	25701182	27108038	28105228	29146058	30436916	31606993	29388047	31.89
	1042787	1208443	1296465	1284375	1293926	1161023	1279343	1502961	1787297	1227083	1004540	1.13
	4663300	7590000	8488000	9231000	9825000	11959000	13535000	14750000	16109000	17896000	20512000	22.26
	20844081	37458066	40325904	41775056	43129144	44718471	46405206	48426264	51743880	51990256	47689508	51.70
	9761576	14522884	16115690	17901478	19420958	22505840	25064925	27103889	29539339	32733810	36564464	39.66
	1491788	2126928	2524656	3195181	3734939	4245697	5226355	6152641	6301083	7173111	7970904	8.64

Source: FAO Annual Fertilizer Review, 1976

109. World consumption of fertilizers: The consumption of fertilizers in the world and also different regions of the world is shown in Table II.2,

Table II.2: World consumption of all fertilizers 1971/72-1975/76 in tons

Region	1971/72	1972/73	1973/74	1974/75	1975/76	1975/76 Percentage
World	71,964,406	76,911,391	83,571,377	80,890,362	88,680,971	100.00
Africa	1,827,042	2,014,117	2,076,822	2,162,744	2,406,811	3.05
N.C. America	17,804,050	18,652,036	20,192,864	18,908,699	22,913,238	22.91
South America	1,750,232	2,325,477	2,452,849	2,590,434	2,614,084	3.27
Asia	12,410,998	13,746,780	15,473,451	15,115,137	15,808,543	18.17
Europe	25,303,982	27,037,365	28,691,189	27,063,997	28,416,503	32.39
Oceania	1,456,102	1,679,616	2,124,202	1,369,351	1,234,792	1.69
USSR	10,412,000	11,456,000	12,500,000	13,580,000	16,187,000	18.52
Developed	38,693,663	40,449,266	43,359,229	38,928,593	41,831,884	47.17
Developing	9,729,545	11,104,685	12,041,974	12,169,094	13,118,563	14.78
Centrally Planned	23,541,198	25,357,440	28,170,174	29,792,675	33,730,524	38.05

Source: FAO Annual Fertilizer Review, 1976

110. From table II.2, it is obvious that while the consumption of fertilizers in the developed part of the world was 47.17 per cent, the centrally planned economies 38.05 per cent, the consumption in the developing countries was only 14.78 per cent and particularly in the African countries it was only 3.05 per cent of the total world consumption.

111. Again it is worth observing that while the developed countries produced 51.7 per cent of the fertilizers, they consumed only 47.17 per cent, and the rest was exported to the developing countries, which as against their production of 8.64 per cent consumed 14.78 per cent of the world production. The consumption of countries with centrally planned economies was 38.05 per cent against their production of 39.66 per cent. The data regarding the production and consumption of fertilizers percentage wise is shown in Table II.3.

Table II.3: Per cent consumption and production of all fertilizers in developed and developing countries of the world in 1975/76

Region	1975/76 Production (%)	1975/76 Consumption (%)
Developed countries	51.70	47.17
Developing countries	8.64	14.78
African countries	1.96	3.05
Countries with Centrally Planned Economies	39.66	38.05

112. While the data in Tables II.2 and II.3 indicate the relative overall consumption and production of fertilizers in different regions of the world, it would also be quite instructive to know the extent of use of fertilizers in different regions of the world. Therefore Table II.4 lists data indicating the extent to which fertilizers are applied to land and also their per capita consumption, in developed and developing countries. Detailed regional per capita consumptions are shown in Annex I of the report.

Table II.4: Comparative consumption of fertilizers in different region of the world 1975

Region	Total consumption of fertilizers in 100 gms.	
	Per HA of Agri.. land	Per capita
Developed countries	327	552
African countries	24	60
Developing countries	62	68
Centrally Planned Countries	290	262

113. It would be obvious from the consumption data of fertilizers stated above that the use and application of fertilizers is the lowest in the developing world. In Africa, although the per capita consumption of 6kg. compares favourably with the rest of the developing world at 6.8 kg. yet the per hectare use of fertilizers at 2.4 kg. is almost 2/5th of the average figure of 6.2 kg. per hectare for the rest of the developing world, and about 1/14th of the figures of developed countries.

114. This clearly leads to one conclusion, that while the developed countries of the world have almost reached the upper limit in their application and consumption of fertilizers, the developing countries have still considerable scope for increasing fertilizer inputs in agriculture to attain optimum level of food production. This again in terms of fertilizer production would mean that logically the major part of future development in fertilizer production should take place in developing countries, and out of the developing countries more so in Africa, to meet the future demand for fertilizer in these regions of the world. This possibility is further strengthened by the fact that African countries are very rich in mineral resources, like phosphate rock, natural gas and even potash minerals, which are the basic raw materials for the production of fertilizers. There are of course the infrastructural requirements for the development of fertilizers and other important inputs like trained manpower, which would need to be developed as prerequisites for the proper growth of this important chemical industry and these will be discussed in subsequent sections in this report.

115. Basic chemicals: Since basic chemicals mainly serve as an input in the production of other finished chemical products, and the consuming process industries are still in the developing stages in the African countries, therefore most requirements of basic chemicals have been imported so far. There is some production of basic chemicals like sulphuric acid and caustic soda - chlorine, but this again is for the captive use of phosphate fertilizer plants or pulp and paper plants, and the establishment of basic chemicals manufacture as an independent industry supplying an open market has still to take place in Africa. To give an idea about the present market in Africa for chemicals, the chemicals imports for different regions is shown in Table II.5

Table II.5: Total chemicals imports for different African regions in 1000 US dollars

Region	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
<u>North Africa</u>	287403	328703	349331	397456	481709	611438	107986	1536573	2466341	1806985
<u>West Africa</u>	186027	217816	280691	345690	322197	432477	62573	910385	1012234	1538841
<u>Central Africa</u>	100439	115065	138755	150506	175341	227385	286203	354284	365128	352730
<u>East Africa</u>	171820	192309	216790	246001	256238	322002	512223	539651	487958	558060
<u>Other Develop- ing Africa</u>	46083	46432	51604	61233	67153	87391	104224	110209	115276	7134445
<u>Developing Africa</u>	791772	890327	1037171	1200886	1302638	1680693	2608268	3451102	3446337	4391111
<u>South Africa</u>	217924	232409	273231	320956	397760	455458	896750	703548	629796	522810
<u>Total Africa</u>	1003078	1114502	1300932	1509752	1595406	2115179	3474995	4120157	4034764	4861991

Source: ECA Statistical Division

116. As would be observed from Table II.5, the total imports of chemicals in Africa has been increasing steadily and from a little over 1 billion U.S. dollars in 1968 reached 4.86 billion U.S. dollars in 1977 - which is almost a five-fold increase. With the stepping up of the general industrial activity in Africa, it is expected that the import curve will take a still sharper upward swing in the future, which would indicate among other chemicals, higher import for basic chemicals also.

117. **Pesticides:** In the year 1975 the countries of the world imported pesticides of the total value of 2.11 billion U.S. dollars. In 1970 the world imports were around 669 million U.S. dollars and this figure rising to three times its value by 1975, shows the tremendous increase in the use of pesticides in the world. The imports of pesticides in different regions of the world over the period 1970-1975 are shown in Table II.6.

Table II.6: World imports of pesticides 1970-75 in 1000 U.S. Dollars

Region	1970	1971	1972	1973	1974	1975
World	669,641	669,835	801,784	1,177,845	1,667,801	2,114,131
Africa	91,559	99,007	108,070	142,800	219,165	281,508
N.C. America	105,503	102,631	121,465	168,084	227,207	340,563
South America	43,505	45,989	73,523	117,097	150,511	146,557
Asia	116,574	120,375	114,515	174,343	263,371	340,494
Europe	252,712	270,569	320,654	488,416	498,675	834,316
Oceania	12,000	11,221	13,806	14,244	14,747	23,234
USSR	47,788	50,043	49,751	72,861	94,125	147,459
Developed	278,713	308,267	367,090	546,553	776,240	954,062
Developing	296,359	284,028	317,714	463,273	659,044	813,653
Centrally Planned	94,569	107,540	116,980	168,019	232,517	355,434

Source: FAO Trade Yearbook, 1976, Vol. 30.

118. While in case of developed countries the imports of pesticides may not precisely represent total consumption, as there would additionally be production of pesticides within the country too. However for the African countries on account for very small local production of pesticides, the imports by and large reflect the consumption of the region.

119. It would thus be observed from the data in Table II.6 that against the total world imports of pesticides of the value of 2.11 billion U.S. dollars, Africa imported 281 million U.S. dollars worth of pesticides. The share of the developing countries as a whole was 813 million U.S. dollars. On the basis of world imports, the respective share of the developing countries was 3.8 per cent and that of African countries, 1.3 per cent.

120. This again is indicative of the growth potential for pesticides manufacture in the African region, and gives the necessary infra-structural support promises a bright future for pesticides industry in this important region of the globe.

Prerequisites for the development of chemical industry

121. Having surveyed the world position in respect of fertilizers, basic chemicals and pesticides above, it is considered relevant now to discuss the prerequisites for the development of chemical industry in developing countries as well as the special characteristics of this industry, so that this information could be useful in formulating the strategy for the planning of chemical industry in new developing countries.

122. Markets: The first and foremost prerequisite for the growth and development of chemical industry (and for that matter any industry) is the existence of a market for its products, of a size which would justify production at the minimum economically profitable scale of operations. Particularly as the economic viability of chemical process plants is highly sensitive to the economies of scale, the present and potential size of the market is a matter of crucial significance in the planning of chemical industries.

123. Raw materials: Given a suitable size market for its products, the next important consideration is the availability of raw materials and their landed price at the site of operation, for the particular chemical industry. If the raw materials are to come from local mineral deposits, it is important to know the total extent of proved reserves, whether or not the mines are already developed and if they are, the price at which the raw materials are likely to be available at the mine head, and also at the plant site. The quality of raw materials and their suitability for the process is also to be considered. If on the other hand the mines are not developed, then the extra investment in the development of the mines along with the related transportation system to the plant site must be taken into consideration. For raw materials of imported origin, the landed price at the plant site and also the capacity of the transport infrastructures - port handling facilities, railway or truck transportation etc. must be taken into account.

124. Infrastructures: Next after raw materials, the availability of essential services like electricity, fresh water and cooling water, must be considered and also their costs at the plant site. Another important consideration for chemical plants is the facilities for effluent disposal, particularly, if the effluents are of a corrosive nature.

125. Transport and communications infrastructures are again extremely important as without their availability at reasonable cost neither the raw materials can come to the process plant nor the finished products can be transported to the markets. The availability of telecommunication services can hardly be stressed too much as they are so critical to the efficient operation of an enterprise.

126. Manpower: One of the most important prerequisites for the proper development and successful operation of chemical process industry is the availability of qualified and trained personnel for design-engineering, construction, operation and management of chemical industrial enterprises. Frequently, problems which arise in the successful operation of chemical plants, can be traced to the lack of proper training and experience of personnel in charge of the plants. Therefore the availability of properly trained and qualified personnel is absolutely essential for the proper development of chemical industry.

127. Finance: Availability of finance on reasonable terms, is of course a must for every industry. Usually financial requirements for plants in developing countries,

can be broken down into local currency needs and foreign currency requirements for the purchase of imported equipment and services. Both currencies must be available at reasonable rates of interest and also with adequate grace periods before commencement of repayment schedules from development banks, in order to ensure trouble free operation of enterprises.

Stages of development of chemical industry

128. The stages through which the development of chemical industry has to pass in a country, depends generally on the ultimate market for the products of the industry. In case the products are destined for an export market, then usually large scale chemical plants capable of being competitive in an international market have to be set up specifically to manufacture the product required by the export market.

129. However for domestic market based production, the development of chemical industry usually follows a certain set pattern which constitutes initially the development of first generation industries, which manufacture consumer products directly required by the domestic market using imported intermediates. Once the first generation industries are well established, then the second generation industries come into manufacture the intermediates required by the first generation industries, either by importing or locally obtaining primary raw materials.

130. Finally the third generation industries are set up in those cases where primary raw materials require chemical processing in order to make them suitable for the manufacture of intermediates. This is usually the pattern which chemical industries follow specially in developing countries, where the markets for the products, as well as the prerequisites and infrastructures for industry also have a gradual growth and development.

Characteristics of chemical industry

131. The chemical industry as distinct from other types of industries like mechanical and electrical engineering industries, is characterized by certain special features which are common to the chemical sector.

132. Generally speaking chemical industries are highly capital intensive, but on account of involving generally automatic processing operations have a comparatively lower labour intensity. Usually chemical plants involve high level complex technological operations, which call for a high degree of professional education, training and experience, on the part of management and operating personnel to successfully operate the complex chemical process at the required level of efficiency.

133. The economics of operation of the plants is generally quite sensitive to the economics of scale and the size of a plant is a very critical factor in determining its competitiveness in a particular market. In addition, rapid changes in process technologies often make chemical plants vulnerable to process obsolescence, which quite often calls for a much higher rate of amortization on process plants as against other industrial plants. Further, in planning chemical plants, it is essential to take up an integrated approach with regard to its products i.e. the products from one

plant must fit in as raw materials in another plant, otherwise operational problems arise both in respect of the disposal of products, as well as economics of operation. Quite often while planning manufacture of a specific product, several process routes and alternative raw material sources are possible to achieve the same end-product and a final decision regarding the ultimate process to be selected must be made on the basis of economics and other operating considerations.

134. Finally it must be mentioned, that chemical plant operations generally involve a risk element more than other types of industries, on account of processes frequently operating at high temperatures and pressures and also because of the use of corrosive chemicals in process streams. Therefore it is necessary to maintain a high degree of precise monitoring and control system in chemical plants to avoid any plant accidents, which can at times be very dangerous. On account of this risk again, the industrial safety practices in a chemical plant must be given a high priority, and so should the plant inspection and maintenance procedures to avoid any chances of equipment failures causing plant accidents.

B. SURVEY OF THE AFRICAN REGION

135. While the world position in respect of chemical fertilizers, basic chemicals and pesticide sub-sectors has been surveyed in the earlier chapter, it is now proposed to survey the position of these sub-sectors of chemical industry in the context of the situation in the African region. The consumption, production/imports of these sub-sectors in African countries is discussed below.

Fertilizers, basic chemicals and pesticides in the region

136. Fertilizers: As has been mentioned earlier, of the total world consumption of fertilizers in 1976/77 at 94,644,976 tons, Africa consumed 2,688,076 tons i.e. about 2.84 per cent. The consumption of fertilizers in different countries of the African region during the period 1961/62 to 1976/77 is shown in Table II.7.

Table 11.7: Total consumption of fertilizer (N + P₂O₅ + K₂O) in Tons for 1961/62 to 1976/77

	61/2-65/6	66/67	67/68	68/69	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77
WORLD	37890218	50985580	55008812	59490676	62954558	68142661	71965656	76980033	83587204	81090833	88905360	94644976
Africa	890700	1118710	1237061	1345978	1452833	1606292	1827042	2015717	2076822	2162117	2377091	2688076
Algeria	49710	51300	46340	49361	89400	112100	166200	191600	202448	160700	162400	192200
Angola	1620	4600	6100	7400	10500	11300	25000	22300	21400	15100	4100	2100
Benin	565	950	2495	2986	4540	5700	5300	5946	4376	4581	2414	2600
Botswana	1402	2120	2700	1500	1500	100	1030	170	190	1961	2400	2000
Burundi	100	100	100	100	254	555	788	806	581	950	747	500
Cameroon	5440	12000	13212	17209	14349	20255	14900	11861	16180	16654	12200	17400
Cape Verde									74	64	100F	160
Cent Afr												
Emp	439	1000	1300	1600	128	2223	2100	1813	1657	2930	1700	900
Chad	203	480	1122	1480	1764	1908	2232	2465	4772	8900	5900	5600
Congo	1290	2035	2187	4000	6324	7141	7600	7200	5706	4300	2300	3100
Egypt	279929	287867	280750	321072	347867	372103	372400	418697	404481	428600	501192	593800
Eq Guinea	890	1100	1800	1600	1600	1900	1200	1200	100	100	100	100
Ethiopia	1400	2700	3500	4700	5000	5300	5340	11008	16919	19144	31200	21100
Gabon								47	21	30	400	500
Gambia	81	552	457	304	220	293	400	850	917	1086	755	2500
Ghana	1450	1200	1319	1356	1198	3343	2885	4502	6642	9729	24500	20500
Guinea	2258	3500	3500	2500	2500	2000	2900	2800	1000	1828	1500	1300
Guin Bissau									100	453	300	200
Ivory Coast	9064	12500	13869	11704	13845	21196	23670	30696	29833	30872	37700	41000
Kenya	16502	30672	33300	32800	42100	49300	47100	53189	50862	52700	44494	53806
Lesotho	404	650	800	328	450	374	1072	632	898	802	1500	1300
Liberia	140	1400	1600	1200	1800	2300	1900	3734	3292	3300	4858	3887
Libya	4103	6780	9117	10293	8622	12460	17500	16600	14200	21900	35900	43400
Madagascar	3355	6250	7600	6481	12400	14400	12666	13529	8900	8658	5947	9200
Malawi	4470	5000F	6000	7000	7088	10999	15062	13343	16392	10630	15021	26131
Mali	325	1413	1569	2322	2400	5500	7200	7246	8817	7442	2200	11800
Mauritania		50	100	200	200	700			221	481	1150	500
Mauritius	23429	18893	22604	21769	21820	21996	21538	31958	26164	26914	24142	28800
Morocco	40288	57417	74400	93947	93030	87400	109729	114425	132200	148300	163000	184100
Mozambique	5010	5000	5141	5953	7293	6565	5547	15500	12700	6963	5700	11200
Niger	40	100	100	100	100	123	178	368	378	157	601	1118
Nigeria	2264	7330	7261	10100	10105	6894	9245	19553	15200	20900	54300	112300
Reunion	7977	14500	14519	14870	13700	12600	13300	11100	14100	11900	9400	11300
Rhodesia	55239	75200	84200	83000	94200	106700	133400	127900	153300	154500	152000	156000
Rwanda		50	50	50	213	200F	220		333	463	280	312
Senegal	9699	16105	21950	19158	7630	7915	13505	15684	15080	36100	44700	37200
Sierra Leone	244	502	850	1100	2287	2522	1600	1226	2797	3348	5100	1600
Somalia	800	1100	2000	2100	3500	2600	3600	3600	2800	2900	3640	
South Africa	295594	397900	464300	498900	500600	548700	606800	683000	685500	701212	755312	793147
Sudan	23103	29650	39800	42300	39607	33007	38203	53163	54838	60316	95100	105000
Swaziland	4182	5800	6500	4731	5370	6023	7275	6657	12744	9200	9400	9100
Tanzania	3821	8800	8700	9000	11000	15000	17400	16028	19937	31144	29670	29700
Togo		50	100	200	254	436	495	559	642	2142	2291	2837
Tunisia	19771	24322	22985	28776	38555	34100	37500	36000	39479	50263	52377	60548
Uganda	3293	5272	3770	4723	4570	7000	8100	7696	7187	3600	1689	1656
Upper Volta	83	100	100	200	456	572	884	1102	603	1200	1200	4800
Zaire	1031	2200	2700	3400	4000	4700	4700	4287	6600	6700	10713	12684
Zambia	9882	12200F	14800	19100	16409	36199	53298	41763	43451	62000	53500	63800

Source: FAO: Annual Fertilizer Review, 1977

137. As against the total consumption of fertilizers shown above African countries produced 1,858,578 tons of fertilizers in 1976/77, which constituted 1.89 per cent of the world production at 98,445,275 tons in that year. The total production of fertilizers in the African countries, during the period 1961/62 to 1976/77 is shown in Table II.8.

Table II.8: Total production of fertilizers ($N + \frac{P_2O_5}{2} + \frac{K_2O}{2}$) in Africa during the period 1961/62 to 1976/77

	61/62-65/66	66/67	67/68	68/69	69/70	70/71	71/72	72/73	73/74	74/75	75/76	76/77
WORLD	40097445	5107878	58966250	62870833	66285041	71470008	76689073	81682987	87546118	91837480	92047000	98445275
Africa	518505	786545	898207	1006008	1175569	1272851	1559225	1761124	1671407	1793233	1730163	1858578
Algeria	12059	14800	15200	17600	31000	38300*	55400*	88400*	124900*	140500*	95500*	93100*
Cameroon												2400*
Congo					67000*	123000	257820	284280	265440	285060	277140	266800
Egypt	156930	209830	198350	196650	177197	192640	193800	267317	131700	195200	227540	289685
Ivory Coast						1800	5503	10702	11381	13412	6000	8500*
Kenya	600	600*	600*									
Mauritius										1000*	3900*	6900*
Morocco	23982	104528	109100*	151571	130511	111900*	164399	166070	185250	159300*	131900*	116300*
Mozambique				120	108	778	2739	12200*	9100*	3900	3700*	6700
Nigeria											1000*	3700*
Rhodesia	14400	20000	25500	24500	51200*	68500*	96900*	96000*	111300*	109500*	110000*	100000*
Senegal			4240	10952	14063	21604	25650	30691	29168	28300*	28700*	30000*
South Africa	215687	287000	357100*	415800*	516200*	524500*	547500*	588000*	595000*	642200*	675000*	717000*
Tanzania								12000*	11968	18433	18309	14200*
Tunisia	92708	145385	182867	183565	183690	177805	195753	193564	187800	184828	145024	182413
Uganda	2139	4602	5250	5250	4600	5900*	5061	5000*	4100*	4000*	850*	4000
Zambia						6124	8700	6900*	4300*	7600*	5600*	7100*

Source: FAO: Annual Fertilizer Review, 1977

138. While the data in Table II.7 show the total consumption of fertilizers, the data regarding application of different types of fertilizers per unit of land as well as the per capita consumption of fertilizers in different African countries is shown in Annex II.B of the report.

139. Basic chemicals: While data in respect of the import of basic chemicals as a separate group is not available in statistical records, the import of all chemicals in different countries of Africa is shown in Annex II.C, which could give a fair indication of the requirements of the African region.

140. Pesticides: The imports of pesticides, and also their exports to neighbouring countries for the period 1970-1975 are shown in Annex II.D along with the total world figure for purposes of comparison.

Summary report on the fertilizer, basic chemicals and pesticides in the African countries visited

141. The chemical industry development programme mission visited six countries in Africa with the object of assessing the present level of development of the subsector's under its terms of reference, of understanding and analyzing their difficulties and constraints, and suggesting solutions to these difficulties, in order to ensure smooth operation of industries, as well as their satisfactory future growth and development. While individual country reports containing detailed findings and recommendations of the mission have been separately prepared, a summary report on the countries visited is reproduced below with the purpose that some of the missions recommendations may also be useful to other countries of the region whose problems may be similar to the countries included in the mission's visit.

142. A summary of the mission findings regarding the fertilizers, basic chemicals and pesticides subsectors are stated below:

TANZANIA

143. Considering the general level of development of chemical industry in Tanzania, the country has practically covered the first stage of development of setting up the first generation industries and is now gradually moving into the second stage developments. In addition it is also planning to set up large chemical plants (export-cum-domestic market oriented) for the manufacture of products such as ammonia and pulp and paper.

144. Fertilizers: In the field of chemical fertilizers, the country already has a 105,000 tons/year phosphate fertilizer plant, capable of manufacturing triple super phosphate, diammonium phosphate, ammonium sulphate and compound fertilizers, using imported phosphate rock and ammonia, and plans are under consideration for setting up a natural gas based ammonia plant for meeting domestic as well as export requirements of ammonia for fertilizer manufacture.

145. Basic chemicals: In the area of basic chemicals, comparatively less progress is noticeable, as apart from sulphuric acid manufacture for the captive use of the phosphate fertilizer plant, there is only one other small electrolytic caustic soda-chlorine plant having a 4-ton/day capacity, which is also not fully utilized, on account of the limited market for chlorine at the moment. There is a sizable market

in the country for caustic-soda of the order of about 6,000 tons/year, but as chlorine demand does not exceed 500 tons/year, it is acting as a serious constraint on the production of the plant, as for every ton of caustic-soda about one ton of co-product chlorine must be produced. This in fact points out to the need for integrated planning of the chemical industry sector, if full benefits are to be reaped of the investment in installed production capacities. If an outlet for chlorine does develop through PVC manufacture, regarding which there is serious thinking at the moment, there would be adequate justification for setting up additional caustic-chlorine capacity to the extent of 7,000 tons/year of Caustic-Soda. Besides, Caustic-Soda and chlorine, the country has potential for natural Soda Ash manufacture from its lake Natron bitterns, regarding which two exploratory missions from Japan have carried out investigations and submitted reports. However, in view of very large investments involved in the project, which essentially would have to come from external sources, no final decision about this project has so far been taken.;

146. Pesticides: In the field of agricultural pesticides, Tanzania has a well established formulation industry comprising of about six formulation factories, but no attempt at manufacture of basic active materials has so far been made, and all the active materials are imported in bulk. In view however of large value of current imports (about US\$18 million) there appears to be a good potential for the development of active pesticide materials in the country.

147. General comments: While generally the planning in respect of chemical industry seems to be well taken care of by the government and parastatal organizations, there is still a dearth of operational experience in the country specially in relation to chemical industry. Both in respect of management policies as well as actual plant operations, there is need for induction of more expertise specifically related to chemical industry, to solve some of the present problems and avoid similar difficulties arising in the future. Lack of communications at different levels, inadequate co-ordination between agencies concerned with the production and marketing in larger plants and inadequate working finance, seem to be the root causes of problems which apparently could be sorted out with the help of better communications and understanding.

148. Also, the paucity of technically trained and experienced manpower is another constraint with which the country is faced and it would be well for the government to pay special attention to this aspect of manpower development as the demands of industry are likely to grow quite fast in the future, and the country could not afford to depend indefinitely on expatriate expertise in this area.

GABON

149. Gabon imports a large proportion of its consumer products from outside, against exports from petroleum refineries which have been in operation for some years. Other first generation chemical industries are still in the process of development. On account of the oil boom since 1974, the country's economy has been mainly dependent upon income from oil, which has enabled the country to pay the large import bill for consumer products. However with the country's oil production levelling off around 10 to 11 million tons/year and also the international oil market situation becoming less optimistic, the government of Gabon has been giving serious thought towards diversifying industry and going into oil and gas based ammonia and other petrochemical plants.

150. Fertilizers: As the agricultural sector in Gabon is still not very developed, the current domestic demand for chemical fertilizers is very small and is being met by imports. The country had planned to set up a gas based ammonia plant of 60,000 tons/year capacity, but the project had to be abandoned half way, as its economic viability became doubtful in view of the decline of ammonia prices in world markets. However, it is felt that the size of the plant selected (200 tons/day) initially was rather too small for export purposes, as generally a plant size 600 tons/day and over can be expected to be competitive from the export angle. It is considered possible that a higher size plant based on the market of UDEAC countries may be successful in Gabon, and reconsideration of this project along the lines suggested, with ECA/UNIDO expert assistance has been recommended.

151. Basic Chemicals: In the area of basic chemicals again, except for a sulphuric acid plant which meets the captive requirements of a uranium extraction plant at Franceville, there is no production of basic chemicals. This is quite understandable, as the first generation industries requiring the consumption of basic chemicals are still not fully developed, and the small requirements of these chemicals for sundry market needs are being met by imports. As plans are currently underway in Gabon for the establishment of a pulp plant at Kango of 200 to 250 thousand tons/year capacity and this would require about 20,000/25,000 tons/year of Caustic Soda, this would open up the possibility of setting up electrolytic-caustic soda and chlorine industry in the country, the co-product chlorine from the plant being possibly used for the manufacture of PVC which is another important product in the field of petro-chemicals, which Gabon has the potential to develop. In view of the encouraging results recently reported by the geological section of Elf-Gabon regarding mineral sodium chloride salt deposits near Port Gentil, the potential for Electrolytic caustic-chlorine development assumes greater significance.

152. Pesticides: As mentioned earlier agriculture is not very much developed in Gabon so far, and therefore the requirements of pesticides is not very sizable at the moment. However, the Gabon's Ministry of Agriculture, which is making efforts to bring more and more land under cultivation, indicated plants to use about 142,000 litres of pesticides. If these requirements are to be actually met, they could justify local formulation in a small plant instead of direct imports of finished pesticides from abroad. Setting up formulation, even in a small plant, would constitute at least a beginning in the direction of pesticide manufacturing activity which could later be expanded to include manufacture of active ingredients also. It has therefore been suggested that the Government of Gabon with ECA/UNIDO expert assistance investigate this possibility and take steps to set up local formulation of pesticides.

153. General comments: Gabon's dependence on oil in the past has resulted in a pattern of economic development supported on a narrow base. The government of Gabon is quite aware of this weakness and is presently trying to diversify industry to broaden the economic base. This is of course a policy in the right direction and would require a balanced development of all sectors of the economy including the agricultural sector in particular. In respect of the development of the industrial sector and particularly the chemical industries subsector, there is need for more experience and expertise specially in the area of project contract negotiation and purchase of technology, as this knowledge could be useful in planning and negotiating contracts for the larger plants which the government is planning to set up. Till such time as this experience is developed within the country, the government would be well advised to take assistance in this area from the ECA/UNIDO technical assistance system.

154. In addition, there is need for industrial planning research and development institutes which could develop and promote resource based industries in the country. In this context the desire of the Gabon's Ministry of Scientific technology and research to obtain assistance from ECA/UNIDO for the further development of its research institution is whole heartedly supported.

155. Another future constraint to the development of industry, which is looming large in the distance, is the lack of developed manpower. It would be well for Gabon to pay attention to the development of human resources in the country, as this could pose a serious problem in its development plans at a later stage, unless something is done about it right from now.

CAMEROON

156. Cameroon's level of industrial development is almost similar to that of Tanzania, in as much as, the first generation industries are mostly developed and the country is gradually moving into the second stage developments along with certain major projects in the field of petroleum refining, pulp and paper etc.

157. Fertilizers: Cameroon already has a phosphate fertilizer plant having a rated production capacity of 85,000 tons/year and capable of manufacturing single super phosphate, ammonium sulphate and mixed fertilizers. The plant is managed and operated by SOCAMÉ a company with 49 per cent government holdings, 25.5 per cent private investment and 25.5 per cent holdings of Klockner Industrie Anlagen GmbH. The plant went into production in mid 1976 and operated until the end of 1977, when it had to be shut down due to various financial problems.

158. Basically the financial constraints resulting in the closure of the plant have arisen from an unreasonable loan agreement with a foreign Bank under which there was only a two year grace period before commencement of the repayment schedule. Again the cost of expatriate services at the plant added to the financial burden of the enterprise and as a result of these financial problems the plant had to be closed. As a solution it has been recommended by the mission that the Government of Cameroon obtain World Bank assistance in resolving the present financial crisis, and restart plant operations, as it would be a pity to keep the plant closed and keep on importing fertilizers from outside.

159. Another fact worth mentioning regarding the problems of this plant, is the fact that during the earlier operations, as the plant was not operating to capacity, the cost of production of fertilizers was higher than the cost of the imported product. This caused serious objections from the government's agricultural purchasing agencies. But things came to a head when the Ministry of Agriculture received a free gift of fertilizers from FAO, and refused to buy from the local fertilizer plant.

160. This incident holds out an important point for other countries of the region as similar situations can develop there too. First of all, as a matter of policy, governments must decide to purchase from nationally operated plants, if industry has to be supported, may be at a cost plus reasonable profit basis. Secondly, international UN bodies like FAO should in such situations prefer to give raw materials for fertilizer production to a plant rather than give finished fertilizers to the country and force the ultimate stoppages of an industrial venture. These problems are being highlighted, as they may serve to inform other countries of the region about such problems, and enable them to take suitable policy decisions and other measures to forestall them.

161. Basic chemicals: With the exception of a sulphuric acid plant for the captive use of fertilizer production, there is currently no other basic chemicals production in Camerron. The country has a sizable market for caustic soda on account of its current consumption in soap manufacture, (3,300 tons), projected requirements for pulp and paper (2,200 tons) and alumina production (8,400 tons). However, as a decision on alumina project has still to be taken, the requirements could well be placed around 5,500 tons per year for which a 7,000 tons/year capacity plant would be quite adequate. Part of the chlorine produced from the plant would be consumed in pulp bleaching and for the rest a market could be found in pesticides manufacture in the country.

162. Cameroon also has requirements for other chemicals like sodium carbonate, sodium bicarbonate, sodium sulphate etc., but at the present quantities required are too small for economical production, they have to be imported at least in the foreseeable future.

163. Pesticides: As the agricultural sector is quite developed in Cameroon, it has a sizable requirement of pesticides and 1975 imports were valued at above 4 million U.S. dollars. Currently there is very little local manufacturing or formulation activity in the country and most pesticides are imported as finished products.

164. In view of the growing markets for pesticides in the country, there is good scope for pesticides formulations industry, which could later be expanded to include manufacture of active materials also. It has therefore been recommended to the government of Cameroon that this area be further investigated with expert assistance from ECA/UNIDO.

165. General comments: Generally planning in respect for future development seems to be well taken care of in Cameroon. The problems which have arisen operationally about the fertilizer plant for instance, indicate the need for induction of more expert knowledge in the area of chemical plant financial agreements, negotiation of contracts and purchase of technology etc. From the stand point of trained human resources, the country is better placed than some other countries of the region and this does not appear to constitute a very serious constraint at least at the present time.

NIGERIA

166. As a result of the oil boom during 1974/76 Nigeria has been passing through a bouyant phase of economic activity, and based upon anticipated inflow of income from oil exports has planned several large projects in the field of petroleum refining, pulp and paper, nitrogenous fertilizers etc. These project activities along with the operational activities of existing first generation industries has apparently strained the existing infrastructure almost to its breaking point in the country. Considerable attention is now being paid to the development of port handling facilities, transportation development and other infrastructures vital to the successful operation of industry.

167. Fertilizers: Nigeria's consumption of all fertilizer nutrients in 1975/76 was about 53,000 tons and this figure according to current estimates is expected to increase to 181,000 tons by 1982.

168. Nigeria has at present, one phosphate fertilizer plant of about 100,000 tons/year capacity at Kaduna, but due to various reasons, such as transport of raw materials, power shortages, plant breakdown etc., the plant has been operating much below its rated capacity. The present problems of the plant are due principally to the infra-structural constraints, at present affecting almost every other activity in the country, and it is expected that as soon as the infrastructural problems have been sorted out, the plant will pick up on its production programme, and meet the phosphate fertilizer needs of the country.

169. In order to meet the nitrogenous fertilizer requirements of the country, Nigeria has under consideration plans to set up a 1500 tons/day ammonia plant at Alese/Elemo, about 28 kms. from Port Harcourt. The down stream products from the plant are expected to include 1500 tons/day of urea and 1000 tons/day of mixed fertilizers. Under a slightly different product slate Calcium Ammonium nitrate and nitric acid may also be produced. The government of Nigeria is presently negotiating for foreign technical and financial assistance for this project and currently discussions with a Japanese consortium are reported to be in progress. If these materialize, the project may be in operation by around 1981/82.

170. With the completion of this project, Nigeria would have the capacity to meet its requirements of nitrogenous fertilizers, and between this plant and the one at Kaduna for phosphate fertilizers would be self sufficient in respect of its fertilizer needs in respect of phosphate and nitrogenous fertilizers. The surplus from these plants is expected to be exported to the neighbouring countries.

171. Basic chemicals: In the basic chemicals subsector, presently there is only production of sulphuric acid in Kaduna to meet the captive requirements of the phosphate fertilizer plant.

172. Nigeria has a substantial demand for Caustic-Soda of over 31,000 tons/year mostly on account of its consumption in soap and textile industries. But as chlorine consumption has ranged around 500 tons/year, it has acted as a constraint on Electrolytic Caustic-chlorine production in the country.

173. However, as the country is planning to go in for as many as three large pulp and paper plants and these would provide an outlet for chlorine, there seems a sound case for a 100 tons/day (33,000 tons/year) Electrolytic Caustic-chlorine plant to be set up in the country to meet its present requirements of Caustic-Soda. The additional requirements for Caustic-Soda which would be generated by the pulp plants, would call for additional Caustic-chlorine capacity to be set up to the extent of 56,000 tons/year of Caustic-Soda. Planning for this additional capacity must be tied up with utilization of chlorine for petrochemicals and pesticides manufacture in the country and depending upon the extent to which chlorine can be absorbed in these products, additional caustic-chlorine capacity could be planned.

174. In addition to Caustic-chlorine, there would of course be production of hydrochloric acid which would meet the current market requirements in the country. The production of nitric acid would of course be dependent upon its demand, and also the product slate decided in respect of the ammonia plants currently being considered by the Government of Nigeria.

175. Pesticides: Nigeria currently consumes pesticides worth over 19 million U.S. dollars annually. There is only one formulation plant in the country operated by National Petroleum Company and most of the pesticides are imported as finished products. One of the anomalies in the import duty structure which encourages imports against local formulation is an additional 5 per cent duty on locally formulated products over and above a 10 per cent paid on all imported materials. This makes locally formulated products more expensive in comparison to finished product imports. In order to encourage local formulation and manufacture, it is suggested that a duty structure favourable to local production should be substituted.

176. In view of comparatively large consumption of pesticides in the country, there is good potential for more formulation units to be set up in Nigeria as also for manufacture of some of the active materials used for formulation. It has therefore been recommended that Nigeria looks closely into these possibilities with ECA/UNIDO expert assistance in this area.

177. General comments: The main problem with which the country appears to be struggling at the moment, is the inadequate development of infrastructures to meet the current needs of the productive sectors of economy. This situation, obviously points to the need for balanced sectoral development in an economy in any country to avoid bottlenecks which can otherwise cause operational problems in the productive sectors.

178. Port handling facilities, transport, communications, and essential services, seem to be the main constraints and bottlenecks even for the operating industry, not to speak of future projects. However, the government seems to be fully alive to the situation and efforts are going on to strengthen the infrastructures.

179. It must however be realised that full benefits of future investment in the productive sector of the country can only be reaped, if the supporting infrastructures are strong enough to allow productive industries to operate successfully. It is however, hoped that the country will overcome its present problems, and will be able to achieve its future ambitious development programme in the years to come.

UPPER VOLTA

180. In Upper Volta agriculture is the most important economic sector accounting for about 44.7 per cent of the GDP in 1977 and industry's comparative contribution has been 14.4 per cent in the same year. The country has comparatively a small industrial sector comprising of about 30 enterprises engaged in the processing of agricultural products like cotton, meat and other consumer product. The first generation industrial development is still in progress and future plans include establishment of industries such as a brewery, a tannery and a footwear factory.

181. Fertilizers: Although agriculture is the country's economy yet the current consumption of fertilizers in Upper Volta is very little and in 1975/76 the country's total fertilizer imports were about 300 tons. In view of this small requirement, it is rather premature to think of a fertilizer production plant in the country based only on domestic market needs.

182. Upper Volta is however trying the use of natural phosphate fertilizers in agriculture and with the help of bilateral assistance from West Germany a project is

already in operation to mine and grind natural phosphate rock, and distribute it to farmers at a nominal price. On account of soil acidity, it is expected that the soil will absorb the total phosphate content of 30 per cent P_2O_5 in about 3 years time, necessitating a once in three years application. The project is at an experimental stage, and actual results would be known in the future.

183. In view of the fairly large good quality phosphate rock deposits in the country, raw material wise Upper Volta is well placed to think of processed phosphate fertilizer industry, but lack of fuel resources and markets are major constraints. Possibilities of a regional project based on a larger regional market may warrant consideration, if the cost of other imported material and fuel inputs are within reasonable limits.

184. Basic chemicals: Since the first generation industries, which normally consume basic chemicals, are not well developed in Upper Volta, the consumption of basic chemicals is small and totalled under 1000 tons in 1976. It therefore seems too early for the country to plan any basic chemicals manufacture at the present time and the small quantities required for current consumption will continue to be imported.

185. Pesticides: In 1976, Upper Volta imported pesticides and fungicides worth 460.8 million CFAF (approx. US\$2 million). As at present there is no local formulation of pesticides, the entire requirement of these agricultural chemicals are met by finished product imports. However, in view of the sizable volume of these requirements, there appears to be good potential in the country for a formulations plant to be set up. It has therefore been recommended that the Government of Upper Volta look into this possibility with expert assistance from ECA/UNIDO.

186. General Comments: Upper Volta being an agricultural country, has potential for the development of agricultural based industries. In addition, the country has rich deposits of several mineral resources which indicates a potential for the development of metallurgical industries.

187. As these industrial sub-sectors did not fall within the terms of reference of the missions studies, therefore no detailed comments on these have been offered. However it is suggested that an industrial studies institute, which is currently being set up under a UNIDO project in the country, should undertake detailed feasibility studies in these potential areas, and based on these studies identify projects in agricultural and metallurgical sectors for future development.

188. The manpower development aspect also needs specific attention of the government as the future of industry is closely linked with the level of expertise and knowledge about industry in the country.

EGYPT

189. Out of the six countries visited by the mission, Egypt of course stands out in the forefront, as by far the most advanced as far as the level of industrial development is concerned. Egypt's total GDP in 1975 was 3505 million L.E., to which, after the contribution of agricultural sector at 28.9 per cent, the services sector at 20 per cent, industry's contribution stood at 16.2 per cent. Most of the first generation consumer product industries are already developed in Egypt and the country has also developed some of the second generation industries.

190. The level of operation and management of large chemical plants visited by the mission also appeared to be reasonably satisfactory.

191. Fertilizers: On account of the fact that Egypt has to produce its agricultural products, from comparatively limited area of land in the delta, it has to undertake intensive agriculture with high input of agricultural nutrients. Therefore the requirement of fertilizers is quite high and ranged around half a million tons of total nutrients in 1975/76. Out of this nitrogenous fertilizers accounts for 415,000 tons (N), Phosphate fertilizers 83,000 tons (P_2O_5) and potash based fertilizers 3,192 tons (K_2O). The country's overall requirement was met partly by domestic production and partly from imports, because although Egypt has a sizable phosphate fertilizer industry, the greater part of nitrogenous fertilizer capacity is still in the process of development. On account of this, the country met the requirements of nitrogenous fertilizers to the extent of 150,540 ^{8/} tons from local production while 221,000 tons were imported during 1975/76. Local production of phosphate fertilizers was 77,000 tons and only a nominal quantity of 1,500 tons was imported. Potash fertilizer imports were of the order of 5,328 tons during the same year ^{9/}.

192. Egypt has at present, 3 phosphate fertilizer plants in operation one each at Kafr-el-Zayat, Asuit and Abu Zaabal, also having programmes of further expansion of their capacities. In addition, for nitrogenous fertilizer production, operating plants include the ones at Aswan, Suez and Talka with some production at Helwan from by-product ammonia. Two major ammonia urea plants are under construction - one at Talka (No. 2) and one at Abu-kir- and are expected to go on stream early in 1979.

193. With the commissioning of these plants, Egypt will almost be self-sufficient with regard to its nitrogenous fertilizer needs. As in respect of phosphate fertilizers the country is already fully self-reliant, the only imports would be in respect of Potash fertilizers, for the manufacture of mixed nutrients.

194. The level of operation of the plants visited by the mission was generally satisfactory.

195. Basic Chemicals: As the first generation industries, which generate the demand for basic chemicals, are fairly developed in Egypt, there is a substantial demand for major basic chemicals like, sulphuric acid, caustic-soda, chlorine, hydro-chloric acid, Nitric acid, Soda Ash etc. The market requirements of these chemicals are met both from local production as well as imports, because although local production is quite sizable yet not always adequate to meet total market needs.

196. Sulphuric acid production is concentrated at the phosphate fertilizer plants which besides meeting their captive requirements also have some surplus capacities to produce for the domestic market. Similarly nitric acid is being produced as a by-product at the coking plant at Helwan and also at the ammonia fertilizer plants. There is an Electrolytic Caustic-Soda-Chlorine plant at Alexandria which meets partly the market requirements of these chemicals, also producing by-product hydrochloric acid. Alongside also is a Soda Ash plant at the same site manufacturing solvay process sodium carbonate and by-product chemical caustic.

197. Invariably all the plants have further programmes of expanding their capacities to meet the growing market requirements of basic chemicals.

198. Apart from some technical plant problems, there were no special difficulties observed in the plants visited by the mission i.e. difficulties arising out of lack of proper planning, development or management of these plants. In respect of certain

^{8/} FAO: Annual Fertilizer Review, 1976

^{9/} All figures are in terms of nutrients (N, P_2O_5 , K_2O)

plant problems referred to the mission such as, the requirement of a coal blending pilot plant, operational problems of a lime kiln, air pollution problems at the coking plant etc., suitable action for ECA/UNIDO expert assistance has been recommended by the mission.

199. Generally the planning and development of basic chemical sub-sector industries seemed to be quite satisfactory in Egypt and it is expected that with the implementation of its current expansion programmes the sub-sector will fully meet the requirements of the country for basic chemicals.

200. Pesticides: Egypt's annual requirements of pesticides are worth over 40 million L.E. (about US\$60 million). Most of these are met by imports of finished pesticide materials.

201. Egypt's only government owned plant for pesticide formulation located at Kafr-el-Zayat produces only a limited range of products valued at about 4 million L.E. However, this plant, if given necessary assistance in the area of development and extension of its products, could increase its contribution significantly in import substituting pesticides currently required and used in the country. Besides, with a pesticides market of this size, the country should seriously consider going into manufacture of active pesticide materials consumed in large tonnages in the country.

202. It has therefore been recommended by the mission that Egypt should look closer into the potentialities suggested for the development of this sub-sector with ECA/UNIDO expert assistance in this specialized field.

203. General Comments: As has been remarked earlier, Egypt's industrial activity, in respect of planning, implementation and operation of its productive sectors of industry, as well regarding its infrastructural development, appears to be quite satisfactory. The country has already attained an impressive level of development in the chemical industry sector and even the level of expertise at the development planning stage and also at the management and operation of plants seemed quite satisfactory.

204. Egypt is distinctly at a stage now, when it should seriously think of going into the design and engineering and project implementation phases of chemical plants, as it is still dependant upon outside expertise and assistance in these areas. It is timely for the country now to set up centralized institutional facilities for undertaking project engineering functions and provide these services to future chemical projects in the country. In addition another closely related area which needs to be developed is the manufacture of process equipment within the country. It is therefore recommended that the Government of Egypt specifically look into these possibilities in the context of the future development of the chemical industry, in order to make the country self reliant in expertise relating to all aspects of this important sector of the industry.

C. DEVELOPMENT PROBLEMS IN AFRICA

205. The mission's tour of six developing countries in Africa, which are at varying levels of industrial development of chemical industry, has highlighted certain problems which are being encountered generally by the African countries, and which are typical of the problems which generally developing countries pass through during the earlier stages of their development. However, as a result of the experiences of other developing countries of the world, who have already passed through similar problems, typical solutions have also emerged to such difficulties. It is therefore proposed to discuss here such problems, which were noticed during the missions tour of the six African countries and also suggest solutions to them, with the object that other countries of the region may benefit from this information, and it may enable them to take suitable advance measures to forestall similar difficulties.

206. Typical development problems in African countries: The following typical problems have generally been found in developing African countries, and these have been exercising varying degrees of constraints in either the planning/development or operation of chemical process plants in the region:

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|--|------------------------|
| (a) Markets too small for economical production units; | } Planning problems |
| (b) Lack of experience in project planning and contract negotiation; | |
| (c) Exploitation by unscrupulous foreign companies; | |
| (d) Exploitation by foreign banks supplying capital; | |
| (e) Lack of co-ordination between production management of plants and purchasing agencies; | } Operational problems |
| (f) Lack of communication between government agencies; | |
| (g) Lack of operational/maintenance experience of plants; | |
| (h) High cost of expatriate technical/management personnel. | |
| (i) Inadequately developed infrastructures; | } General problems |
| (j) Management pattern of Enterprises, with minority government holdings | |
| (k) In-appropriate import duty structures; | |
| (l) Non-availability of suitably qualified and trained national manpower | |

207. A detailed discussion of these problems and the suggested solutions is undertaken below:

208. Markets too small for economical production units: One of the most common problems which planners in smaller sized developing countries face, is the inadequacy of the domestic market for a particular product, which from other considerations like raw material resources may have a potential for development in the country. Chemical process plants generally are quite sensitive to economies of scale, and usually, depending upon the cost of different inputs, there is a minimum scale of operations below which a plant is not likely to prove profitable in financial terms. Quite a few projects in developing countries get bagged down at the feasibility evaluation stage, because the total market within the country is not large enough to justify the minimum economic size processing unit and the export possibilities to neighbouring countries, although definitely there, cannot be fully relied upon. It is not uncommon, particularly in the African region to come across situations, where a group of countries in a region, may individually not have a market large enough to set up a production unit and may therefore be importing their requirements from outside, while the region as a whole may have the required market.

209. Of course, the only solution which can be suggested for such a problem is the development of such projects on a regional or subregional basis combining the domestic markets of a group of countries, in order to form a total market large enough to sustain an optimum sized production unit.

210. This approach has undoubtedly been emphasized also by all international bodies like the United Nations and its specialized agencies, as well as regional organizations like OAU, OAS, etc. and in fact forms the corner stone of the economic integration policies of regional common markets like UDEAC and ECOWAS in Africa, and CARICOM and ABDEAS in Central and Latin America.

211. However, in spite of very well intentioned policies, the implementation of the regional common market system has not met with much success in the developing regions of the world. Quite often individual members countries of a regional common market, have been heard to be voicing grievances that all important industries have been allocated to the other countries of the region and the decisions are unfair and politically motivated. This feeling of an unfair treatment obviously strikes at the very root of the spirit of co-operation on which the entire concept of the common market system rests. In addition, instead of fostering co-operation and mutual understanding, it develops misunderstandings and a lack of confidence amongst the member countries, which makes co-operation in joint industrial ventures all the more difficult. This lack of confidence amounting to almost suspicious distrust of each other, is the root cause of the apparent failure of regional common market system particularly as far as co-operation in joint industrial ventures is concerned. Therefore, if the common market system which is the only hope for the economic emancipation of the small developing countries has to be made to work, first and foremost the countries of the region must develop complete mutual faith and confidence in each other for their common good.

212. In addition, particularly for the purpose of developing joint regional ventures, they must agree upon a standard institutional framework for such ventures, in which each country has its commitments and its stakes and also its corresponding share of rewards. Such a framework must ensure that the countries participating in the venture share the common feeling that they are all in the same boat, and they sink or swim with it. Once this feeling is there, there would be no alternative except co-operating together to ensure the success of the joint venture to the good of all concerned.

213. The framework for joint ventures should of course, be based in principle upon mutual financial participation of the countries of the region concerned, with commitments from each of the participants to purchase their share of the produce of the plant in preference to imports from outside the region. Each participating country should be proportionately represented on the board of management of the enterprise and in case of disagreement on any matters at the Board management level, a procedure for arbitration at a regional level should be provided, so that the ventures do not get bogged down due to lack of co-operation at one level.

214. It is hoped that with co-operation along the lines suggested, this typical problem of small markets in developing countries can be successfully solved.

215. Lack of experience in project planning and contract negotiation: Generally the countries of the African region, are new to such areas as industrial project planning, purchase of technology, contract negotiation for purchase of technical services etc. This is a highly specialized field in the world of technology today, and for countries

which are planning ambitious programmes of investment in major chemical projects, lack of experience in this critical field, can make them vulnerable to all sorts of problems, including exploitation by unscrupulous plant vendors, project engineers, financing institutions etc. Cases have come to the attention of the mission, of countries in Africa having been cheated by unscrupulous firms of plant vendors and project engineers and also highly unreasonable and unfavourable financial agreements having been obtained by foreign financing companies from African countries for the supply of foreign credit. As a consequence of such unscrupulous practices, the industrial ventures concerned got bogged down either technically or financially and either never got off the ground or faced premature closure of operations.

216. While building up of expertise in the area of project contract planning and negotiation etc. should undoubtedly be pursued by governments with the assistance of ECA/UNIDO, who should organize seminars and short duration workshops in this field, but in order to meet the immediate needs of projects in their current development programmes, the governments of African countries should request ECA/UNIDO for expert assistance in this area, and project contracts should be finalized with the assistance and advice of experienced experts from ECA/UNIDO. Many developing countries in other parts of the world are following this practice and avoiding unnecessary problems at the subsequent stages of their projects.

217. In addition, as an institutional approach towards the solution of this problem it is recommended that ECA/UNIDO set up an initial division of technology transfer at the proposed fertilizer and pesticides development centre which is being recommended for being set up for in Africa for providing assistance in this area to African countries. The technology transfer division should provide necessary advisory expert services to African countries, on matters relating to purchase of technology, contract negotiations and financial agreements etc. At a later stage this division can be formed into an independent Technology Transfer Centre for Africa. It is sure that a solution to this problem would be found along the lines of these short term and long term measures.

218. Exploitation by unscrupulous foreign companies: Reference has been made above to exploitation by unscrupulous foreign companies of governments in Africa in matters relating to implementation of chemical projects. In view of the serious happenings reported to the mission of such cases, it is considered necessary to discuss this matter in more detail. It came to the attention of the mission that one particular foreign company was specifically engaging in unscrupulous practices while entering into agreements for the supply of equipment and installation of fertilizer plants. After the agreements were signed, the company purchased used second-hand junk from overseas and dumped at the plant construction sites. It is reported that none of the plants contracted for by this company ever reached the operation stage or ever operated successfully. This company has created serious problems of this type at least in two African countries reported to the mission and was reported to be on the look out for some more business in the African region.

219. It is strongly recommended that African governments should watch themselves very carefully in dealing with prospective project engineering and contracting companies, and generally select foreign companies with a standing and reputation to deal with. They should always check the reputation of a new company and its previous performance record before entering into project contracts.

220. Exploitation by unscrupulous banks and financing institutions: An instance has come to the attention of the mission, where taking undue advantage of the shortage of foreign credit in an African country, a foreign bank extended credit to a fertilizer plant project on highly unreasonable terms involving a grace period of only two years, before starting of the repayment schedule. As a result of this, the project did not have enough breathing time even to stabilize its production, when heavy repayments of money became due. Later after an initial operation of about one and a half years, as a result of heavy financial burden of repayments and high cost of expatriate services, the plant had to stop operations, as it was almost completely drained of working capital.

221. To avoid such financial problems, African countries should exercise great caution and care in entering into financial loan agreements. For example the grace period before repayments should usually be not less than five years and preferably ten years, and all other terms and conditions of the agreements should be carefully considered with the help of expert advice from institutions such as ECA/UNIDO or World Bank. In fact, it would be prudent to have expert advice from such institutions as ECA/UNIDO on the financial agreements before finalizing them.

222. It is also suggested that the proposed fertilizer and pesticides development centre should plan to have expertise in this area to be able to assist African governments on evaluation of financial agreements for obtaining long and short time financing of projects.

22.4. For financing of projects, African Countries would be well advised to first approach either the Joint UNIDO/WORLD BANK division at Vienna or World Bank Group (International Bank for Reconstruction and Development/International Finance Corporation/International Development Association) at Washington D.C., to explore the possibilities of part or whole financing of projects, and should go to other private financing institutions only in case they are not able to obtain their full financial requirements from the international financing bodies. They could also obtain guidance regarding proper financial agreements from ECA, UNIDO or WORLD BANK in relation to their development projects. In this way, the chances of their getting exploited by unscrupulous financing institutions would be eliminated and their financial interests well secured.

225. Lack of co-ordination between production management of plants and purchasing agencies: The mission, during its tour came across this specific problem in at least three different countries of Africa, where serious difficulties had arisen in fertilizer plants, because of lack of co-operation and co-ordination between fertilizer plant managements and the government Agricultural Ministries who are usually the purchasing agencies for fertilizers. In one case, the purchasing agency, had the practice of purchasing fertilizer supplies on the basis of indents which were issued at intervals of 6 months or more. This resulted in huge stock piles of fertilizer products in the plant in the intervening period, and the plant operations had quite often to be slowed down and on occasions even to be stopped in order for the stock piles to be cleared. This also gave rise to a financial problem, as so much working capital got tied up in finished stock inventories, that until the stocks were sold, there weren't enough funds left to purchase fresh raw materials to keep the plant going.

225. In the other case, a somewhat similar problem was noticed. On account of the fact that during the initial period of operation, due to various reasons, the plant's annual production was low and consequently the cost of production higher than the price of imported fertilizers, the purchasing agency was first reluctant to purchase and later outright refused to buy local production from the plant and instead imported fertilizers

from outside. This in fact resulted in the eventual closure of the plant.

226. In view of such serious problems having arisen, it is considered necessary to emphasize the importance of close co-operation and co-ordination particularly between plant management and purchasing agencies in developing countries, where the sustained and continued operation of a national venture is perhaps more important than the price considerations of the product.

227. It is not uncommon for chemical plants to take 2 to 3 years to reach their optimum level of production and during the initial period of operation the cost of production is usually higher than anticipated. Besides, in view of small domestic markets for which these comparatively smaller plants are designed and set up, their costs are even inherently going to be higher than much larger plants operating in developed countries from which imports normally come. It would therefore be unfair to compare the costs of the smaller national plants with the cost of imports, particularly during the initial period of the operation of national plants.

228. Therefore, if the national industry has to be given an opportunity to grow and stand on its own feet, either the purchasing agencies must fully co-operate with plant management and commit themselves to purchase local production or else the government in these countries must give tariff protection to these industries during their earlier stages, by increasing import duty on imported products, to enable local products to successfully compete with imports. It may be mentioned that in certain other developing countries like India for example, tariff protection was the regular strategy used in 1930's to protect local industry against foreign competition till local industry was strong enough to stand on its own feet. Of course, it must be stressed that tariff protection, should be given, wherever necessary, only for a limited period like 5 years for instance, during which the industry must come to its full stature and stand on its feet. Protection for indefinite period tends to make industry slack and inefficient, and a government should not make the country pay for the inefficiencies of an industry.

229. Lack of communication between different government agencies: Another problem relating to industry, which the mission noticed was a certain lack of communication and information exchange between different government agencies, which quite often showed the pace of development activities. It was not unusual, in certain countries, that information about either the activities or problems of one set of organizations reached other government organizations through the missions visits or discussions. In this respect it is felt that more frequent meetings and consultations between different organizations would be very helpful, and would bring about overall improvement in the working and effectiveness of the government development machinery.

230. Lack of operation and maintenance experience in chemical plants: As most African countries are rather new to the field of chemical industry, it is understandable that there is lack of experience in areas relating to the operation and maintenance of chemical plants. As a consequence of this, plant breakdowns and operational problems in plants, were found to be responsible for an appreciable loss of production.

231. This is of course, both a training and organizational problem. In respect of plant operations, firstly emphasis must be given to training, of operators and supervisory personnel, and if there are any plant efficiency or process operation problems, a separate work-study and process development section in the plant should be set up to tackle such problems, and bring the plant operations upto the required level of efficiency.

232. In respect of chemical plant maintenance, besides training of staff, it is very important to organize the maintenance programmes. The plant should gradually be put on a planned preventive maintenance system with proper scheduling of inspection and preventive maintenance services for equipment, to prevent sudden breakdowns. In addition, the maintenance of breakdown spare parts stocks through establishment of maximum and minimum stock limits, should be established, as availability of spare parts is extremely important for maintaining a chemical plant in efficient operation.

233. With proper organization and training, as suggested above, both the operation and maintenance of plants would improve and consequently their operational efficiency.

234. High cost of expatriate technical/management personnel: It is of course, expected that Expatriate personnel would cost higher than nationals. However, every effort should be made to obtain expatriate personnel only for limited periods and train up nationals to take over responsibilities from them as quickly as possible. This aspect should even be taken care of at the initial contract stages, when limited contract periods should be planned for expatriate assistance. This aspect is particularly highlighted, because the cost of expatriate services in one plant in an African countries was reported to have developed into such a major financial burden on the company, that it significantly contributed to the eventual closure of the plant.

235. Obviously, developing countries should not take the risk of such situations developing in their industrial ventures.

236. Inadequate development of infrastructures: How important the development of infrastructures is for the successful operation of the productive sectors of industry, becomes only too obvious, when visiting certain countries in Africa, where as a result of inadequate attention having been paid to the infrastructural sector, the productive sector is almost paralyzed or working at greatly reduced capacities. For instance a fertilizer plant was reported to be operating at almost 15 to 30 per cent of its design capacity, because of transport bottlenecks in the country, which made raw material deliveries to the plant very uncertain and also because of frequent power failures in the region. Other infrastructural weaknesses, such as failure of the telephone system due to overload, and traffic congestions adversely affected practically every other industrial and commercial activity in the country. This situation came about just because enough attention was not paid towards the parallel development of infrastructures while planning directly productive sectors of industry.

237. It would therefore be wise for African countries to plan a balanced development of all sectors of the economy, while formulating their development plans, paying particular attention to the development of infrastructures, so that no problems arise at a later stage.

238. Management pattern of enterprises: African countries, while planning major industrial ventures in the chemical field, generally seem to favour a corporate management pattern involving financial and technical participation from some foreign company from a developed country. This type of participation of foreign partners, in principle, is quite beneficial, as it facilitates bringing in of technology and experience in a new field in the African countries. However, the success of this pattern of financial and management control depends a lot upon the foreign partner selected and his general business ethics in dealing with the counterpart country's interests. In two plants in African countries, where this pattern was followed, difficulties subsequently arose, and in a third country the plant never got off the ground, because the foreign partner

was apparently an inscrupulous organization. Therefore generally African countries should exercise great care in the selection of financial and technical partners in industrial ventures, and select only companies with a standing and established reputation. In addition, they must ensure that the government of the country holds the controlling financial interest in the joint venture. Even after the plant goes into operation, the government should be represented adequately on the Board of Management and should monitor the operations of the company. The government's holding the majority interest and actively participating in the operational management of the venture would avoid a whole lot of problems, which could otherwise develop in such joint venture companies.

239. Inappropriate import duty structures: Quite often it happens that, while the various duties and taxes are structured in a country a certain economic situation, although the situation changes, but the tax structure remains as before, sometimes causing unnecessary problems. It is therefore desirable in developing countries in which the economic situations are fast changing, to periodically review the excise and import duty structures to ensure that they are in consonance with the development policies in the country.

240. A case worth mentioning in this context, is the situation reported to the mission in one developing country, where the import duty on all imported pesticides - whether finished products or component materials - was 10 per cent, but there was an additional 5 per cent tax on locally manufactured or formulated products. The result of this duty structure was, that finished pesticides imported directly from outside were taxed at 10 per cent, while the same products if formulated locally by importing component materials were taxed at more than 15 per cent, and thus made uncompetitive with the imported finished products. Obviously, this type of taxation policy encouraged imports and discouraged local manufacture. This situation was however brought to the attention of the government of the country concerned by the mission, and it is hoped that the government will take necessary steps to modify the import duty structure.

241. However, such situations can occur in other African countries too, who would therefore be well advised to periodically take a look at the taxation and duty structures in order to ensure that they do not come in the way of their development plans.

242. Non-availability of suitably qualified and trained national manpower: This is, of course, a problem which is common to most developing countries in Africa, and the governments of the countries are also generally aware of it. The object of mentioning it here, is just to highlight this problem and to stress its importance and bearing on the industrial development plans of the countries.

243. Qualified and trained manpower is a very crucial factor in achieving successful implementation of a country's development programmes and the lack of this resource can act as a serious constraint in achieving development objectives. Expatriate assistance is at best a temporary palliative and must be looked upon as such. The permanent requirement of expertise in a country and also its future growth can be met only by training and developing a cadre of suitably qualified and trained persons in the country, in all important fields.

244. African developing countries should therefore lay special attention to this important area of development to ensure the success of their future development programmes.

D. PLANNING AND DEVELOPMENT STRATEGY

245. While considering the development strategy in the context of the situation in Africa, one has obviously to think of two aspects of the strategy required - one for development at the national level and the other for development at the subregional/regional level. It is therefore proposed to discuss here the strategy and policy to promote development at the national level. The aspects of strategy and modalities of co-operation at the subregional/regional level will be discussed in the next chapter of this report.

246. National development strategy: Economic planning and development is not a new field and in fact the regular economic planning processes and procedures which are involved in formulation of development plans in countries, are well known to economists and planners all over the world. However, what are not so well known, are the experiences of some of the developing countries, which have gone through the process of planned development based on the regular system - both their success and failures, the weakness they found in the system, and the measures they adopted to overcome these weakness and achieve development targets. In fact out of the experiences of other developing countries, and more result oriented system has evolved, and it is proposed to discuss here this somewhat modified system with heavy emphasis on implementation phase of development, so that this information can be useful to developing countries in Africa, which are currently at the threshold of their development programmes.

247. Structure of a planning and development system: Initially when planned development approach was adopted in a number of developing countries, which perhaps have now passed through the earlier and intermediate stages of development, the greatest emphasis was laid, in the sequence of development activities, on the economic planning stage, wherein the economic targets were fixed and projects identified towards achieving these targets. However, subsequent experience in these countries, showed that although economic planning was very useful and helpful, in as much as it ensured balanced development of all sectors and also gave a proper direction to the development process, yet if the country did not have a proper institutional machinery for implementing the development projects, the development programmes failed to bear fruit and the country's economic targets merely remained as plans on paper. In fact, in course of time the emphasis in development strategy shifted considerably on the implementation and monitoring of development projects and it was only after this was done that industrial development started bearing results.

248. Therefore in the context of these experiences an institutional framework for the planning and implementation of development programmes evolved in these countries, which comprised of the following functional institutions, to handle their share of the development responsibility:

<u>Institutions</u>	<u>Responsibilities</u>
1. Government economic planning organization	Preparation of national development plans
2. Industrial studies and project planning institutes	Identification of potential industrial projects and their feasibility evaluation.
3. Industrial promotion institutes	Project planning, financing and implementation

Institutions

Responsibilities

- | | |
|---|--|
| 4. Project design-engineering organization | Design-engineering and construction of projects and other engineering consultancy services |
| 5. Project executing and operating organizations. | Corporations responsible for execution and subsequent operation of projects |
| 6. Government monitoring bodies | Government bodies set up for monitoring of government owned industrial ventures. |

249. From the institutional framework mentioned above the functional role of each institution in the planning and implementation of the development programmes of the country, would be amply clear. It would also be observed that the greater part of the emphasis is on the implementation phase of the development projects.

250. Functional role of the development planning and implementing institutions: In order to further clarify the exact functional role that the institutions normally play in handling different development activities in a country, a more detailed description of their functions is given hereunder:

251. Industrial study institutes: These institutes generally undertake industrial studies, such as resource surveys, market surveys, project identification surveys, pre-feasibility studies, feasibility studies, project appraisals, project reports, etc. with the object of first identifying different industrial possibilities which may seem to indicate a potential for development in a country, and then evaluate their exact feasibility in terms of technical soundness and economic viability to establish their definite potential for economic success.

252. These institutes normally work very closely with both the government economic planning bodies and also the promotional organizations (Industrial Development Corporations), and provide these organization with the supporting data, information and services, which are very necessary for both economic planning as well as project implementation functions.

253. Industrial development corporations: These industrial promotion institutions provide the vital link in the process of development of a project from the stage of its initial investment decision by the government, to the final stages of project completion. Their services normally include, initial planning for project implementation, purchase of technology, negotiating and finalizing project design-engineering and construction contracts, dealing with contractors, project management, etc. After a project is completed, they hand over the plant to a separate company formed for operation and management of the plant. Sometimes in addition to project development work they also handle development financing activities, although the latest practice is to let development financing be the responsibility of a national development bank. Thus, the industrial promotion institutions provide a very important service and fulfill a very crucial role in the development land implementation of projects in developing countries.

254. Project design and engineering organizations: The project-designers and project engineers handle the actual design-engineering, equipment procurement, and erection-construction of chemical plants. In countries, which are at the earlier stages of their development, these services are purchased from outside by inviting project design-engineering and construction companies to handle them under a contract. However, in

other developing countries which are fairly advanced in their level of development, the national project design-engineering organizations handle these function, and provide these technical and engineering services from within the country. The development of such organizations makes a country completely self-reliant in respect of all the technical engineering services required for setting up new chemical plants, and invariably enables the country to execute the projects at a lower cost and with higher utilization of local resources and equipment - which in turn gives an economic impetus to other services and equipment supplying industries in the country.

255. Project executing and operating organizations: The role of project executing and plant operating organizations is generally complimentary to that of Industrial Development Corporations. Usually, depending upon the stage of the project at which the executing company is set up, it shares the responsibility for executing the project and later the operation of the plant. The executing and operating organization is, of course responsible for the eventual operation and management of the chemical plant.

256. Monitoring organizations: The evolution of monitoring organizations has taken place, very much out of sheer necessity to monitor the performance of government companies in developing countries and to ensure their proper working. The monitoring bodies are generally set up at a fairly high level in the government machinery, and usually comprises of committees reporting to either the parliament or the Prime Minister or President of the country, on the overall performance of each government company involving a major national investment. The object of the system is to maintain a high degree of accountability on the part of the top management of government companies, and to ensure that enterprises involving large public investments are operating at the expected level of efficiency and providing services to the country for which they were set up.

Present weaknesses in the development strategy of African countries and recommended ensures to overcome them

257. Institutional framework: As against the institutional requirements of an effective development system outlined above, when the situation in different African countries is reviewed, significant gaps in their systems are identifiable, and the lack of these institutional facilities and the expert services which they normally provide, are really responsible for either the slow rate of development in these countries or the industrial problems which are arising there.

258. Most African countries, of course, have a government planning ministry or other organization to take care of plan formulation for the country. But of the six countries visited by the mission, only two had properly organized industrial studies institutes to undertake evaluation studies, three had industrial promotion bodies, none had a design and engineering organization or a monitoring body. Whenever a project was planned an executing agency was created for it, often as a joint venture company with an outside partner.

259. It is quite understandable, that it is too early for most African countries to think of setting up design-engineering institutes or monitoring bodies, but unless they take necessary steps to set up supporting services institutions like the Industrial Study Centres for the identification and evaluation of potential industries in the countries, and promotional organizations like Industrial Development Corporations, which provide the very essential project planning and implementational services, also handling project development financing at times, the countries will not be able to

achieve fast enough progress in their development plans. Actually, in the absence of necessary institutional facilities mentioned above, the countries are trying to fill the gap through contracted consultancy assistance from outside.

260. But as they would have realized themselves, by now, this could at best be a stop gap arrangement and could not provide the continuity of expert assistance which is so necessary to the fulfilment of development needs over a long period of time. Therefore the only lasting solution of the problem is to create the necessary institutional machinery for the successful implementation of development programmes. Of course, it must be mentioned, that for the development of such institutions the governments of countries in Africa should obtain necessary assistance from ECA/UNIDO, who would be very happy to assist in such institutional development programmes. In fact UNIDO is currently setting up an industrial studies institute in Upper Volta and UNIDO assistance for development of an existing institute to handle such functions has been recommended by the mission in Gabon. Such institutes have also been set up with UN assistance in other parts of the developing world with both financial as well as expert assistance from the United Nations Development Programme.

261. Expertise: Besides the gaps in the institutional development framework in African developing countries, another crucial area of weakness is that of expertise relating to development planning and implementation activities. Most countries are rather new to particularly the implementational phase of large chemical projects, and totally dependent upon, often not too reliable, consultancy services in these matters.

The only solution of this problem is to train and develop national manpower to handle these activities. Although this may be a process spread over a time period, but in any case it has to be gone through, and so it is good to make a beginning as early as possible.

262. Usually, a good practice and procedure to train up national in the development planning and implementation activities is to counterpart nationals with experienced U.N. Experts, who will be required to staff the various institutions in the earlier stages, and also by involving national engineers and other qualified personnel in actual projects at different stages - design-engineering, equipment procurement, erection, construction and start up, alongside expatriate project personnel of the project contractors. For this purpose, necessary provision for training of nationals through direct involvement in project work must be made in the contract agreements entered into with project engineering organizations, at the time of signing the contract agreements.

263. Transfer of technology and contract negotiation in the chemical industry sector: One of the most important areas in which expertise is necessary in developing countries, which are planning to set up large scale chemical plants with imported technology and expatriate project engineering services, is that of technology transfer and contract negotiation. Unfortunately, this is another significant gap in the present level of expertise available in African developing countries and accounts for a number of problems which have arisen in the recent past.

264. While purchasing technology for fertilizer and chemical plants, there are several aspects of technology transfer which have to be considered by the prospective purchaser, such as the suitability of technology, the exclusiveness or non-exclusiveness of the use of technology (whether the technology is being supplied exclusively for use of one single plant or can it be used for any further plants that the purchaser may set up),

the process guarantees and the engineering guarantees to be provided by the technology suppliers and project engineers, the patents involved in the process technology, etc. Therefore unless the purchaser is fully familiar with the implications of these aspects of technology purchase, he would be in a rather vulnerable position while negotiating for technology purchase.

265. Similarly, the area of contract formulation and negotiation for the purchase of engineering services, has its own technicalities, which call for thorough familiarity with them on the part of prospective purchasers. For instance, the several types of contracts which are available for purchase of design, engineering, procurement and construction services are 10/:

- (a) Turn-key lump-sum contract: This contract covers supply of process know-how, engineering services, procurement of machinery, equipment and materials, civil works and construction of plant and equipment. The contractor is responsible for all work up to the final acceptance test; he accepts full responsibility for the plants performance. The work is performed for a fixed total price.
- (b) Cost-reimbursable contract: This contract covers most of the services included in the turn-key lump-sum contract. The contractors responsibilities are more limited in certain areas such as procurement and know-how. Procurement and engineering are provided for a fixed fee, while all other costs are charged on a reimbursable basis.
- (c) Semi-turn-key contract: This contract covers supply of same services as in the turn-key lump sum contract, but excluding civil works and erection at site for which the purchaser is responsible. Most of the work is performed by the contractor for a fixed fee. The contractor accepts responsibility for the plants performance, but not for completion on time.
- (d) Supply of know-how and engineering services: This contract covers supply of the process know-how, basic engineering, procurement assistance and supervision of the construction of the plant. The contractor accepts responsibility for the plants performance. The contract could be entered into for these services to be provided for one plant or a number of similar plants at different locations, for varying fees.

266. The prospective buyer of technology and project engineering services, must of course identify exactly the type of contract which would suit the requirement of a particular country and then invite bids and negotiate on that basis.

267. In addition to this, there are the legal aspects of such contracts which involve certain typical causes such as: the scope of the contract, scope of work, obligations of contractor, obligations of purchaser, prices and terms of payments, performance bonds and bank guarantees, performance guarantee tests, conditions of acceptance, warranties, penalties and liquidated damages, bonuses and incentives, insurance, variations in the scope of work, secrecy, Force Majeure, settlement of disputes and arbitrations, etc.

268. UNIDO is presently engaged in the extremely useful exercise of developing model forms of contracts for fertilizer plants, for use in the developing countries. It is

therefore recommended that as soon as these model contract forms of agreements have been finalized, African governments should obtain these documents and use them as guidelines for the purchase of technology and project engineering services for fertilizer and other chemical plants to be set up by them.

269. In addition, for the development of expertise in this important area, it is recommended that ECA/UNIDO organize a programme of seminars and work-shops on technology transfer and contract negotiations on a regional basis in different African regions, in order to disseminate information among African countries in this important area.

270. Further, till such time as in-country expertise is well developed on this subject, African countries planning new fertilizer and chemical plants would be well advised to associate U.N. experts with the project planning and contract negotiating teams, in order to avoid the pitfalls which are present in this phase of industrial project planning.

271. Policy measures necessary for promoting development. The object of proper government policy formulation is essentially to create the necessary environment and climate in which industry can flourish and grow. Therefore industrial policy must be designed in a manner so as to encourage new industry to develop and existing industries to flourish and grow. Various policy measures are adopted by developing countries to encourage new industries such as, subsidizing the cost of feasibility studies undertaken by new private entrepreneurs, making available finance at a concessional rate of interest, tax-holiday to new industries for an initial period of five years, assistance in supply of raw materials, assistance in marketing or preferential purchasing by government of the output of new industries, etc.

272. Other policy measures, quite often taken by governments to ensure satisfactory operation and growth of industries includes such steps as, proper import duty regulations to protect industries facing competition from imports, export incentive policies to assist export oriented industries, etc.

273. In addition, for regulating industry, governments also have to institute measures such as pollution control regulations, quality control requirements, labour regulations and sometimes price regulatory measures. However, the final decisions about the industrial policies to promote and regulate industry must be taken by government in the context of the situation prevailing in the countries.

E. REGIONAL CO-OPERATION AND DEVELOPMENT

274. Regional co-operation: The need for regional co-operation is a matter on which enough has been said and written by various international as well as regional organizations in Africa, and it is hardly necessary to enumerate the advantages and benefits of regional co-operation to stress its desirability. However, in spite of what has been said and written, and despite even the formation of some regional common markets in Africa (UDEAC & ECOWAS etc.), the actual economic integration of the regions and the development of the real spirit of co-operation amongst the member countries, has still to come. As this is the only policy which holds but a promise, and a future hope of economic emancipation for the countries in Africa, an effort must be made at all levels to bring the countries closer and make the different economic market plant really work.

275. Levels at which co-operation Must be organized: There are four different levels at which co-operation in the economic regions must be organized:

1. The political level - OAU

2. The subregional organization level - UDEAC, ECOWAS, etc.
3. The country level
4. The United Nations level

275. The Organization of African Unity (OAU) must continuously impress upon the governments of the countries in Africa the need for close co-operation with each other in making the system of economic communities work. In addition, it should ensure that the various decisions which are taken by the subregional economic organizations are fair to all the countries of the region, and there are no partialities or favouritisms involved in these, which could subsequently become a source of bickerings and disunity in these organizations.

277. The subregional secretariates of the economic communities should strive their utmost to translate the decisions taken at the political level into actual economic realities and bring the countries of the region round the table and make them participate actively in joint ventures for the development of the region. They should also devise and decide upon the actual framework for co-operation for different economic activities, in consultation with the governments of countries concerned.

278. The countries of the region in their common interest should try their best to develop an atmosphere of mutual trust and confidence between themselves for co-operation in the subregional activities. It is only through subregional co-operation that they can hope to achieve development and a solution of the economic problems of the region.

279. The United Nations Organization has undoubtedly to play a very important role mainly through its specialized agencies - principally ECA, UNIDO and UNDP, in helping countries achieve industrial and economic integration and also assisting subregional development through financial and technical assistance programmes.

280. The mechanisms and framework for regional co-operation: One of the weaknesses which exists at present in the system of subregional co-operation, is the lack of a clearly defined framework for co-operation for difficult types of economic activities. For instance while there is no much stress laid upon joint venture projects, yet no clear cut framework for participation has been devised and decided upon so far. Therefore this is a task to which the subregional secretariates must address themselves and develop the necessary organizational frameworks for achieving necessary participation in every type of economic activity, through obtaining its acceptance by each one of the governments of the region. For instance as suggested earlier, an organizational framework for the joint venture projects should be developed in a manner so as to allow financial participation of different countries of the region, with proportional representation at the Board of Directors level and also a proper procedure for arbitration and settlement of any matters, which cannot be settled at the Board levels. Similar organizational frameworks could be devised, with mutual agreement, for various other activities involved in subregional economic communities.

281. Fertilizer, basic chemicals and pesticides projects suggested for subregional development: During the course of the mission's tour of different African countries, some fertilizer and other chemical projects were identified, which would be suitable for development on a subregional basis. Brief particulars in respect of these projects are stated below, including a mention of related developments in the region. In most cases, more detailed studies will be called for, on the basis of which decisions regarding their exact locations in the subregions and other technical and economic parameters, could be taken. The following projects are recommended for consideration in the

multinational regional context:

282. Ammonia project in East Africa: A multinational ammonia plant for the East African region is an imperative need. Tanzania is currently considering setting up a natural gas based ammonia plant for meeting its own nitrogenous fertilizer needs as well as exporting to other neighbouring countries of the region. The plant capacities being considered are between 200 t/d and 600 t/d. Kenya also is going ahead with plans for large scale fertilizer production. It would however be advantageous to plan capacities around 1000 t/d and above for plants for the East African countries to make them competitive against the cost of ammonia from imported sources in the world, since international ammonia plant capacities currently range between 1000 t/d - 1500 t/d. However, this could be done only, if a plant is based on an assured regional market.

283. Pesticides active materials manufacturing project for East Africa: There is an appreciable demand for pesticides in the East African subregion, but generally East African countries are either directly importing their finished pesticides requirements from outside or formulating them from imported active materials. However in view of the large market for pesticides in East Africa, it is felt that there is good potential basis, to meet the requirements of various national formulation plants in different East African countries. It is therefore recommended that a feasibility study be conducted on this project and in keeping with the recommendations of the study, implementation action be taken.

284. As a study on this project has already been prepared in the past by ECA, it is suggested that this study be up dated to recommend parameters for capacity and also location of the plant, etc. It is recommended that this project be considered for implementation at the subregional level, in accordance with the findings and recommendations of the up dated study on this project.

285. Ammonia project for UDEAC countries: The nitrogenous fertilizer requirements of UDEAC countries are progressively increasing.

Gabon had planned sometime ago to set up a 200 t/d ammonia plant at Port Gentil based on natural gas. However, on account of the subsequent drop in the world ammonia prices and serious doubts about the competitiveness of a small plant of this size in this situation, the project had to be abandoned halfway. However, it is felt that it could be an economically viable venture and could satisfactorily meet the nitrogenous fertilizer needs of the UDEAC countries.

286. A study on the economics of such a project on a multinational basis is therefore recommended. It is further recommended that this project be considered for implementation for meeting the nitrogenous fertilizer requirements of the UDEAC countries, in keeping with the recommendations of the report on this project.

287. Caustic - soda and chlorine project for UDEAC countries: There is a sizable market for caustic soda in the UDEAC countries, but most countries are planning to set up their own small plants (generally 7000 t/y) based on imported salt supplies, because co-product chlorine utilization is a serious constraint. Both Congo and Gabon have mineral salt resources, and the latter also has a potential outlet for chlorine in the form of petrochemicals. It is suggested that multinational projects for the manufacture of electrolytic caustic soda and chlorine be considered in the UDEAC. The project can partly meet the caustic soda and chlorine requirements of the pulp and paper plant being set up in Gabon and also supply the requirements of other UDEAC countries. For Gabon's and Congo's pulp projects requirements of caustic soda a 50 t/d caustic soda plant each would be required. The exact plant capacities, and their locations could of course be decided only after a studies on the projects have been completed. It is therefore recommended that a studies on the establishment of electrolytic caustic-soda and chlorine plants for UDEAC countries be undertaken and based on the recommendations of the study implementation action for these projects be taken.

288. Phosphate fertilizer production for UDEAC countries: In addition to nitrogenous fertilizers it is also necessary to plan phosphate fertilizer production for UDEAC. Cameroon already has a phosphate fertilizer plant of 85,000 t/y capacity, which is presently closed on account of certain financial problems. Recommendations for solving the present financial problems of this plant through World Bank assistance have been made by the mission, and no doubt these will enable this plant to resume operations.

289. One of the ways to meet the phosphate fertilizer requirements of the UDEAC region will be to expand this plant to meet the requirements of the member States. For the added capacity, phosphoric acid could be purchased from Togo and the products supplied to the UDEAC countries. There could be other possibilities of setting up phosphate fertilizer production elsewhere too. It is therefore recommended that a study to identify the total regional requirements and fix the project parameters and location, etc. be undertaken in this context and implementation action be taken in accordance with the recommendations of the study.

290. Pesticides manufacturing project for UDEAC countries: There is a sizeable demand for pesticides in the UDEAC common market countries, but on account of individual country markets being too small, pesticides for agricultural and other pest control operations are being imported from outside. However, it is felt that, if the total requirements of the UDEAC countries are put together, an economic size pesticides manufacturing plant to undertake manufacture of active materials and supply them to formulation plants for manufacture of finished products could very well be justified. A feasibility study on the project is recommended.

291. Fertilizer project for ECOWAS countries: In order to meet the nitrogenous and phosphate fertilizer requirements of the ECOWAS countries, there is need for manufacturing capacities to be set up for both these fertilizers in this region.

292. Nigeria has at present one phosphate fertilizer plant of about 100,000 t/y capacity and is planning to set up a natural gas based ammonia/urea plant of 1500 t/d capacity. These plants are mainly based on Nigeria's domestic requirements of these fertilizers although they include some provision for export to neighbouring countries. Senegal and Ivory Coast also have fertilizer production. It is however necessary that the requirements of the ECOWAS for nitrogenous and phosphate fertilizers are studied independently, and decisions are taken in respect of meeting these requirements by creating adequate production capacities at suitable locations in the region. It is therefore recommended that a study be undertaken in this context and based on the findings of the study a decision for developing regional production of fertilizers for ECOWAS countries be taken.

293. Pesticides manufacturing project for ECOWAS countries: There is a sizeable market and hence a potential for the establishment of a pesticides manufacturing plant for the ECOWAS regional market.

It is therefore recommended that first a feasibility study on the project be done to decide about the capacity, product mix and location of the project and based on the recommendations of the study decisions to implement the project be taken.

294. Regional Design and Engineering project for North African countries: As has been mentioned earlier, the level of development of chemical industry in some of the countries in Northern Africa, such as Egypt and Algeria is sufficiently advanced to justify the establishment of institutions for the provision of project engineering services to the chemical industry. Such institutions, in addition to meeting the domestic requirements of chemical industry, could also provide these much needed services to other countries of the region. It is therefore recommended that establishment of a regional project for providing design, engineering, procurement and construction services to fertilizer and chemical industry be considered in the North African region. A report on this project should first be prepared and based on the recommendations of the report, implementation action should be taken.

295. Areas for Joint Co-operative Action: In the context of the implementations of the projects identified earlier some of the activities which the economic communities could undertake on a co-operative basis are:

- (a) Joint venture industrial projects;
- (b) Joint marketing and distribution arrangements;
- (c) Joint market research within and outside the communities;
- (d) Standardization and quality control;
- (e) Joint acquisitions of technology and its development and adaptation;
- (f) Bulk purchase of materials;
- (g) Harmonization of investment codes;
- (h) Joint mobilization and allocation of financial resources;
- (i) Joint exploitation of natural resources;
- (j) Joint manpower development programmes;
- (k) Joint organization of information systems; and
- (l) Joint development of infrastructural facilities.

296. These are some of the main areas suited for subregional co-operation, although co-operation could be organized in many more economic activities.

297. Modalities for Integration and Co-operation: The broad spectrum of activities on which co-operation can take place at the regional level has been described above. However, in order to achieve co-operation in a

wide range of activities, it is felt that besides the Subregional Secretariates there should be other levels at which continuous contact is maintained by representatives of the governments of the region to discuss and co-ordinate various activities. It is therefore suggested that the following institutional modalities be adopted for the purpose of such co-ordination and co-operation:

- (a) Intergovernmental expert meetings;
- (b) Consultation meetings between governments; and
- (c) Meetings of plenipotentiaries;

297. In addition it is felt that development of regional institutions would further strengthen co-operation among countries. In this context the creation of the following institutions is specially recommended:

- (a) Subregional institutions for providing industrial consultancy services;
- (b) Subregional Executing Agencies such as African Multinational Corporations; and
- (c) Subregional UN assisted institutions such as the African Fertilizer Centre and the African Technology Transfer Centre.

F. ROLE OF ECA/UNIDO/OAU IN AFRICAN DEVELOPMENT

298. As has been mentioned earlier, the United Nations organization has to play a very active role in assisting African countries in their struggle for development and the two UN specialized agencies - ECA and UNIDO will have to take the major burden of the development responsibility of the region on them with the financial backing of UNDP. Again, the policies and assistance programmes of ECA/UNIDO will have to be co-ordinated and implemented with OAU policies and programmes in Africa. The areas in which ECA/UNIDO must plan future assistance in the African continent are described below:

299. Development of Regional Institutes: As has been said earlier, regional institutes for the development of chemical and fertilizer industry are very necessary for the provision of technical as well as promotional expertise for the development of this chemical sector in Africa. It is therefore suggested that ECA/UNIDO assist in the development of the following institutes:

- (a) Fertilizer and pesticides development centre; and
- (b) Chemical technology transfer centre.

300. Initially, if necessary, both these functional services can be housed under the same roof, although eventually it would be better to develop them as separate institutions. The fertilizer and pesticides development centre must be geared to provide all the necessary advice and assistance to African countries on all aspects of fertilizer and pesticides production and development, starting from market demand assessments to commissioning and operation of plants.

301. Similarly the chemical technology transfer centre should provide all the expertise necessary for the development of other chemical industries from their initial concept through construction and operation stages. These institutes should particularly assist African countries in areas such as the selection of technology, selection of reliable and reputable process suppliers and project engineers/contractors, arrangements for financing of projects, contract negotiation and contract finalization etc. They should also assist in the development of subregional projects, through formulating such projects and enlisting the participation of countries through OAU and subregional secretariats to implement them under their expert guidance.

302. Development of National Institutes: Another area which ECA/UNIDO must assist with both financially and with technical expertise, is the development of institutes at the national level. There is at the moment considerable need for technical supporting services in several developing countries in the African region, as they are almost grouping in the dark for planning their future development programmes. It is therefore extremely important that these countries be provided with Industrial Studies Institutes, which can give them necessary information, and provide them with necessary supporting services for planning and developing industry. Already UNIDO is planning to set up one such institute in Upper Volta and the mission has recommended assistance for the development of a similar institute in Gabon. Industrial Studies Institutes would undoubtedly be required in other countries of this vast continent too, and it is recommended that ECA/UNIDO provide active financial and technical assistance for their development in view of the much needed services they are likely to provide for the development needs of African countries.

303. Expertise for Project Assistance in African Countries: In addition, several projects have been identified during the mission's tours in the African countries, which call for ECA/UNIDO expert assistance for either feasibility studies or assistance on other technical aspects of industry. Details in respect of the expert assistance required for these projects have been indicated in the different country reports. It is recommended that ECA/UNIDO provide necessary expert assistance on these projects as recommended by the mission. Further a number of regional projects have also been identified, and ECA/UNIDO assistance on these is also recommended.

304. Regional fertilizer, basic chemicals, pesticides and other projects on which ECA/UNIDO assistance is recommended are stated below:

Regional projects:::

- East Africa: (a) Study for the development of fertilizer production for the East African subregion;
- (b) Study for the development of pesticides active materials for East African countries;
- UDEAC: (c) Study for the development of nitrogenous fertilizer production for UDEAC market;
- (d) Study for the development of phosphate fertilizer production for UDEAC market;
- (e) Study for the development of caustic soda/chlorine production for UDEAC market;
- (f) Study for the development of pesticide manufacture (active materials) for UDEAC market;
- ECOWAS: (g) Study for development of nitrogenous and phosphate fertilizer production for ECOWAS;
- (h) Study for the development of pesticides manufacture (active materials) for ECOWAS;
- NORTH AFRICA: (i) Preparation of a report on the establishment of a Design, Engineering and Construction Services Institute for chemical industry;
- AFRICAN CONTINENT: (j) Establishment of a Fertilizer and Pesticides Development Centre for Africa; and
- (k) Establishment of a chemical Technology Transfer Centre for Africa.

305. Financing of Chemical Projects: Besides technical and development assistance in national and regional projects, another important areas for ECA/UNIDO assistance is in respect of the financing of bankable projects in Africa. It is recommended that the requirement of African countries for financial assistance for their projects be given special consideration by the WORLD BANK/UNIDO Division at UNIDO Headquarters in view of the need for special assistance to this part of the developing world, and every effort should be made to extended part or whole financing of fertilizer and chemical projects in this region.

306. Further, in respect of projects, which cannot be wholly financed directly by WORLD BANK/UNIDO sources, it is suggested that the World Bank/UNIDO Division extend necessary assistance to the countries concerned by putting them in touch with reliable financial institutions and giving them assistance and guidance in obtaining project financing on reasonable terms and conditions conforming to international practice.

Estimates of manpower need for ECA for the recommended assistance programme

307. For the implementation of the technical assistance programme recommended for the development of fertilizer, basic chemicals and pesticides manufacturing industries in Africa, the following manpower need requirements are envisaged (see Table II.9).

Table II.9: Estimates of Manpower need for ECA for the Recommended assistance programme

Particulars of staff/ consultants	Level	Total man-months	Phasing (man-months)				
			1979	1980	1981	1982	1983
<u>ECA headquarters</u>							
Industrial Development Advisor (fertilizers, basic chemicals and pesticides)	P.4/5	60	12	12	12	12	12
<u>Field work:</u>							
Consultants for regional development programme	Consultant	66	18	12	12	12	12
Consultants for country development programme	Consultants	39	35	4			
Total		165	65	28	24	24	24

308. It is recommended that financial provision for the above manpower budget may be made for implementation of the recommended development programme.

CHAPTER III: PETROCHEMICALS

A. THE ROLE AND SIGNIFICANCE OF THE PETROCHEMICALS SUB-SECTOR

AT THE GLOBAL LEVEL

Historical Development

309. In the early stages of the development and growth of the petroleum refining industry, its hydro-carbon derivatives were known limitedly for their value as combustible materials and their use remained as a domestic, industrial and transportation fuel. Later investigations have established that they can also be used as valuable feedstocks for production of many useful organic chemical products which were hitherto derived from coal (and its bye-products like coal tar) and other materials of animal or vegetable origin occurring in nature or as agricultural outputs. Today, the gaseous, liquid or solid hydrocarbons available from petroleum or natural gas constitute the major building blocks for the production of a vast range of petrochemicals.

310. The impetus for the processing of petroleum and natural gas resources which began during World War II, was necessitated by the unbalance of a fast growing demand for aromatics and the insufficient supply from the bye-product activities of the coal-coking industry, attached to steel making. The period following this witnessed an intensive development of the petrochemical industry resulting in petroleum replacing coal as the main source of aromatic chemicals and the petrochemical industry taking over a large part of the production of alcohols formerly obtained only from fermentation of carbohydrates. World War-II also ushered in the era of synthetic polymer substitutes for manufactured materials like metals and glass and for natural materials like leather, wood, rubber, fibres, glues etc.

311. The principal end-use products of the modern petrochemical industry include the following broad classifications: plastics and resins, synthetic elastomers, synthetic fibres, detergents, solvents, paint vehicles, and plasticizers, agricultural chemicals, such as fertilizers, pesticides and herbicides, automotive chemicals, including anti-freeze agents and lead alkyls and pharmaceuticals. Apart from fertilizers, the first four are the main large-tonnage end-product petrochemical group or families.

Pre-requisites for the Development of the Petrochemical Industry

312. Existence and Development of Market: The first requisite for the setting up of a petrochemical industry is the existence of a market, denoting either a ready and primed demand or a potential demand. The rapid development of the petrochemical industry can be traced to the fact that the industry was able to meet the demand with large-scale supplies of the desired products with superior appeal-characteristics and on fair pricing and a stream-lined marketing system.

313. Availability of Petroleum Raw Materials: The second requisite for the development of the petrochemical industry is the availability of basic petroleum raw materials either in the form of gas or petroleum fractions obtained through crude oil refining natural gas. It may be noted that, with the exception of the United States where a relatively large part of the petrochemical industry is based on natural gas, most of the countries where the petrochemical industry is well developed - such as Europe and Japan - are not themselves producers of crude oil, but they have refining facilities linked to easy and ready access to crude supplies from other sources.

314. Out of the total crude oil and natural gas produced the proportion used in petrochemical industry, although constantly growing, is still small. It was less than one per cent

in 1950 and is currently somewhere between 4.5 and 5 per cent.

314. Existence of a Refining Industry: The existence of adequate local refining industry is an important factor conducive to the development of the petrochemical industry. Apart from being an indispensable source of supply of direct raw materials, it provides a substantial output of valuable by and co-products from petrochemical operations which, in turn, can be processed further into useful products - as for example, 1 ton of ethylene by the steam cracking of naphtha automatically yields about 0.2 ton of LPG and 0.65 ton of gasoline. Finally, there is a great deal of complementarity and supplementarity in the refining and petrochemical industries in terms of technologies, process operations and even specialised personnel and manpower skills. In a sense, therefore a petrochemical complex becomes a necessary adjunct to a petroleum refinery wherever conditions in terms of large refinery capacity and adequate market ideally exist or are capable of existing.

315. Availability of Manpower: Petrochemical technology is very complex, being influenced by the technical developments in such field as metallurgy, mechanics and electronics apart from chemistry. The personnel in charge of erection, operation and maintenance of plants is therefore made up essentially of a highly specialized work force. Also, the plant and equipment is highly sophisticated and complex and generally tailor-made. In consideration of the huge investment involved and the adverse effect of too frequent stoppages on the economical viability of the plant, it is advisable that the operation and maintenance of petrochemical plants should be in the hands of very experienced personnel. Timely and adequate training of engineers and technical operating and maintenance specialists as well as chemists and managers is a decisive factor.

316. Investment Financing: Petroleum refining and petrochemical industry is characterised by high capital investment and automation of process operations. Access to the means of financing these very high investments, has been and will increasingly be a major element governing the establishment and development of the petrochemical industry. The project gestation period being long. Such financing has obviously to be based on easy and soft terms.

317. Existence of a Processing Industry: The end-products of the petrochemical industry are not sold directly to the ultimate consumers. The petrochemical industry finds its outlets in other processing industries, i.e., chemicals, plastics, textiles, and tyres industries. In the absence of a production base for such industries already existing in a country or area, there is no effective built-in outlet for the petrochemical industry products, even if an ultimate consumer market may exist in that country for finished products such as pipes, sheets, films, tyres etc. Thus, the existence and development of a processing industry are indispensable for promoting the production of petrochemicals. Processing industries are very different in nature from the petrochemical industry; they do not require such high investments; they can employ a large work force because of the manual content of the operations; and their economic size of plant capacity and operation is lower. Above all, their location can be pragmatic depending upon several factors.

Stages and Patterns of Development

318. During the decades that followed World War II, numerous factors motivated an accelerated expansion of the petrochemical industry. Expanded knowledge of surface phenomena led to the discovery and development of variety of synthetic detergents, adhesives and water repellants. A better understanding of molecular system and polymerization led to a whole series of new families of materials such as plastics, synthetic fibres, foams, synthetic rubber and coating materials.

319. Of large significance was the synthesis of aromatics by catalytic reforming and the development of processes for the inexpensive extraction of the building blocks aromatics, benzene, toluene and xylenes from reformates. To adjust the imbalance between benzene and the co-aromatics, processes were developed for the dealkylation of the latter to produce the former.

320. Processing arrangements within petrochemical complexes are governed by universal practices since the variety of intermediate or end-products is rather common wherever petrochemical manufacture is undertaken on a large-scale. However, certain raw-material sources could differ from one country to another. For example, in the United States ethane and propane have been recovered quite cheaply from natural gas and have therefore been the raw material for most of the ethylene production. Apart from ethylene, catalytic cracking units in the United States provide almost all of the propylene and butylene required. In Europe and Japan on the other hand of the light hydrocarbons not being readily available catalytic cracking is employed to a much less extent with the result that production of ethylene and other olefins has usually been based on the pyrolysis of naphtha. The pyrolysis units in these countries also meets a good part of their light-aromatic raw-materials needs.

321. Plants in Europe, the United States and Japan account for nearly 94 per cent of world ethylene capacity, 97 per cent of world benzene capacity and 93 per cent of world butadiene capacity. The importance of these areas in terms of production capacity also covers intermediates and end-products and more than 90 per cent of the facilities for intermediates, plastics and synthetic rubber productions are located in in these areas.

322. The number of developing countries which have a sizeable basic petrochemical industry in operation is yet small at present. Brazil, Mexico, Venezuela, Algeria, Libya, the Republic of Korea, Taiwan and India are some examples where petrochemical complexes are existing or under construction or will be implemented. The share of developing countries in petrochemicals production may however be expected to grow. Taking into consideration the projected plants that will start up before 1980, the ethylene capacity in Latin America, Africa (excluding South Africa) and Asia (excluding Japan) will increase from 2.6 million to 7.3 million tons between 1978 and 1980 - that is, by about 280 per cent -; during the same period, the capacity increase in Europe, the United States and Japan will be from 36 to 49.9 million tons that is, less than 40 per cent.

323. World projected demand for the main basic petrochemicals in 1985 is shown in Table III.1:

Table III.1: World Demand for Main Basic Petrochemicals (1985)

	Ethylene	Propylene	Butadiene	Benzene
	(1000 Tons)			
West Europe	21,400	11,064	1,766	8,669
Eastern Europe	6,150	3,050	2,156	4,098
North America	23,380	11,056	2,569	10,640
Latin America	4,990	2,149	684	1,848
Africa	1,938	772	322.2	947
Asia (excluding China)	13,480	7,990	1,973	6,112
Pacific Area	1,218	557	93	520
Total World	72,936	36,638	9,563.2	32,834
Of which Dev. countries	12,108	5,243	2,034.2	5,206

Source: Summary of the Draft World-wide Study of the Petrochemical Industry (UNIDO/ICIS.72), 15 June 1978.

324. World production of the main basic petrochemicals is shown in Table III.2.

Table III.2: World Production of the Main Basic Petrochemicals

	(Million Tons)		
	1965	1970	1976
Ethylene	8.0	18.5	26.0
Propylene	4.4	9.5	13.7
Butadiene	1.9	3.0	4.9
Benzene	4.8	8.8	13.3

Source: Summary of the Draft World-wide Study of the Petrochemical Industry (UNIDO/ICIS.72), 15 June 1978.

325. The percentage regional share in world basic petrochemicals production is shown in Table III.3.

Table III.3: Percentage Regional Share of Basic Petrochemicals Production

	1965	1970	1976	1965	1970	1976
United States	58	42	38	56	44	34
Western Europe	25	32	37	30	31	31
Japan	11	16	15	8	18	14
Others	6	10	10	6	7	21

Source: Summary of the Draft World-wide Study of the Petrochemical Industry (UNIDO/ICIS.72), 15 June 1978.

326. World demand for the main petrochemical products in 1975 and projections to 1985 and 2000 were estimated by UNIDO's International Centre for Industrial Studies (ICIS) as shown in Table III.4.

Table III.4: World Demand for the Main Petrochemical Products in 1975 and Projections to 1985 and 2000

	DEVELOPED COUNTRIES				DEVELOPING COUNTRIES				WORLD TOTAL		DEVELOPING COUNTRIES SHARE (in per cent)			
	1985		2000		1985		2000		1985		1985		2000	
	Actual	Forecast	Hypothesis B	Hypothesis A	Actual	Forecast	Hypothesis B	Hypothesis A	Actual	Forecast	Hypothesis B	Hypothesis A	Actual	Forecast
Plastics	34.0	101.3	196.5	130.1	4.4	19.0	47.1	62.4	38.4	120.3	243.6	192.5	11.5	15.8
Synthetic Fibres	5.9	12.6	36.8	23.9	1.6	6.0	14.3	21.7	7.5	18.6	51.1	45.8	21.8	32.2
Synthetic Rubbers	6.5	10.1	22.8	16.9	0.9	2.7	6.4	7.5	7.4	12.8	29.2	24.5	11.9	21.0
Synthetic Detergents	8.6	12.7			2.2	4.5			10.8	17.2			20.5	26.2
Ethylene		60.8	111.5	68.8		12.1	25.2	36.8		72.9	136.7	107.4		

Source: The Growth of the Petrochemical Industry in the World up to year 2000 (ID/WG.268/5), 4 April 1978.

Note: Hypothesis B for the year 2000 is based on economic growth rates assumed in Leontieff's Study - developed countries 4.5 per cent per annum, developing countries 5.9 per cent per annum. Hypothesis A for the year 2000 is based on economic growth rates assumed in another UNIDO study - developed countries 2.9 per cent per annum, developing countries 6.8 per cent per annum.

327. World demand (by regions) for the main petrochemical products in 1985 is estimated as shown in Table III.5.

Table III.5: World Demand (by Regions) for the Main End-product Petrochemicals in 1985

(1000 tons)				
REGIONS OF THE WORLD	PLASTICS	SYNTHETIC FIBRES	SYNTHETIC RUBBER	SYNTHETIC DETERGENTS
WESTERN EUROPE	36,330	3,200	2,533	(1975) 4,800
EASTERN EUROPE	13,975	2,645	3,394	2,700
NORTH AMERICA	33,575	4,545	3,681	3,600
LATIN AMERICA	7,886	1,490	909	1,850
AFRICA	3,255	749	431	580
ASIA (excl. CHINA)	23,310	5,650	2,710	3,240
PACIFIC AREA	1,975	293	123	410
TOTAL WORLD	120,306	18,572	12,801	17,180
Of which developing countries	18,971	6,017	2,722	4,480

Source: Summary of the Draft World-wide Study of Petrochemical Industry (UNIDO/ICIS.72), 15 June 1978.

328. World production of the main end-product petrochemicals is shown in Table III.6.

Table III.6: World Production of the Main End-Product Petrochemicals
(million tons)

	1950	1960	1970	1974	1975
Plastics	1.5	7.0	30.2	44.6	38.5
Synthetic fibres	0.1	0.7	5.1	7.5	7.5
Synthetic rubbers	0.7	2.0	5.9	7.7	7.4
Detergents	0.7	3.5	9.0	11.0	10.8

Source: Summary of the Draft World-wide Study of the Petrochemical Industry (UNIDO/ICIS.72), 15 June 1978.

329. The present trend in petrochemical complexes is towards increased and product mix. However, there is no stereotyped petrochemical complex and each differs from the other in the variety of raw materials it uses and in the number and kind of intermediates and/or end-products it generates. Because of the high capital investment of olefins production, some countries have, nonetheless, started their petrochemical industries by manufacturing end products from imported intermediate and basic petrochemicals. Other countries are following suit.

330. Because of the depletion of some of the currently-exploited reserves of natural gas in certain areas in the United States, the most recent trend is to produce ethylene from ethane/propane and/or naphtha using flexible multiple feedstock crackers. The Nigerian ethylene based complex will adopt this same approach.

331. A possible development is the production of petrochemicals directly from crude oil without going through the intermediate production of naphtha or other feedstocks. Switchover to the use of coal (which it is believed, will again play an increasing role in chemicals production), wood, alcohol and other feedstocks which are alternatives to crude oil and natural gas is another possibility.

Characteristics and Common Features of the Petrochemical Industry

332. The growth of the petrochemical industry is increasing steadily. World production of petrochemicals rose from a few hundred tons in 1920 to 3.5 million tons in 1950 and now exceeds 70 million tons representing, at 14 per cent per annum, is one of the fastest growths in industry. Its highly competitive position in relation to other traditional products (synthetic and natural), its appeal in terms of certain novel properties not encountered in these traditional products, and its potential for supply of inputs to other industries and its now balling effect in stimulating other economic and auxillary activities are factors behind its dynamic growth, notwithstanding its need to compete with some sectors in obtaining its supply of raw materials. Its capacity to help promote and proliferate small-scale downstream industries and generate a cadre of entrepreneurs is of singularly interest to developing countries.

333. As already explained, this is a highly capital-intensive subsector requiring heavy investment, particularly at the basic petrochemicals production level. Consequently, concepts of economy of scale, are very important and, over the years, have undergone a change, from the point of improved economy of primary investment and operational cost per unit of output. Prior to 1965, a cracker with an annual capacity of 100,000 tons of ethylene was considered to be an economic size but present day plants are being designed for 300,000 ton level and where conditions justify, even for 450,000 - 550,000 tons as laready done in the United States and Europe. Other parameters such as size of compressors, furnaces and exchangers may, however, tend to restruct the concept of limitlessness of cracker capacitys beyond a certain level.

B. THE PRESENT STATE OF THE PETROCHEMICAL INDUSTRY IN AFRICA

334. There is, at present, no petrochemical industry in all the countries visited. There are, however, petrochemicals - processing facilities in all of them varying in type, number and magnitude of the production capacity catering to different domestic market sizes.

The kind of main pre-requisites discussed earlier as necessary for the development of the petrochemical industry generally exist in Nigeria and Egypt; limited opportunities will probably develop in Tanzania and Gabon in the near future and in Cameroon later (probably after 1990).

335. Availability of raw materials: Raw materials for the production of petrochemicals exist in varying measure in all these countries with the exception of Upper Volta, as shown in Table III.7.

Table III.7: Availability of raw materials in countries visited

	<u>Crude oil</u>	<u>Natural gas</u>	<u>Naphta</u>	<u>Ethanol</u>
Tanzania		x <u>a/</u>	x <u>b/</u>	x
Gabon	x	x <u>a/</u>	x	
Cameroon	x	x <u>a/</u>		
Nigeria	x	x	x	
Egypt	x	x <u>a/</u>	x	

a/ Subject to sufficiency of resources.

b/ After the expansion of TIPER refinery by 1981.

336. Production of basic petrochemicals: While there is no production of basic petrochemicals in these countries at present as already explained, Nigeria and Egypt have programmed, in their Development Plan, for the setting up of ethylene units of sizeable capacities from natural gas and/or naphtha, based on domestic demand as shown below:

	<u>Planned ethylene capacity (t/y)</u>	<u>Start-up date</u>	<u>Raw materials</u>
Nigeria	250,000 initially, to be extended to 350,000	1981/82	Ethane/propane and or naphtha
Egypt	200,000 initially, to be extended to 300,000	1984	Naphtha

337. In the case of Tanzania and Gabon, the following two projects for the production or relatively small quantities of ethylene based on domestic demand, were identified as a result of the field mission.

	<u>Identified ethylene capacity (t/y)</u>	<u>Raw materials</u>
Tanzania	11,000 - 15,000	Naphtha or ethanol (from molasses)
Gabon	16,000 (for all UDEAC countries)	Naphtha

338. As far as other basic petrochemicals are concerned (apart from ammonia which is accounted for in Chapter II), there is scope for establishing methanol plants based on natural gas in Tanzania, Gabon and Nigeria. Methanol plants are conventionally large in

size and there is some extra specificity in the investment decisions on such plants vis-a-vis down stream utilisation industries and transportation of methanol and hence. It is felt that a more detailed study may be necessary to investigate and establish the viability of these project possibilities.

339. Production of methanol in Cameroon and Egypt is also a possibility if the reserves of the new finds of natural gas prove to be sufficient to set up viable plants.

340. Production of the Main End-product Petrochemicals: Barring some production of synthetic detergents (besides the local packing) based on imported materials, there is currently no production of the main end-product petrochemical groups (ie. plastics, synthetic elastomers and synthetic fibres in the countries visited. The present Development Plans of Tanzania, Nigeria and Egypt envisage establishment of manufacture of plastics and/or adhesive resins. Other project possibilities for manufacturing plastics and/or adhesive resins (based on domestic demand of each country) are identified in this report.

341. As regards other end-product petrochemicals (i.e. Synthetic rubbers, fibres and detergents) in the countries visited, only Nigeria produces Synthetic fibres (11,000 tons/annum of polyester). Both Egypt and Nigeria have plans to set up new capacities for polyester by 1980.

342. The planned and/or identified project capacities of end-product petrochemicals in five countries up to 1985 are shown in Table III.9.

Table III.9: Planned and/or Identified End-product Petrochemicals Capacities in the countries visited up to 1985

	<u>End-product to be produced</u>	<u>Capacity (t/y)</u>	<u>Raw material</u>
Tanzania	PVC	12,000 (suggested to be increased to 20,000.	VCM (imported)
	VCM (if ethylene is manufactured locally)	21,000 - 30,000	Ethylene and chlorine (locally produced)
Nigeria	PVC	90,000	VCM (locally produced)
	VCM	95,000	Ethylene and chlorine (locally produced)
	LDPE	120,000	Ethylene and chlorine (locally produced)
	HDPE	60,000	Ethylene (locally produced)
Egypt	PVC	80,000	VCM (imported, but will be manufactured locally in Phase II by 1984).
	VCM	83,000	Ethylene and chlorine (locally produced in Phase II).
	LDPE	90,000	Ethylene (imported, but will be manufactured locally in Phase II).

Table III.9 (cont'd)

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	<u>End-product to be produced</u>	<u>Capacity (t/y)</u>	<u>Raw material</u>
	HDPE	40,000	Ethylene (imported, but will be manufactured locally in Phase II).
Gabon	PVC (for all UDEAC countries)	29,000	VCM (imported or locally produced).
	VCM (if ethylene is manufactured locally)	30,000	Ethylene and chlorine (locally produced).
	Urea-and phenol-formaldehyde adhesives	7,500	Urea, phenol and formaldehyde (imported).
Cameroon	Urea-and phenol-formaldehyde adhesives	7,500	Urea, phenol and formaldehyde (imported).

343. Extension of Country findings to the Region: The characteristics of the petrochemical sub-sector in the region, the obstacles to the development and the progress achieved are briefly discussed below.

344. Characteristics and linkages of the Sub-sector in the Region: In the early part of this Chapter reference was made to South Africa, Algeria, Libya, Egypt and Nigeria being endowed with the main pre-requisites for the development of petrochemical industry, the former three countries being the only countries in the region, at present, which have basic and/or end-product petrochemical plants in operation and hence could be described as being at an advanced stage compared to Egypt and Nigeria. The main pre-requisites are expected to come up in the not too distant future in some other African countries such as Tanzania and Gabon.

345. Apart from linkages with the petroleum refining industry, the setting up of petrochemical industries in the region will promote (as has happened already in some countries) following type of linkages within the industrial sector as well as with other economic sectors;

- (a) Augmentation of infrastructure activities and sources for construction, building, agriculture etc;
- (b) Creation of demand for basic chemicals and other inputs required for the production of petrochemicals; and
- (c) Stimulus for the growth of consumer industry sub-sector such as packaging, footwear, plastic pipes, leathercloth, plastic floor tiles, cables, paints, furniture, woodworking electrical and automotive industries, synthetic rubber-goods including rubber types and tubes, synthetic fibres fabrics and detergents

346. Although there are some 33 refineries and about four gas processing plants in Africa (which are conducive to the development of petrochemical industry), the general picture of the development of this industry in Africa is one of nascency.

347. Major Obstacles to Development: The obstacles and inhibiting factors which characterise most of the countries of the region are:

- (a) Relative smallness of the domestic market for the intermediate and end-product

petrochemicals (except in high population base countries such as Nigeria and Egypt);

- (b) Slow rate of growth in the petrochemical processing industries sector;
- (c) Socio-economic factors militating against the expansion of the market;
- (d) Shortage of trained skills;
- (e) Shortage of energy (electrical power and coal);
- (f) Inefficiency and inadequacy in infrastructure resulting in high transport cost; and
- (g) Problems of transfer of new technology and particularly, in the selection and effective utilization of the best available technology appropriate for the conditions prevailing in the region.

348. Progress achieved: The situation in the region as a whole can be summarised in the following paragraphs.

349. The distribution of petroleum and natural gas resources is uneven in the region; in the sense that the North and, to some extent, the West are better-endowed, the South is relatively poor and the East is the least-endowed. The producer countries of petroleum and/or natural gas in Africa are: Algeria, Libya, Tunisia, Egypt, Morocco, Nigeria, Gabon, Cameroon, Congo, Zaire and Angola. Tanzania and possibly Benin are expected to join the ranks of producer countries in the region in the near future.

350. In the majority of African countries, the use of petroleum products is limited mainly to the conventional range of LPG (liquified petroleum gas), gasoline, diesel fuel, kerosine, gas oil, fuel oil, lubricating oil and bitumen (asphalt), the last two finding non-fuel application. Among the light fractions (LPG, gasoline and naphtha), naphtha may increasingly find favour as feedstock for the petrochemical industry, especially in countries where local natural gas is not available or is in shortage.

One other possibility is the catalytic re-cracking of the heavy end such as fuel oil into middle distillates like diesel and kerosene or even into light ends such as naphtha on socio-economic or industrial priority considerations of the demand for particular products.

351. Crude oil refining capacity in Africa was about 61.7 million tons in 1975. Based on the expansion of existing units and new refineries which were set up or which are under construction during the period 1975 - 1980, it is expected to increase to about 75 million tons in 1980 and 150 million tons in 1990. It is expected that in the crude oil producing countries substantial development will be directed towards the establishment and diversification of the petrochemical industry.

352. The recent petroleum refining capacity in the region (1977) is shown in Annex III.A.

353. African demand for basic petrochemicals was estimated by UNIDO's ICIS (see Table III.10).

Table III.10: African Demand for Basic Petrochemicals (1985)

Subregion	(1000 tons)			
	Ethylene	Propylene	Butadiene	Benzene
North Africa	661	245	97	290
West Africa	366	121	75	173
East Africa	300	87	70	121
Central Africa	181	51	23.6	56
South Africa	440	268	56.6	307
Total Africa	1,938	772	322.2	947

354. The only countries at present engaged in the production of basic petrochemicals are Algeria and Libya. However, Nigeria and Egypt are planning to have their ethylene plants by 1981/82 and 1984 respectively.

355. Current products and planned capacities of basic petrochemicals in the region are shown in Table III.11.

Table III.11: Current Production and Planned Capacities of Basic Petrochemicals in Africa

Country	Basic Petrochemical Produced	Existing	Capacity (t/y)	
			Under Construction	Planned
Algeria	Ethylene	120,000		
	Ethylene			500,000
	BTX		600,000	
	Xylene		38,000	
	Ammonia	300,000		
	Ammonia			300,000
Libya	Methanol	330,000		
	Ammonia	330,000		
	Ammonia		330,000	
	Ethylene		330,000	
South Africa	Ethylene		182,000	
	Ethylene			
Nigeria	Ethylene			250,000 <u>a/</u>
Egypt	Ethylene			200,000 <u>b/</u>

Source: Information obtained during the field mission and from international publications.

a/ Planned for 1981/82, to be increased to 350,000 after 1985.

b/ Planned for 1984, to be increased to 300,000 after 1984.

356. Apart from Nitrogenous fertilizers, the main end-product petrochemicals are:

plastics (including formaldehyde based resins),
synthetic elastomers (rubbers),
synthetic fibres, and
synthetic detergents.

357. From information obtained from the countries visited and those available on other countries of the region, it appears that plastics are the main petrochemicals of significance as regards production or potential production in several African countries in the near future.

358. World demand for plastics was 44.603 million tons in 1974 and is estimated at 121.125 million tons in 1985. The corresponding African shares are 0.724 and 4.074 million tons respectively.

359. The breakdown of demand for plastics by African subregions is shown in Table III.12.

Table III.12: Demand for Plastics by African Subregions in 1974 and 1985

Subregion	1974	1985	Average annual growth rate (1965-1975) (%)
North	220	1,090	19.1
West	102	575	19.8
East	108	490	18.7
Central	64	295	9.4
South	<u>230</u>	<u>805</u>	<u>-</u>
Total Africa	724	3,255	17.7

Source: Summary of the Draft of World-wide Study of the Petrochemical (UNIDO/ICIS.72), 15 June 1978.

360. The average annual growth rates (AAGR) of demand for plastics by the different African subregions (1965-1975), estimated by UNIDO's ICIS, are shown in Table III.12.

361. In this connexion, it is worthwhile mentioning that the value of imports of plastics by the African region in 1975 was 328.8 11/ million Dollars as compared with 2,450 11/ million Dollars for all chemicals imported and 588.2 11/ million Dollars for pharmaceuticals.

362. Urea- and phenol- formaldehyde resins are among the plastics of some significance to a number of African countries. As they are used as adhesives in the wood working industry (particularly plywood, wood pannels and particle-board), apart from that use for moulding purposes.

363. A trend towards diversification is evident in existing establishments in Africa, especially in plastics-processing plants.

364. The current production and planned capacities of plastics end-product petrochemicals and formaldehyde based resins in the region are shown in Table III.13.

11/ OECD Statistics of Foreign Trade, 1975.

Table III.13: Current Production and Planned Capacities of Plastics
Formaldehydebased Resins in Africa

Country	Plastic or Resin Produced	Existing	Capacity (t/y)	
			Under Construction	Planned
Algeria	VCM		40,000	
	PVC		35,000	
	LDPE	48,000		
	Urea-formaldehyde		8,000	
Libya	VCM			60,000 (1979)
	PVC			56,000 (1979)
Morocco	VCM	27,000		
	PVC	25,000		
South Africa	VCM	115,000		
	PVC	100,000		
	Urea and Melamine-formaldehyde (moulding powder)	5,000		
Nigeria	VCM			95,000 (1981/82)
	PVC			90,000 (1981/82)
	LDPE			120,000 (1981/82)
	HDPE			60,000 (1981/82)
Egypt	PVC			80,000 (1981)
	VCM			83,000 (1984)
	LDPE			90,000 (1981)
	HDPE			40,000 (1981)
	Urea- and phenol-formaldehyde			6,700 (1981)
Tanzania	PVC			12,000 (1982/83)

Source: Information obtained during the field mission and from international publications.

365. Other End-product Petrochemicals: The demand for other end-product petrochemicals, by African subregions is estimated by UNIDO's ICIS as shown in Table III.14.

Table III.14: Demand for Other End-product Petrochemicals by African Subregions in 1974 and 1985

Subregion	1974			1985		
	Synthetic Fibres	Synthetic Rubber	Synthetic Detergents (1975)	Synthetic Fibres	Synthetic Rubber	Synthetic Detergents
North Africa	50.6	51	110	270	129	290
West Africa	29.3	45	50	168	100	110
East Africa	21.3	39	40	75	95	90
Central Africa	9.4	11	25	29	31	50
South Africa	86.3	16	25	207	76	40
Total Africa	196.9	162	250	749	431	580

Source: Summary of the World-wide Study of Petrochemical Industry (UNIDO/ICIS.72), 15 June 1978.

366. The production of other end-product petrochemicals in the region (apart from plastics and resins) is very limited or non-existent. The current production and planned capacities of other end-product petrochemicals in the African subregions is shown in Table III.15.

Table III.15: Current Production and Planned Capacities of Some End-product Petrochemicals in Africa

Subregion	(1000 Tons)		
	Synthetic Fibres	Synthetic Rubber	Synthetic Detergents
North Africa	56 (including 53 planned for 1980)		
West Africa	33 (including 22 planned for 1980)		
East Africa			
Central Africa			
South Africa	51	30	5
Total Africa	140	30	5

Source: Information obtained during the field mission and from International publications and UNIDO's ICIS - Summary of World-wide Study of the Petrochemical Industry.

C. AFRICAN POLICIES AND STRATEGIES GEARED FOR THE DEVELOPMENT
OF THE PETROCHEMICAL INDUSTRY

Investment Codes and Incentives

367. The petrochemical industry being capital intensive its requirement of high investments can be financed by one or two ways:

- (a) Full contribution by the State or the Public Sector, as is the case in Algeria and Libya; and
- (b) Joint venture arrangement between government and local foreign partners as is the case with the Nigerian and Egyptian petrochemical complexes.

368. Construction costs in Africa (and developing countries in general) are substantially higher than in industrialized countries. Local conditions greatly affect the constituent elements of the construction cost, mainly due to infrastructure problems and the dependence on imports for materials as well as the contractor and supervisor services.

369. In African countries where foreign and private sector participation in investment is required incentives are offered by governments in the form of duty-free imports of machinery and raw materials, as well as temporary or partial relief of income tax and production tax.

370. Investment codes, generally, aim at creating attractive conditions for foreign investors to participate in large-scale joint venture projects such as petrochemical complexes. These codes include conditions, among others, which allow the repatriation of the foreign capital as well as all or part of the foreign partners profit. The new Investment Law of Egypt (Law No.43) may be quoted as an example of a recent formulation of a code for the attraction of foreign investors. In general, there is no harmonization of these codes between African countries at present. Such harmonization is necessary, especially at the subregional and multinational levels.

Selection, Procurement and Transfer of Technology

371. The petrochemical industry is characterised by rapid technological change and therefore, is subject to premature obsolescence. African countries can at present, handle, a very limited number of questions relating to selection, procurement and transfer of petrochemical industry technology.

372. Domestic capabilities in technology as well as management of petrochemical plants must be developed in African countries in the shortest possible time, as it will be wasteful of resources to go in for frequent technological modernisation of the means of production on grounds of early obsolescence apart from the need to reduce the dependence on external sources for know-how and technology. It is not sufficient to view the transfer of technology as a flow of know-how and information from the industrialized countries to developing African countries; it is also important to recognize that significant developments in technological innovation and adaptation and transfer of technology of petrochemical industry could come from the exchange of information among African countries themselves. African countries should, when making new investments, be alive to the major trends in feedstocks technology for the production of basic petrochemicals and in production processes for intermediates and end-products and their advantages/disadvantages vis-a-vis local conditions.

Infrastructure

374. In a number of African countries, such infrastructure as it exists or had originally been designed, does not fit into the present day needs, particularly for large-scale projects such as petrochemical complexes. The lack or inadequacy of physical infrastructure in some African countries is one of the main obstacles to industrialization in general and particularly to the promotion of African multinational industries.

375. Transport should be accorded high priority in the investment programmes of African countries at the national level since it is critical to the movement of raw materials, intermediates, machinery and other supplies etc. Inefficiency and gaps in transport links and facilities, as well as congestions at ports have the following negative effects in several African countries:

- (a) high cost of transport and accordingly, increased cost of the transported item, including the need to use the relatively expensive air transport to avoid delay;
- (b) stoppage or delay of production;
- (c) undesirable over-stocking of imported raw materials, intermediates and spare parts to avoid stoppages in production;
- (d) prolongation of the gestation period of projects resulting in increased investment and production costs; and
- (e) unnecessary resort to imports of the finished product, in the meantime with foreign exchange expenditure.

Manpower Development

376. The present number of highly qualified, specialized and trained personnel working in petroleum refining in African countries and who could potentially be suitable to operate petrochemical plants is not sufficient. Efforts should be intensified to overcome the lack of managerial and technical personnel so as to build up a national cadre of skills for developing the petrochemical industry (as well as other basic industries). The main problem in providing the skilled manpower for the development of the petrochemical industry in African countries is the structure disproportions between graduates supply and demand, which is due to the lack of sufficient specialization in chemical and mechanical engineering and all kinds of skilled manpower, including graduates of vocational education institutes. There is also a lack of qualified trainers and adequate training programmes and facilities and institutes.

377. Thus, the main policies for manpower development aimed at meeting the growing requirements of the development of the petrochemical industry in African countries, should include the following areas of activities:

- (a) manpower planning;
- (b) co-operation and co-ordination of activities between the petrochemical industry and the educational system;
- (c) training policy and development of the institutional training;

- (d) assistance of ECA/UNIDO and other United Nations Agencies as well as industrialized countries in manpower development.

Pollution-Control

378. Few African countries have pollution control regulations. Specific anti-pollution regulations to deal with problems presented by the petrochemical industry must be drawn up by the relevant authorities. Such regulations are indispensable to contractors for the design of pollution control systems and must therefore be in existence when the tender documents are sent out. It is recommended that the different ministries concerned e.g. industry, health, urban development, agriculture, etc. should draw up relevant regulations, referring if necessary to other countries' experience.

Multinational, Subregional and Regional Co-operation

379. Regional co-operation schemes have, at various times, been conceived by African countries with a view to ultimately creating fully-fledged economic unions at the multinational, subregional or regional levels. The institutional machineries created, such as free trade areas, sectoral co-operation arrangements, custom unions and common markets are examples of such attempts. In this connexion it should be noted that industrialization has proved to be the most difficult and complex subject to tackle in all the organizations established for economic co-operation and it is the area where progress has been minimal irrespective of the instruments of co-operation employed.

380. Within the petrochemical industry sub-sector, there has hardly been any multinational, subregional or regional co-operation or planning that has effectively taken place barring three regional conferences on hydrocarbon processing, petroleum industry development and development of petroleum refineries. The petrochemical complexes and units which have been set up recently or which are either under construction or being planned in African countries to-day, are the outcome of policies and strategies adopted in the National Development Plans of these countries without giving consideration to regional or subregional demand and production. Obviously, this policy has the risk of resulting in over-capacities or under-capacities at the subregional or regional level, as is expected to take place in North Africa and possibly in other subregions in the near future, unless this policy is remedied soon.

381. Suggestion relating to approaches to development of multinational, subregional and regional co-operation in the area of petrochemical industry, are discussed in Section VI of this Report. One of the important aims of African multinational, subregional and regional co-operation in the field of petrochemical industry should be to promote investment in new subregionally based petrochemical industries in which economies of scale are important.

D. APPROACHES TO DEVELOPMENT OF THE PETROCHEMICAL INDUSTRY AT SUBREGIONAL AND REGIONAL LEVELS

Necessity of Regional, Subregional and Multinational Policy for Future Development of the Petrochemical Industry in Africa

382. The development of the petrochemical industry in Africa has, up to now, been based on national policies and strategies without giving consideration to multinational, subregional and regional planning. In some countries such as Algeria and Libya, large-scale production of petrochemicals is oriented towards export as well as domestic market. However, in other countries such as Nigeria, planned production is based on the domestic market demand only.

383. Nigeria and Egypt, African countries do not generally have large national markets to absorb the output of a petrochemical complex, based on capacities which are considered to be of minimum size in industrialized countries today. If these countries were to set up petrochemical units to serve their local markets only, these units will have to be scaled-down to correspond to the size of the domestic markets with implications of higher production costs and competitive weakness vis-a-vis imports; besides, adaptation of petrochemical industry technology to smaller sized plants has not, up to now, been successful in many cases. It is therefore strongly recommended that African countries should adopt multinational or subregional approach for the establishment of petrochemical industries by combining their markets as well as their capital, human and raw material resources.

384. In the case of North African countries, where the national petrochemical industry development has been undertaken without co-operation with other countries, the same policy of setting up multinational or subregional industries should be adopted in regard to new petrochemical opportunities to be set up or planned in the future.

385. In short, the objectives of the development of the petrochemical industry in Africa should be based on the concept of multinational, subregional and regional co-operation.

Objectives of the Development of the Petrochemical Industry

386. The objectives of the development of the petrochemical industry in African can be summarised in the following:

- (a) A rational and well planned integrated development of the petrochemical industry at the multinational, subregional and regional levels for both domestic and export purposes;
- (b) Efficient and economic utilization of African hydrocarbon resources (natural gas and petroleum and its derivatives);
- (c) Promotion of rational specialization and complementarity in production of petrochemicals among the participating countries at the multinational, subregional and regional levels;
- (d) Development of the petrochemical (end-product) processing industries at the national level in co-ordination with subregional and regional markets demands;

- (e) Overcoming major problems and obstacles to development such as shortage of specialized manpower and inadequate infrastructure at the national and multinational or subregional levels; and
- (f) Establishing subregional centres for research and development to cope with the continuous technological changes in the petrochemical industry.

387. To implement the above objectives an agreed multinational industrialization policy in regard to petrochemical industry is required.

388. The very nature of the petrochemical industry offers scope for sharing manufacturing facilities as economies of scale are most crucial (especially in the production of basics and intermediates). It is therefore, suggested that the development of the industry should be planned on the basis of properly located large-scale multinational basic, intermediate and end-product petrochemical units, which will supply other processing facilities at the national level with petrochemical materials as inputs for the production of end-use consumers goods.

Identification of Priority Areas/Complexes Offering Opportunity for Co-operative Development

389. Based on parameters of economic interdependence, comparative advantages, specializations, complementarity and demand/supply of the subregions (mentioned before under Section IV of this Report), the following areas/complexes are identified in regard to the subregions:

North Africa

Basic Petrochemicals

Table III.16 shows the projected deficit/surplus situation of basic petrochemicals in North Africa by 1985.

Table III.16: Deficit/Surplus of Basic Petrochemicals in North Africa by 1985

<u>Basic Petrochemical</u>	<u>Demand in 1985 a/</u>	<u>Production in 1985 b/</u>	(1000 Tons)
			<u>Deficit (-)</u> <u>Surplus (+)</u>
Ethylene	661	1,150	(+) 489
Propylene	245		(-) 245
Butadiene	97		(-) 97
Benzene	290		

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during field mission and from international publications.

390. It is obvious from Table III.16, that North Africa will have a surplus of 489,000 tons of ethylene in 1985 which will have to be oriented to export markets, mainly in Europe. The 600,000 tons BTX plant under construction in Algeria should be able to meet the 290,000 tons estimated demand for benzene. As for the remaining basic petrochemicals the following project opportunities are identified for 1985:

- (a) Two units of 100,000 and 150,000 tons/annum of propylene costing about 180 and 270 million dollars respectively, and
- (b) Two units each of 50,000 tons/annum of butadiene each costing about 75 million dollars.

If additional benzene capacity of the range of 100,000-200,000 tons/annum is to be set up, it would require an investment of about 450-700 dollars per ton of capacity.

391. The investment estimates were based on OECD forecasts for investment costs in 1985 ^{12/} and on the assumption that costs in North Africa are at least 25 per cent higher than those in European countries.

392. It should be noted that propylene is produced along with ethylene in the naphtha or ethane/propane crackers while butadiene is recovered from the C₄ stream produced in naphtha, crackers along with ethylene and propylene.

393. The three aromatics, benzene, toluene and xylenes (BTX) are principally produced today by catalytic reforming of selected naphtha cuts, with the relative yields depend on the quality of the feed to the reformer. Thus, a heavy naphtha will produce more of the heavy aromatics, the xylenes. To produce more quantities of benzene (which is usually in greatest demand), the toluene produced through catalytic reforming is hydrodealkylated to produce additional quantity of benzene.

Plastic

394. As mentioned in Section B of this Chapter, the demand for plastics in North Africa in 1985 is estimated at 1,090,000 tons compared to production of about 387,000 tons ^{13/}. Additional capacity of about 700,000 tons will, therefore, be needed in 1985. This can be met by setting up plants in more than one country of the subregion.

395. It is not, at this stage, possible to attempt an estimate of the breakup capacities for the different types of plastics or resins against this total of 700,000 tons. This would require further survey to identify the type and quantity of each plastic and resin including provision for export. ECA/UNIDO technical assistance could be provided in this connexion.

Other End-product Petrochemicals

396. Table III.17 shows the deficits of some end-product petrochemicals in North Africa by 1985.

^{12/} European Chemical News, June 9, 1978.

^{13/} Information obtained during the field mission and from international publications.

Table III.17: Deficit of Some End-product Petrochemicals in North Africa by 1985

<u>End-product Petrochemical</u>	<u>Demand in 1985 a/</u>	<u>Production in 1985 b/</u>	(1000 Tons) <u>Deficit (-)</u> <u>Surplus (+)</u>
Synthetic fibres	270	56	(-) 214
Synthetic rubber	129		(-) 129
Synthetic detergents	290		(-) 290

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during the field mission and from international publications.

397. From Table III.17 the following project opportunities for 1985 are identified:

- (a) A 214,000 tons/annum synthetic fibres demand which can be met by setting up four plants on specialization and complementarity.
- (b) A 129,000 tons/annum synthetic rubber demand, which can be met by setting up two plants of about 65,000 tons each.
- (c) A 290,000 tons synthetic detergents demand, which could be met by setting up several units.

398. For the same reasons as for plastics it is not, at this stage, possible to break down the above demands by type and quantity.

With respect to detergents alkyl benzene sulfonates are, by far, the main active materials used for preparing detergents. Biodegradable detergents have largely displaced conventional detergents based on dodecyl-benzene sulfonate.

West and Central Africa

Basic Petrochemicals

399. Table III.18 shows the projected deficit of basic petrochemicals in West and Central Africa by 1985.

Table III.18: Deficit of Basic Petrochemicals in West and Central Africa by 1985

<u>Basic Petrochemical</u>	<u>Demand in 1985 a/</u>	<u>Production in 1985 b/</u>	(1000 Tons) <u>Deficit</u>
<u>West Africa</u>			
Ethylene	356	250 to be increased to 350	
Propylene	121		121
Butadiene	75		75
Benzene	173		173
<u>Central Africa</u>			
Ethylene	181		181
Propylene	51		51
Butadiene	24		24
Benzene	56		56

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during the field mission and from international publications.

400. From Table III.18, it is obvious that the deficits of basic petrochemicals in Central Africa are relatively small. Except for ethylene they would not justify the setting up of economically viable units based on the subregional demand. Under the circumstances, it is suggested that the resources of West and Central Africa be pooled together and that large scale plants for non-ethylene basic petrochemical be set up to serve the needs of the markets of the two subregions as well as potential export markets. Accordingly, the following projects possibility have been identified: 14/

- (a) A 180,000 ton/annum ethylene unit involving an investment of about 530 million dollars;
- (b) A 170,000 tons/annum propylene unit costing about 320 million dollars;
- (c) A 100,000 ton/annum butadiene unit at a cost of 160 million dollars;

14/ Based on OECD forecasts for investment costs in 1985, plus an assumed 30 per cent increase for constructing the plant in West and Central Africa.

- (d) A BTX Unit capable of producing 230,000 tons of benzene at an estimated cost of 110 million dollars.

Plastics

401. As mentioned in Section B of this Chapter, the demand for plastics by West and Central Africa in 1985 is estimated at 575,000 and 295,000 tons respectively, with the corresponding production figures of 270,000 and 45,000 ^{15/} tons respectively. Thus the deficit of plastics in both subregions will be about 300,000 and 250,000 tons respectively. Plants for the production of these quantities of plastics could be set up in one or more countries of each subregion, since each subregion would be expected to have its own ethylene plant. However, it is not possible at this stage to estimate the capacities and types of plastics or resins which would be required in each subregion, since this cannot be made before detailed market surveys in these subregions are carried out.

402. While planning for the production of plastics in West and Central Africa, it should be kept in mind that it would be possible that petrochemicals like VCM could be manufactured in countries of both subregions where the suggested large ethylene plants would exist, but the monomer (VCM) could then be shipped to other countries of each subregion for manufacturing PVC. This arrangement could make it possible for petrochemical industries to be set up in different countries of each subregion.

Other End-product Petrochemicals

403. Table III.19 shows the deficit of some end-product petrochemicals in West and Central Africa by 1985.

Table III.19: Deficit of Some End-product Petrochemicals in West and Central Africa by 1985

End-product <u>Petrochemical</u>	Demand <u>in 1985 a/</u>	Production <u>in 1985 b/</u>	(1000 Tons) <u>Deficit</u>
<u>West Africa</u>			
Synthetic fibres	168	33	135
Synthetic rubber	100		100
Synthetic detergents	110		110
<u>Central Africa</u>			
Synthetic fibres	29		29
Synthetic rubber	31		31
Synthetic detergents	50		50

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during the field mission and from international publications.

Table III.18: Deficit of Basic Petrochemicals in West and Central Africa by 1985

<u>Basic Petrochemical</u>	<u>Demand in 1985 a/</u>	<u>Production in 1985 b/</u>	(1000 Tons) <u>Deficit</u>
<u>West Africa</u>			
Ethylene	356	250 to be increased to 350	
Propylene	121		121
Butadiene	75		75
Benzene	173		173
<u>Central Africa</u>			
Ethylene	181		181
Propylene	51		51
Butadiene	24		24
Benzene	56		56

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during the field mission and from international publications.

400. From Table III.18, it is obvious that the deficits of basic petrochemicals in Central Africa are relatively small. Except for ethylene they would not justify the setting up of economically viable units based on the subregional demand. Under the circumstances, it is suggested that the resources of West and Central Africa be pooled together and that large scale plants for non-ethylene basic petrochemical be set up to serve the needs of the markets of the two subregions as well as potential export markets. Accordingly, the following projects possibility have been identified: ^{14/}

- (a) A 180,000 ton/annum ethylene unit involving an investment of about 530 million dollars;
- (b) A 170,000 tons/annum propylene unit costing about 320 million dollars;
- (c) A 100,000 ton/annum butadiene unit at a cost of 160 million dollars;

^{14/} Based on OECD forecasts for investment costs in 1985, plus an assumed 30 per cent increase for constructing the plant in West and Central Africa.

- (d) A BTX Unit capable of producing 230,000 tons of benzene at an estimated cost of 110 million dollars.

Plastics

401. As mentioned in Section B of this Chapter, the demand for plastics by West and Central Africa in 1985 is estimated at 575,000 and 295,000 tons respectively, with the corresponding production figures of 270,000 and 45,000 15/ tons respectively. Thus the deficit of plastics in both subregions will be about 300,000 and 250,000 tons respectively. Plants for the production of these quantities of plastics could be set up in one or more countries of each subregion, since each subregion would be expected to have its own ethylene plant. However, it is not possible at this stage to estimate the capacities and types of plastics or resins which would be required in each subregion, since this cannot be made before detailed market surveys in these subregions are carried out.

402. While planning for the production of plastics in West and Central Africa, it should be kept in mind that it would be possible that petrochemicals like VCM could be manufactured in countries of both subregions where the suggested large ethylene plants would exist, but the monomer (VCM) could then be shipped to other countries of each subregion for manufacturing PVC. This arrangement could make it possible for petrochemical industries to be set up in different countries of each subregion.

Other End-product Petrochemicals

403. Table III.19 shows the deficit of some end-product petrochemicals in West and Central Africa by 1985.

Table III.19: Deficit of Some End-product Petrochemicals in West and Central Africa by 1985

<u>End-product</u>	<u>Demand</u>	<u>Production</u>	(1000 Tons)
<u>Petrochemical</u>	<u>in 1985 a/</u>	<u>in 1985 b/</u>	<u>Deficit</u>
<u>West Africa</u>			
Synthetic fibres	168	33	135
Synthetic rubber	100		100
Synthetic detergents	110		110
<u>Central Africa</u>			
Synthetic fibres	29		29
Synthetic rubber	31		31
Synthetic detergents	50		50

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during the field mission and from international publications.

404. From Table III.19, the following areas/project opportunities are identified for West and Central African subregions in 1985:

- (a) Two units of combined capacity of 135,000 tons/annum of synthetic fibres in West Africa;
- (b) A 30,000 tons/annum synthetic fibres unit in Central Africa;
- (c) One of 130,000 or 2 of 65,000 tons/annum each of synthetic rubbers in West and Central Africa; and
- (d) More than one unit of detergent plants in each subregion with combined capacities of 110,000 tons in West Africa and 50,000 tons in Central Africa.

East Africa

Basic Petrochemicals

405. Table III.20 shows the deficits of basic petrochemicals in East Africa by 1985.

Table III.20: Deficits of Basic Petrochemicals in East Africa by 1985

<u>Basic Petrochemical</u>	(1000 Tons)		
	<u>Demand in 1985 a/</u>	<u>Production in 1985 b/</u>	<u>Deficit</u>
Ethylene	300	15	285
Propylene	87		87
Butadiene	70		70
Benzene	121		121

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during field mission and from international publications.

406. From Table III.20, the following areas/project opportunities were identified for 1985 16/.

- (a) A naphtha cracker capable of producing 300,000 tons/annum ethylene based on naphtha from refineries in the subregion and costing about 830 million dollars;
- (b) A 90,000 ton/annum propylene unit involving an investment of about 170 million dollars;
- (c) A 70,000 ton/annum butadiene unit at a cost of about 110 million dollars;
- (d) A BTX unit capable of producing 120,000 tons/annum of benzene (possibly) incorporated to refineries in the subregion and costing about 90 million dollars.

16/ Based on OECD forecasts for investment costs in 1985, plus an assumed 30 per cent increase for constructing the plant in East African countries.

Plastics

407. As mentioned in Section B of this Chapter the projected demand for plastics in East Africa in 1985 is estimated at 490,000 tons compared to production of 12,000 tons^{17/} only. Thus, as the deficit will be about 480,000 tons, more than one plant for the production of this quantity could be set up in different countries of the subregion.

408. As was suggested for West and Central Africa, East Africa, when planning to establish petrochemical industries, should make provisions for the setting up of complementary plants in more than one country in the subregion. Thus, VCM, for instance, could be manufactured in the country where the suggested large ethylene plant will be located, but the monomer (VCM) could then be made available to another country in the subregion for the manufacture of PVC.

409. However, it is not possible at this stage to estimate the different types and capacities of plastics required by the subregion. A detailed market survey of the countries of East Africa for this purpose would be necessary.

Other End-product Petrochemicals

410. Table III.21 shows the deficits of some end-product petrochemicals in East Africa by 1985.

Table III.21: Deficit of Some End-product Petrochemicals in East Africa by 1985

<u>End-product Petrochemicals</u>	<u>Demand in 1985 a/</u>	<u>Production in 1985 b/</u>	(1000 Tons)
			<u>Deficit</u>
Synthetic fibres	75	NIL	75
Synthetic rubber	95	NIL	95
Synthetic detergents	90	NIL	90

Source: a/ UNIDO's ICIS estimates.

b/ Information obtained during the field mission and from international publications.

411. From Table III.21 the following areas/project opportunities were identified for 1985:

- (a) More than one unit with combined capacity of 75,000 tons/annum of synthetic fibres;
- (b) Two units each with a capacity of 45,000-50,000 tons/annum of synthetic rubbers; and
- (c) More than one unit with combined capacity of 90,000 tons/annum of synthetic detergents.

412. The particular types and capacities of synthetic fibres, rubbers and detergents to be established could only be estimated after a detailed market survey in the subregion has been carried out.

^{17/} Information obtained during the field mission.

South Africa

413. Approaches to development of the petrochemical industry in South Africa is excluded from this survey.

Estimates of 1985 Subregional Demands for Petrochemicals made by UNIDO

414. The estimates of subregional demands for petrochemicals in 1985, which were made in 1978 by UNIDO's IGIS 18/ and which have been used in this Report seem to be somewhat optimistic. From indications obtained from the field mission, it seems likely that the 1985 demands will probably be attained between 1985 and 1990.

Consequently the identified subregional petrochemical project capacities suggested in this Report may prove to be realistic for implementation between 1985 and 1980.

Manpower Needs

415. The estimated manpower requirements for the petrochemical industry in Africa by 1985 18/ or during the period 1985-1990 is as follows:

Technical personnel (including unskilled)	23,830
Administrative personnel	2,470
Marketing and sales personnel	1,100

416. A further breakdown of manpower needs is provided hereunder:

Technical Personnel including:	Per cent of total	Number
managerial staff and engineers	3	820
foremen and technicians	10	2740
skilled workmen	45	12330
unskilled workmen	29	7946

Administrative Personnel including:

managerial staff	2	550
clerks	7	1920

Sales and Marketing Personnel including:

managerial staff	2	550
clerks	2	550

417. The above data for manpower-need estimates for 1985 should serve as a basis for estimating the African manpower requirements up to the year 2000.

Administrative and Institutional Mechanisms for Multinational Subregional and Regional Co-operation

418. For further development of the petrochemical industry at the multinational, subregional and regional levels, it is suggested that the following measures and activities in the area of petrochemical industries, parallel with other activities and other existing instruments and forms of economic and industrial co-operation be carried out:

18/ Source: Summary of the Draft World-wide Study of the Petrochemical Industry (UNIDO/IGIS.72), 15 June 1978. (Note that the figures were adjusted slightly).

- (a) Exchange of information on transfer of technology and most recent developments in the petrochemical industry;
- (b) Exchange of experts and trainees; and
- (c) Periodic regional and subregional meetings of planning, finance and technology experts from member countries. The objectives of these meetings (also to be attended by representatives from ECA, OAU and UNIDO as well as advisory consultants) would be to:
 - (i) Examine specific aspects of the petrochemical industry relating to the subregion or region;
 - (ii) Harmonize investment, fiscal, custom and other policies of African governments, especially at multinational and subregional levels and
 - (iii) Carry out the necessary preparatory and financing activities of projects of interest at the multinational and subregional levels;
- (d) Creation of a national committees for the development of the petrochemical industry in each country with prerequisites for the development of the industry. This committee should be composed of planning, finance and technology experts as well as others (such as legal experts, etc.) whenever necessary. The main objectives of the committee would be to:
 - (i) Carry out preparatory work for subregional and regional periodic meetings of experts and
 - (ii) Take the necessary follow-up actions or measures at the national level, as a result of decisions taken at the subregional and regional meetings;
- (e) Creation of centres for the development of the petrochemical industry at the subregional level. Priority should be given to the creation of one centre for West and Central Africa and another for East Africa. These should be staffed by a group of highly qualified local and international experts, and equipped with equipment for research, pilot plants and training facilities. The centres could assist in the following:
 - (i) Collection, analysis, dissemination and exchange of information;
 - (ii) Elaboration of short-term and long-term programmes at the subregional and regional levels;
 - (iii) Preparation and evaluation of trends of petrochemical products consumption in member countries;
 - (iv) Market surveys;
 - (v) Preparation of feasibility and pre-investment studies;
 - (vi) Carrying out research related to most recent developments in petrochemical technology;
 - (vii) Standardization of processes, equipment and products as well as quality control, and
 - (viii) Manpower training and development.

The Role of ECA/OAU/UNIDO in the Implementation of the Programme

419. Assistance to be provided for the implementation of programmes are summarized in Annex III B. For the period 1979-1981 they comprise 17 consultants/experts with a total of 64 man-months for the countries visited as detailed in the country reports. With respect to subregional programmes the corresponding requirements for the same period are six consultants/experts and 78 man-months.

420. In addition to the above manpower needs one senior substantive staff officer will be required from 1979 through 1983 at ECA headquarters for co-ordinating and follow-up of the assistance to be provided to African countries and subregions and for the implementation of the programmes. He should be a chemical engineer/or industrial chemist, with wide experience in planning and in the preparation of feasibility studies of petrochemical projects and well acquainted with the uses of petrochemicals.

CHAPTER IV: PHARMACEUTICAL

A. ROLE AND SIGNIFICANCE OF THE PHARMACEUTICAL INDUSTRY

421. The development of pharmaceutical industry is of crucial importance for African countries for a number of reasons which may be summarised as follows:

- (a) Pharmaceutical products are essential commodities from the point of view of health care and improvement of standards of living:
- (b) The demand for pharmaceuticals is far greater than their present supply and it would not be practicable to meet it simply by importing the requirements all the time.
- (c) Pharmaceutical have a socio-political connotation also, since the consumption is financed to a large extent from public sources inasmuch as the supply of pharmaceuticals to the public is, in a number of countries, free, for economically weaker sections of the society.
- (d) An indigenous drug industry may give required filip for the formulation of natural health care policies on lines appropriate and desirable for specific needs of individual countries.
- (e) Establishment of preliminary stages of pharmaceutical manufacture e.g. packing, galenic or formulation activities is generally not a highly complex exercise and can be undertaken easily. It can help minimise import-dependence and reduce cost of medicines, besides ensuring ready availability of products.

422. The pharmaceutical industry is thus one of the very promising areas in the industrialization programmes. Barring the basic drugs subsector, it is amenable to small scale or medium-sized activity within the investment costs relatively low for preliminary stages of pharmaceutical production and only moderate in the case of manufacture of bulk pharmaceuticals. Further more, the investments are relatively quickly recovered and there is this potential for a multiplies - effect on the investments.

423. The technology for establishing the preliminary stages of pharmaceutical production is well known: not complex and can be acquired relatively easily, even from other developing countries. Generally in a form already tried and adapted to the needs of developing economies. The machinery for formulation plants is also not complex and can be used for a variety of end-products. The concept of economy of scale for production is elastic, making it possible to establish production sizes tailored even for limited demands or small markets and yet have the flexibility of easy expansion on demand. For countries already possess formulation and packing facilities backward integration could be considered. Acquisition of even complex technology as required in such cases and for manufacture of bulk chemicals will not have any major problem as there are well established international arrangements for transfer of knowhow, joint ventured and licensing systems.

424. The development of indigenous manufacture of pharmaceuticals in bulk can substantially reduce the cost of products. A number of indigenous raw materials, e.g. medicinal plants, animal by-products, and waste products from chemical and related industries can be used in modern pharmaceutical production. Many African countries have extensive resources of natural plants and vast experience in traditional medicine. The potential for the integration and enrichment of traditional experience with "modern" medicine is increasingly being recognised in Africa.

425. The need for rigorous control, testing, uniformity and other skills inherent in modern pharmaceutical production has an important and beneficial external effect on developing countries. It enables the establishment of testing laboratories and preliminary screening facilities. The introduction of relevant training in education institutions and the diffusion of technology related to chemicals are all essential for continued progress in industrialization and have a catalytic effect on industrial development.

426. The development of the pharmaceutical industry could also promote and influence co-operation among individual countries on subregional basis. Pharmaceutical products in general, can be easily transported and therefore production especially of essential bulk pharmaceuticals and other types can be concentrated where economies of scale may call for larger markets.

B. HEALTH SITUATION AND POTENTIAL NEEDS OF PHARMACEUTICAL PRODUCTS IN AFRICA

427. While health conditions in African countries have improved in recent decades, if measured by the criteria of life expectancy at birth, they still pose major concern.

Table IV. 1. Life Expectancy at Birth (in years)

	1935-39	1950-55	1955-60	1960-65	1965-70	1970-75
Developing regions	32.0	41.7	44.4	47.0	49.0	52.2
Africa	30.0	36.4	38.6	40.9	43.3	45.0
Developed regions	56.0	64.6	67.8	69.2	70.4	71.1

Sources: Health, Sector Policy Paper, World Bank, March 1975

Selected World Demographic Indicators by Region and Country, 1970-1975, United Nations Secretariat.

428. Generally, an important association exists between the health status and per capita income; African countries which have the lowest per capita income in the world, report the lowest levels of health (Table IV. 2).

Table IV. 2. Per Capita GNP and Measures of Health Status in Selected African Countries

	Per capita GNP (US\$ constant) a)	Crude birth rate b)	Crude death rate b)	Infant mortality b)	Life expectancy b)
Eastern Africa					
Burundi	64	47.5	23.0	101	41.0
Ethiopia	83	45.1	22.9	162	41.0
Kenya	180	47.7	15.7	115	50.0
Madagascar	124	49.4	21.0	102	43.5
Mozambique	195	43.1	20.1	...	43.5

	Per capita GNP (US constant) a)	Crude birth rate b)	Crude death rate b)	Infant mortality b)	Life expectancy b)
Somalia	96	47.4	21.8	154	41.0
Uganda	124	43.0	15.9	113	30.0
Tanzania	103	41.7	22.1	165	44.3
Zambia	441	49.0	18.0	159	46.0
Central Africa					
Angola	283	47.2	24.5	...	38.5
Central Afr. Emp.	100	46.6	23.0	163	41.0
Chad	90	47.4	22.6	155	41.0
Congo	269	44.9			
Gabon	1227	32.9	23.1	184	41.0
Cameroon	198	43.7	21.0	110	43.5
Zaire	99	45.5	20.8	115	43.5
Norther Africa					
Algeria	373	48.5	14.6	36	53.6
Egypt	204	43.7	16.6	178	52.9
Libya	2128	45.2	13.6	...	55.1
Sudan	183	48.5	16.3	121	50.6
Morocco	243	48.0	14.4	149	53.5
Tunisia	415	46.2	13.7	120	54.7
Western Africa					
Ghana	297	46.3	16.0	122	48.0
Ivory Coast	283	45.8	20.7	154	43.5
Nigeria	178	49.7	22.8	157	41.0
Upper Volta	55	48.8	26.6	181	37.3
Mali	56	49.2	24.3	168	39.7
Mouritania	165	45.0	20.8	137	43.5
Niger	88	51.7	21.1	140	43.5

Sources: a/ ECA Statistic Division
b/ ECA, Demographic Handbook for Africa, 1970-1975, April 1975

429. Health conditions in most African countries are basically similar. Their basic disease pattern consists of fecally related and air-borne diseases (both infectious and parasitic diseases) which are communicable and those arising from widespread malnutrition. These three elements interact cumulatively and synergistically.

430. Differences between urban and rural areas in developing African countries are reflected alongside substantial inter-country similarity in health conditions, mortality rates being much higher in the rural areas.

431. The gross death rate for 1960 in the rural areas of the developing world was estimated by the United Nations at 21.7 per 1000, compared with 15.4 in urban areas 19/. These differentials are a consequence of the marked contrast in socioeconomic conditions between rural and urban areas.

432. Statistics on patterns of diseases are usually grossly under reported; the degree of under reporting is probably much greater in respect of rural than for urban areas. However, statistics broadly indicate the different disease patterns of developed and developing countries (Table IV. 3).

Table IV. 3. Percentage Distribution of Deaths by Cause in Selected Model Populations

	Model Developing country	Model Developed country
All causes	100.0	100.0
Infectious parasitic and respiratory diseases	43.7	10.8
Cancer	3.7	15.2
Diseases of the circulatory system	14.8	32.2
Traumatic injury	3.5	6.8
All other causes	34.3	35.0

Source: Health, Sector Policy Paper, World Bank, March 1975.

433. In view of the above, priorities for treatment in developing countries are different from those in most developed countries.

434. While the attention - priorities of developed countries lie in respect of diseases of the heart and the central nervous system and psychomatic conditions, those of the developing countries must be towards the treatment of parasitic and other communicable or infectious diseases and the development of treatments suitable for the existing situations.

435. The most widespread in African countries are those transmitted by human feces. The most common ones are the intestinal parasitic and infectious diarrhea diseases. In Egypt, the monthly incidence of diarrhea among children of pre-school age has been estimated to be between 40 and 50 per cent in Upper Volta the number of registered diarrhea cases per 100,000 inhabitants was 1431 in 1975.

19/ United Nations Demographic Trends in the World and its Major Regions 1950-1970 New York 1973.

436. Basically dysentery amoebiasis, enteritis and other diarrhea diseases were the leading identified cases in Nigeria, Cameroon, Gabon and Tanzania. Intestinal parasitic diseases are frequently chronic and debilitating rather than causing acute illness or death.
437. Air - borne diseases occupying second place. The group includes tuberculosis, pneumonia, diphtheria, bronchitis, whooping cough, meningitis, influenza, measles, smallpox and chickenpox.
438. Vector-borne diseases are less prominent in mortality statistics, but are nonetheless significant in the African countries. The most widespread of these diseases is malaria, trypanosomiasis (sleeping sickness) schistosomiasis (bilharzia) and onchocerciasis (river blindness). In Gabon the incidence of malaria was 12,535 identified cases per 100,000 inhabitants (1973) ^{20/} and in Upper Volta 9224 (1975) ^{21/}. In some areas malaria infection rate is as high as 95-100 per cent. More than 10 per cent of Upper Volta population is affected by onchocerciasis and includes 40,000 blind people. Schistosomiasis is debilitating disease in areas of slow-moving water, an ideal habitat for snail colonies e.g. the Nilo Delta region in (Northern Egypt).
439. Even though life expectancy is increasing and the incidence of specific diseases such as cholera and smallpox has, in some countries been eradicated or reduced, poor health persists in African countries influenced heavily by some socioeconomic characteristics of population. Poverty, accompanied by rapidly expanding populations, malnutrition, and congested and unsanitary living conditions are at the root of the health problems in developing countries, particularly in African countries. When large numbers of people live in poor house-holds located in crowded, unsanitary surroundings, communicable diseases spread easily and high mortality and morbidity rates result.
440. Widespread malnutrition is characteristic of poor nations and contributes to the incidence and severity of health problems. It is also a major contributing factor in infectious disease, i.e. by lowering the immunity of the body.
441. The fecally-related or fecally-transmitted diseases generally have a common origin: the contamination of food, water or soil with human waste. Diarrhea diseases, typhoid, dysentery, cholera and other intestinal diseases are spread where the water is not safe for drinking, or where it is insufficient for personal hygiene and sewage disposal. In most African countries only a small proportion of the population has access to modern clean water system.
442. Health services in several African countries are based on the principle that every citizen should be entitled to a proper and free of charge medical treatment. However, Government expenditure on health in African countries seldom exceed 2 per cent of GNP. In the six countries visited, health service outlays as percentage of GNP were between 0.7 per cent in Upper Volta and 1.8 per cent in Egypt, and Government health expenditures per capita were between US\$0.56 & US\$3.91 respectively. These compared with 10.1 per cent and US\$73.75 respectively in Yugoslavia and indicate the existing gap even within the developing countries (Table IV,4). In Upper Volta, the percentage of health budget in the national budget is declining gradually from 9 percent in 1970 to 5 per cent 1976.
- ^{20/} UN World Health Statistics, 1973-1976, Volume II, Infection Diseases.
- ^{21/} Dr. F. Martin-Samos, La Sante Publique en Haute-Volta, Ougadougou 1977.

Table IV. 4. Government Health Expenditures in Selected African Countries

Country	Health budget as percentage of national budget	Health budget as percentage of GNP	Government Health expenditures per capita (US \$)
Upper Volta	4.8	0.7	0.56
Somalia	6.7	2.0	1.40
Ethiopia	6.9	0.8	0.67
Tanzania	6.3	1.5	1.68
Uganda	9.6	1.7	2.24
Cameroon	7.8	1.0	2.02
Egypt	8.4	1.8	3.31
Ghana	7.3	1.3	3.76
Congo	6.1	1.8	4.82
Yugoslavia	38.2	10.1	73.75
Libya	5.8	2.4	35.00
United Kingdom	9.5	4.3	105.16

Source: World Health Organization, World Health Statistics, 1973.

443. A large part of government funds are spent on hospitals and other curative health centres rather than on preventive measures.

444. Hospital facilities are concentrated in urban centres. In Gabon (1976), the percentage of beds in hospitals to percentage of population in different provinces varied from 0.8 to 1.9 (average 1.0). In Cameroon, only the last Five Years Plan (1976-1987) emphasized the necessity to give priority to preventive treatment and to reinforce the health infrastructure in rural areas. In Gabon, 50 per cent of doctors are located in Estuaire district and most of them in Libreville.

445. The health infrastructure and medical manpower are generally insufficient. Physicians usually establish their practice in urban centres rather than respond to the critical needs of rural areas. The number of persons per hospital bed and per physician are, exception of Egypt (Table 5) below the World Health Organizations for developing countries (see also ANNEX IV.1).

Table IV. 5. Health Facilities per Population

Country	Population per Hospital Bed		Population per physician		Population per pharmacists
	1973	1975	1973	1975	
Upper Volta	1667	1170	92828	56480	554550
Tanzania	699	700	20702	18490	409280
Nigeria	1351	1170	20525	14810	42460
Cameroon	480	380	58010	17790	64080
Egypt	463	470	1913	4630	14480
Gabon	...	100	...	5210	33330

Source: Derived from World Health Statistics Annual Vol. III, 1977, WHO, Geneva

446. It should be stated that for most African countries, the health service approaches adopted would be inappropriate unless they are backed up by preventive services, e.g. modern pharmaceuticals, in some instances, bring immediate relief, or even eventual cure, but may have no lasting effect on the health of person who may have to must return to a disease-ridden environment. Treatment of parasitic infections may mitigate the symptoms, but it is not likely to keep a person from becoming reinfected. In general, good water supply, sanitation and housing counter act the incidence of disease, and in this way affect morbidity and mortality. Nutrition alters both the incidence and the effects of clinical disease. Even under very favourable circumstances, curative health care can do little to alter the incidence of disease. In short 70-80 per cent of the population in Africa does not have access to such basic health care services as protective immunization; assistance to mothers during pregnancy and childbirth; pre-natal, post-natal and infant care; safe water supplies; adequate sanitation; health and nutrition education; and first aid and emergency care. 22/

447. In most of the African countries (except Egypt or other North African States) the majority of the population depends upon traditional systems of medicine. In Tanzania, it was estimated that in Dar-es-Salaam in 1973 more than 700 healers were practicing, and the number of patients was 800-1,000 daily. In Upper Volta over 90 per cent of the population consults the traditional healers. In Cameroon traditional treatment is usually the primary health care preceding any exposure to the modern medicine even in serious cases. Important factors for the popularity of traditional remedies are their lower cost compared to modern drugs, which brings them within the reach of the poorer sections, and the historical element of people's faith in the traditional physicians, as they are part of the community. Thus the traditional remedies cannot be ignored when analysing the health conditions in African countries and defining the role of modern pharmaceuticals in this region.

448. While pharmaceuticals alone are not sufficient to provide adequate health care, they play an important role in protecting, maintaining and restoring the health of people. Systematic vaccinations have eradicated small-pox and reduced cholera and tuberculosis in some countries. The use of chloroquine has helped to prevent or to cure malaria, not to mention the role of antibiotics. The on-going health campaign and the gradual increase of health services alongside the increase in population in individual countries generates a growth in the demand for pharmaceuticals. The growth of the potential market for pharmaceuticals in each country is strongly influenced by all the subjective and objective factors discussed before. Some of these factors are extremely difficult to determine. Thus, demand for pharmaceutical products in general is essentially a derived demand, i.e., it depends on a number of factors, such as health facilities, institutions, medical and paramedical personnel, morbidity or percentage of diseased population, demographic situation or population growth. The difficulties that developing countries encounter in the development of pharmaceuticals are far more complex and widespread than those associated with most other sub-sectors.

449. The principal difficulty for individual countries is to determine their potential needs of pharmaceutical as a basis for planning of the development of this industry. Only in a very general way and with a great margin of precision could an indicator suggested in a UNIDO-study be applied for this purpose: "a realistic target for the developing countries seems to be a minimum of \$12 per capita drug-consumption, which should be considered a basis for the planning of total health expenditure. This

22/ African Traditional Medicine, WHO Regional Office for Africa, Afro Technical Report Series No. 1., 1976.

level of consumption must cover all essential and basic pharmaceuticals, so as to fulfill all fundamental health requirements in developing countries". ^{23/}

450. Applying the US\$12 per capita consumption to the countries visited by the mission ^{24/}, the figures would emphasise the existing gap in pharmaceutical supply, although this would not indicate the demand which should be anticipated in connection with the project population growth (Table IV. 6).

Table IV. 6. Present Consumption and Potential Needs of Pharmaceuticals in selected African Countries

Country	Present Consumption of Pharmaceuticals in US Dollars (1977-78) minimum	Potential Needs calculated at minimum US\$12 per Capita at present population	Potential needs to present consumption ratio per cents
Tanzania	27.5 - 30.0	192.0	680
Gabon	8.7	8.7	100
Cameroon	22.0 - 24.0	34.0	3170
Nigeria	220.0	340.0	380
Upper Volta	3.0	72.0	2400

451. This general approach gives some idea about the order of magnitude of the effort which has to be made in individual countries in the development of domestic pharmaceutical production to meet their needs of pharmaceutical. It is equally difficult to determine which pharmaceuticals are to be given priority for individual countries. The African countries not only have the usual medical problems facing any country, but also the task of contending in the first place with widespread endemic diseases which afflict a large proportion of the population. Existing evidence and information in this respect gives an approximate indication only.

452. In the countries visited there were on the market more than 3000 pharmaceutical specialities, most of them belonging to the same therapeutic group, similar or equivalent therapeutic effect. There were many alternative pharmaceuticals available to treat any of disease conditions.

453. The World Health Organization has made an attempt to prepare a basic list of selected pharmaceuticals which could meet the needs of the vast majority of population in the developing countries. A WHO Expert Committee has recommended a model list of Essential Drugs of about 200 pharmaceutical preparation for the medical treatment of people in developing nations. ^{25/}

^{23/} Summary of the Draft World-wide Study of the Pharmaceutical Industry, UNIDO/ICIS, 74, June 1978.

^{24/} Except Egypt where the prices for pharmaceuticals have been frozen at the 1968 level.

^{25/} The Selection of Essential Drugs, Report of a WHO Expert Committee, WHO, Geneva, 1974.

454. The selected pharmaceuticals are those which cost wise give maximum therapeutic efficacy and result in optimum treatment at minimum cost. They are drugs regarding which the chemistry and pharmacology are fully described in the recognised national formularies and pharmacopeias of the world.

455. The Thirty-First World Health Assembly (May 1978) urged member States to establish National drug lists or formularies by international nonproprietary names (generic names) including essential drugs selected on the basis of health needs of the countries and taking into account the criteria of WHO. It was also recommended that the products containing these substances, depending upon the needs of the countries, should be produced locally. Unfortunately until now, none of the African countries visited has prepared a National list of essential pharmaceuticals.

C. PRESENT CONSUMPTION OF PHARMACEUTICALS IN AFRICA

456. Consumption of pharmaceuticals in Africa is relatively low. In 1975/76 it was 1.75 per cent of world consumption, while the share of African countries in world population was 9.5 per cent (Table IV. 7).

Table IV. 7. Consumption of pharmaceuticals in Africa and in some other regions (1975/76)

	Consumption of Pharmaceuticals, millions US Dollars	Population million	Per Capita Consumption in US Dollars
World	40,000	3,970	10.0
Europe - West	12,838	357	35.0
America - North	8,000	237	35.0
Africa (without South Africa)	700	376	1.86
Africa (without South Africa and North African countries)	360	298	1.21

Source: Estimates based on various publications.

457. Consumption in Africa (without South Africa) has been covered mainly by imports which amounted to about US\$550 millions. Local production in the region in 1975/76 was about US\$200 millions (0.5% of world production) (Table IV. 8)

Table IV. 8. Consumption of Pharmaceuticals in Africa by origin(import and local production) 1975/76

	Consumption in million US Total	From local production	From Imports	Per Capita consumption in US Dollars
Africa (without South Africa)	700	200	550	1.86
North Africa	340	160	216	4.34
Africa (without South and North Africa)	360	40	334	1.21

Source: Estimates based on various publications.

458. Consumption of pharmaceuticals in African countries visited is illustrated in Table IV. 9.

Table IV. 9. Consumption of Pharmaceuticals in Selected African Countries, 1977

	Population in millions	Consumption in million US\$ Dollars			Per Capita Consumption in US Dollars
		Total	From domestic production	From imports	
Upper Volta	6.0	3.0	-	3.0	0.50
Tanzania	15.9	27.5-30.0	2.5	25.0-27.5	1.81
Cameroon	6.8	17.5	-	17.5	2.57
Egypt a/	40.0	106.5	96.5	10.0	2.66
Nigeria	70.0	215.0	23.8	191.2	3.14
Gabon	0.8	7.8-8.3	-	7.8-8.3	10.00

Source: Estimates based on different sources.

a/ Prices of pharmaceuticals are established at the 1963 level, thus the consumption level is not quite comparable with other countries.

459. In some other countries per capita consumption in 1975 was US dollars: Libya 9.90, Algeria 5.10, Ghana 4.40, Liberia 2.00, Sierra Leone 0.70. ^{26/}

460. Generally, two distributing channels for pharmaceutical supply are functioning in individual countries: public and private. The public distribution sector is usually a state-owned central whole-sale agency (e.g. Central Medical Stores or Pharmacie d'Approvisionnement) under the supervision of the Ministry of Health. The agency works in the framework of budgetted sums which are frequently far below the critical minimum. The shortage of funds forces the distributing agency to limit as much as possible, the list of pharmaceuticals it handles. Although in none of the visited countries the list of Essential Drugs recommended by WHO has been introduced, semi-official lists of principal medicament are in use in some cases approved by the Ministry of Health, as a basis of pharmaceutical import within the public sector. The number of products used in public health service is about 300-500 pharmaceuticals.

461. It is not normal that, because of financial or other difficulties, the deliveries of pharmaceuticals may be irregular or restricted. The patients are often advised to purchase on thier own necessary pharmaceuticals in the pharmacies even if they have right to free of charge treatment. Thus the more sophisticated and more expensive drugs when indispensable must be bought privately.

^{26/} Summary of the Draft World-wide study of the Pharmaceutical Industry UNIDO/ICIS 74, June 1978.

462. This situation is not typical only for a country like Upper Volta, where the consumption of pharmaceuticals in public sector only 7 per cent of total consumption, but also for Tanzania, where about 50 per cent of the total pharmaceutical are used by the public health service.

463. The public distributing agencies purchase pharmaceutical products by the tender system. This requires that projections of requirements be prepared ahead of time (usually up to two years), since a tender list drawn up at the end of one year and issued at the beginning of the next year would be supplied probably early third year.

464. The private chemicals for pharmaceutical distribution consist of private wholesaler institutions or voluntary health centres and pharmacies. The last offer a whole range of pharmaceutical products of about 3000 or more brand specialities. All of them have to be formally registered with the Ministry of Health, except in Gabon where the registration is not yet introduced.

465. Numerous pharmaceuticals contain identical active ingredients or are therapeutic equivalents. They differ mostly in brand names and in price. Prices of equivalent pharmaceutical vary a great deal. This is illustrated in the Table IV, 10 by cases of acetylsalicylic acid, chloroquine phosphate and tetracycline hydrochloride prices in Nigeria.

Table IV, 10. Prices of Some Therapeutic Equivalent Pharmaceutical Products in Nigeria

Generic Name/Brand Name/ Manufacturer	Price Relations per Unit a/ to the less Expensive Product on the Market = 100
ACETYLSALICYLIC ACID	
Rolprin, Rolfa 300 mg.	100
Rhodin, Specia 500 mg	390
Aspirin, Bayer 300 mg	400
CHLOROQUINE PHOSPHATE 250 mg	
Delagil, Egypt	100
Arechina, Rolfa	138
Assiquine, Assia	165
Melaquine, Grunenthal	200
Scanniquine, Scandrug	160
Resochin, Bayer	230
Novoquin, Biode	250
Aralen, Winthtrop	300
Malarex, Dumex	400
TETRACYCLINE HCl, 250 mg	
Hospicyline, Gertex	100
Tetrerba, C. Erba	100
Ibicin, Inst. Biochimico	270
Flormycin, Italdrug	310
Ambramycine, Lepetit	330
Tevacycline, Dizengoff	330

Generic Name/Brand Name/ Manufactured	Price Relations per Unit a/ to the less Expensive Product on the Market - 100
Biomycin, Biode	520
Elkocycline, Elkomilano	570
Rilfancine, Ralfa	715
Scannimycine, Scandrug	715
Dumocycline, Dumex	860
Flavacyn, Boots	950
Achromycine, Lederle	1000

Source: Derived from Medical Index of Pharmaceuticals Specialities in Nigeria, January-March 1978.

a/ Unit means table or capsule.

466. As shown in Table IV. 11 the major part of pharmaceuticals requirement of African countries are imported. The francophone countries (Gabon, Cameroon and Uper Volta) import 95-100 per cent of their demand from France. These include products made in other countries (e.g. West Germany, Switzerland, etc.) but imported through France. The whole-sale agency operating in countries is a subsidiary of Societe Euro-Africaine Pharmaceutique- Paris. Imports to the anglophone countries, however, come from numerous international companies mainly from Europe and the United States. All important world-wide pharmaceutical companies maintain their representative offices or subsidiaries in each country. In some countries (e.g. Nigeria, Egypt) some of the companies have their repacking or formulation facilities, sometime as joint-venture enterprises.

Table IV. 11. Imports of Pharmaceuticals in 1977 in the Countries Visited

Country	Import of finished Pharmaceuticals in million US Dollars	Imports-share in Total Consumption (%)
Tanzania	25.0-27.5	95
Gabon	7.0-8.3	100
Cameroon	17.5	100
Nigeria	120.0	88
Upper Volta	3.0	100
Egypt	20.0-23.0	10.15

467. The pharmaceutical market in some of the African countries is sizeable. (Annex IV. 2) and therefore attracts keen competition among the exporting companies. They promote their products through the media of information service to the physicians and pharmacists in both public and private health services. The bulk of the promotion effort goes into persuading doctors to prescribe well advertised products by brand names, although less expensive products with identical pharmacological and therapeutical properties are available. It is quite likely that importing countries are paying

more for pharmaceuticals than necessary^{27/}, even if severely conditioned by the limitation of low per capita income of their peoples. The marketing practices which rely on free samples, frequent visits by representatives, voluminous mail literature, and similar promotional gimmicks practised in developed countries are questionable under African conditions.

468. Besides, advertising, geared as it is towards consumer society in industrialized countries, is likely to mislead most consumers in developing countries in to incurring unjustified expenditures. The relatively high consumption of tranquilizers and tonics (5 per cent each of total import) in Nigeria or proliferation of therapeutic equivalent products in Gabon for instance seemed to be evidences of diverse consumption of pharmaceuticals under the influence of advertising blandishments.

469. African countries, despite their low per capita income, are giving relatively high priority to pharmaceutical supplies. Among the imported chemicals, pharmaceutical products occupy the first place. Their import value is more than the combined imports of fertilizers and plastics (Table IV. 12).

Table IV. 12: Imports of Chemical Products by Subsectors in Developing Countries in Africa in 1975

Code No.	Subsectors	Imports in Million US Dollars
5	Chemicals	2,450
512	Organic chemicals	290,3
513/4	Inorganic chemicals	235,3
531/2	Dyestuffs	121,0
533	Paints, pigments	94,6
54	Medical and pharmaceutical products	508,2
541-7	Medicaments	497,7
554	Soap and cleaning materials	95,6
56	Fertilizers	263,5
58	Plastic materials	328,3
59	Miscellaneous	400,9

Source: OECD Statistics of Foreign Trade, 1975.

470. The relation between per capita GNP and per capita consumption of pharmaceuticals in some selected countries is presented in Table IV. 13. A glance at the last column shows that, in general, developing African countries are spending a relatively higher portion of their income on pharmaceuticals compared to developed countries.

^{27/} S. Slatter "Competition and Marketing Strategies in the Pharmaceutical Industry", London, 1977.

Table IV. 13: Consumption of Pharmaceuticals vs. per Capita GNP

Country	Per Capita GNP. In US \$	Per Capita Consumption of Pharmaceuticals in US Dollars	Ratio of Consumption of Pharmaceuticals to GNP (%)
Gabon	4877	10 - 13	0.23
Upper Volta	110	0.5	0.45
Nigeria	582	3.0	0.51
Cameroon	440	2.6	0.59
Egypt	481	3.0	0.68
Tanzania	201	1.80	0.90
United Kingdom	3488	26.65	0.76
Germany, Federal Republic	6774	65.75	0.97
France	5314	54.50	1.02

Source: Estimates based on various publications.

471. In all the countries visited there are legal provisions governing the import, distribution, manufacture and quality of pharmaceuticals. In fact, the pharmaceutical administration within the Ministry of Health in most countries is not able to enforce the rules and to supervise properly pharmaceutical guidelines. Thus quality control on imported or locally manufactured pharmaceuticals is not enforced, because of lack of quality control laboratories. The introduction of drugs in the market or registration procedure does not necessarily require the senior proof of the therapeutic efficacy of the new pharmaceutical. According to the law, pharmaceuticals might be distributed only through the authorized agencies or pharmacies, employing registered pharmacists. In practice, patients in some countries, especially in West Africa, can very often obtain medicines from unauthorized sources. Some of these unauthorized sources include mobile chemist shops in lorries, boats, baskets and sacks. All of them receive supplies of pharmaceuticals which are smuggled from one country to another (e.g. from Ghana to Cameroon) or are pilfered from the public distribution system. While not a problem in Africa at present, unauthorized or spurious drugs traffic can pose a great health danger and the government during regulatory agencies would have to guard against this anti social tendencies as well.

472. The pharmaceutical administration consists usually of limited staff of one or two persons and lack of pharmaceutical inspectors makes it impossible to control the institutions and pharmacies. It seems necessary, along with efforts directed to enforce the distribution and manufacture of pharmaceuticals in the country, to equip the pharmaceutical administration with adequate means for fulfilling all essential tasks.

473. All countries are resolving their pharmaceutical supply problems individually. Until now, no co-operation on regional or subregional basis was established. However, the necessity of closer co-operation, particularly between the less populated countries is now being realized more and more. In this connexion it should be noted that the UDEAC ^{28/} countries have agreed during their last summit meeting (Bangui, December 1975)

^{28/} UNDEAC: Union Douaniere et Economique de l'Afrique Centrale (comprising Central African Empire, Congo, Gabon and the United Republic of Cameroon).

to allocate the pharmaceutical sector to the Central African Empire with the long-term objective of making the UDEAC countries, as far as possible, self-sufficient in pharmaceutical products including the packaging require).

474. According to UNIDO study 29/ the short-term objectives of the pharmaceutical subsector in UDEAC countries include reducing the cost and making available the right kind of drugs to the consumer. As a first step towards this objective the study proposed the establishment of a the "UDEAC pharmaceutical Centre" which should comprise three departments; marketing and purchasing, quality control and production and research, development and training, the first two departments to be given priority. Unfortunately, until the present time (June/July 1978) no decisive steps have been taken to implement the project of UDEAC subregional co-operation. The necessity of co-operation in pharmaceuticals was also recently emphasized though a joint UNIDO/CEAO 30/ project for the establishment of a Regional pharmaceutical Centre consisting of a manufacturing unit and a training centre. This project financed by UNIDO and a voluntary contribution of the Belgian Government is expected to be implemented during 1979.

475. Although statistics are not available, export of pharmaceuticals in Africa is scanty. Exporting countries include Egypt, Algeria, Morocco, Kenya and Senegal. The total value of exported mediaments could be roughly estimated to be less than 10 million US dollars. The customers are the neighbouring countries of Egypt, Algeria and Morocco, i.e. mainly Arab countries. The trade balance in pharmaceuticals as estimated hereunder showed high deficites. (Table IV. 14).

Table IV. 14: Trade in Pharmaceuticals in Africa (1975)

	Production	Imports	Exports	Apparent consumption	Trade balance
	(1)	(2)	(3)	(1+2)-3	(2-3)
Africa	210	500	10	700	490

D. PRESENT STAGE OF PHARMACEUTICAL PRODUCTION IN AFRICA

476. The pharmaceutical industry in Africa is in an infant stage and her share in world production in 1975 was only 0.55% (Table IV. 15).

29/ Report sur les Projets Industriels Communantaires de L'UDEAC, TS/RAF/76/007, September 1976.

30/ CEAO = Communité Economique de l'Afrique de l'ouest (Senegal, Mali, Upper Volta, Niger, Ivory Coast, Mauretania).

Table IV. 15: Production of Pharmaceuticals, 1975

Region	Production in Billion US Dollars	Share Per cent
World	36,224	100.00
Developed countries	25,510	70.42
Developed countries	4,214	11.63
Africa	200	0.55
Latin America	2,360	6.51
Asia, Middle East	1,404	3.87
Far East	250	0.70
Centrally planned economies	6,500	17.95

Source: Estimates based on various publications.

477. Generally speaking, African countries can be classified broadly into five following groups on the basis of the present stage of development of pharmaceutical industry (Table IV. 16).

Table IV. 16: Present State of the Pharmaceutical Industry in Africa

Countries without manufacturing facilities and totally dependent upon imports	Countries with repacking or simple formulation manufacture from imported bulk pharmaceuticals and ancillary materials	Countries with broad range of formulation manufacture from imported bulk pharmaceuticals and ancillary materials	Countries with preliminary pro-production of production of bulk pharmaceuticals or ancillary materials and broad formula-tions manufacture	Countries with production of broad range of bulk pharmaceuticals from local and imported intermediates
Benin, Burundi Cape Verde, Chad Congo, Equatorial G. Gabon, Gambia Guinea Bissau Ivory Coast, Liberia, Libya Malawi, Mauritania Mauritius Mozambique Niger, Reunion Rwanda, Sierra Leone Somalia, Togo, Uganda U.R. of Cameroon Upper Volta	Angola, Ethiopia Madagascar, Mali Nigeria, Senegal Sudan, Tanzania Zaire, Zambia	Algeria, Ghana Kenya, Morocco Tunisia	Egypt	

Source: Compiled on the basis of classification made by UNIDO.

478. Among the countries visited only Egypt, Nigeria and Tanzania manufacture pharmaceutical formulations (Table IV. 17).

Table IV. 17: Pharmaceutical production in selected African Countries by Origin of Input, 1977, in Million US Dollars

	Total output	Output from imported input	Output from locally produced bulk input
Egypt	96.5	90.0	6.5
Nigeria	23.8	23.8	-
Tanzania	1.5	1.5	-
Cameroon	-	-	-
Upper Volta	-	-	-
Gabon	-	-	-

479. The production of bulk pharmaceuticals is carried out only in Egypt, in a limited way, where the synthesis of salicylates and sulphamides was established a few years ago (El-Nasr Pharmaceuticals Co.).

480. Until the present time, no production of essential antibiotics of common use (penicillin, streptomycin, tetracyclines) has been established in the African region, not to speak of the other sophisticated bulk pharmaceuticals. Only recently, a project for antibiotic manufacture through fermentation was reported under implementation in Algeria and some other projects are under consideration in Arab countries. Intravenous solutions from another group whose manufacture has so far, been limited to few African countries. These products containing more than 95 per cent water are imported from Europe thereby raising enormously the treatment costs in hospitals.

481. Except in Egypt (and probably Algeria) there are no chemical inputs in the form of intermediates, organic chemicals, solvents, etc. in African countries for the synthesis of essential pharmaceutical products. In Egypt, where the production of coke and also the manufacture of dyestuffs along with some processes typical of small-scale organic chemicals manufacture have been established, a basis for the development of pharmaceutical bulk production can be regarded as having been established. The availability of chemical intermediates for the pharmaceutical production will improve considerably with the implementation of petrochemical projects in some countries. That would be the case in Algeria Egypt and Nigeria, where the first steam cracking installations are already or would be put into operation during the first half of 1980s. Thereby working important raw materials for packing (P.V.C., PE, etc.) and some petrochemicals as intermediates available from domestic production. Also the implementation of related industries e.g. ethyl-alcohol (from molasses), starch, calcium carbonate and some packing materials as cellophane, aluminium foil etc. will increase the percentage of domestic input in pharmaceutical production in countries, like Nigeria and Tanzania, bringing savings in foreign exchange.

482. However, the scarcity of chemical inputs should not discourage some of the African countries from establishing production facilities for essential bulk pharmaceuticals, which are of widespread use. The production of antibiotics where the incidence of raw

materials cost is not very significant and the synthesis of salicylates, sulphonamides, antimalarials, antiparasites, etc. could be taken into consideration also based on the imported inputs.

483. On the other hand African countries are rich in important medicinal plants, which are also playing a substantial role in traditional medicine. In Tanzania for instance, a Chinese team has identified occurrence of about 1,000 herbs. In 1977, a UNIDO exploratory mission visited Burundi, Uganda, Botswana and Tanzania with object of collecting information on the availability of medicinal plants and their locations.

484. Cameroon is a traditional exporter of medicinal plants, such as Voacanga, Rauwolfia, Yohimbe, Strophantus, Vinca Rosea, Pygeum Africana, etc. with 1978 exports valued at 1.3 million US dollars. Although the majority of the medicinal plants can be processed in relatively simple equipment in laboratories into galenic products, this kind of manufacture has not been established yet in the countries visited. Recently research centres for Traditional medicine and medicinal plants have been established in Tanzania, Gabon and Cameroon with the objective of indentifying medicinal plants and promoting their processing into galenic preparations or isolation of active substances.

485. Animal by-products and waste products as base for drug production, might be considered, for instance, in Upper Volta, where, in 1975, a modern slaughter-house was established in Ouagadougou with the assistance of EEC. Production is, however, actually only one third of the existing capacity (13 thousand tons/year of meat) and consequently the input of animal by-products is not sufficient for economic size units even if the essential requirement that organs of completely healthy animals only should be processed.

486. Egypt is the only African country producing bulk pharmaceuticals on the industrial scale (Table IV. 13). Some packing material are also available in Egypt, Nigeria and Tanzania.

Table IV. 13: Bulk Pharmaceuticals produced in Egypt (El-Nasr Co.)

Product	1977 output (tons)
<u>Sulphonamides</u>	
Sulphanilamide	4.9
Sulphaguanidine	26.7
Sulphadiazine	28.4
Sulphadiazine Na	17.2
Sulphacetamide Na	3.2
Tolbutamide	25.3
<u>Salicylates</u>	
Salicylic acid, crude	...
Salicylic acid, subl.	13.9
Acetyl-salicylic acid	461.9
Sodium Salicylate	11.3

Product	1977 output (tons)
<u>Salicylates</u>	
Methyl Salicylate	13.9
Salicylamide	14.3
Calcium Benzamido-salic	13.6
Paracetamol	4.9
<u>Chloramphenicol</u>	
Chloramphenicol-Palmitate	2.5
Chloramphenicol-Stearate	1.0

Source: El-Nasr Pharmaceutical Co.

487. In Egypt, about 90 per cent of marketed pharmaceutical formulations come from local production. The pharmaceutical industry in Egypt is represented by 7 state-owned companies engaged in formulations. There is one company for basic pharmaceutical substances and one company for pharmaceutical packing materials, made from plastics, aluminium and paper. There are three joint-venture companies in collaboration with some international pharmaceutical companies (Pfizer, Hoechst and consortium of Swiss firms: Ciba-Geigy, Sandoz, Wander) and private Egyptian share-holders. The manufacture of formulations is based on licence agreement with international companies who charge royalty of 10-15 per cent.

488. The plants visited (Chemical Industries Development Co., C.I.D. and Alexandria Company for Pharmaceuticals) are producing a wide range of formulations in tablets (coated and uncoated), hard gelatine capsules, ampoules, dry-powders, syrups, suspensions, suppositories and ointments. These plants are equipped with modern equipment. The technical level of production seems to be adequate.

489. In Nigeria there are 15 Companies registered as pharmaceutical manufacturers, all of them joint venture companies with Nigerian private share-holders. Almost all leading international companies are represented in Nigeria, some of them only with re-packing or marketing activity. In the public sector, two small laboratories attached to the pharmaceutical Administration in the states of Lagos and Benin are producing a very limited range of essential formulations. The domestic production in Nigeria is barely 10 per cent of the total consumption. The technical level of equipment and processing in joint-venture companies is quite satisfactory out in State laboratories rather poor.

490. The private firms promote the brand-medicines of their parent companies. Medicines, such as tranquilizers and tonics do not necessarily correspond to those given priority from the national health point of view.

491. Formulation production in Tanzania is concentrated within the public sector. The main producer is Keko-Pharmaceutical Co. built with Chinese assistance and operating since 1975. Production is often disrupted because of electricity cuts, accidental breakdown of machines and unsatisfactory skills of personnel. Even under these conditions, the Keko plant was able to produce a range of essential formulations

needed by the National Health Service and saved about 100,000 US dollars in foreign exchange during the first year of operation. Another manufacturing unit in Tanzania is located in Zanzibar where laboratory attached to the hospital covers part of the hospitals requirements of various pharmaceuticals (tablets, syrups, suspensions, ampoules and intravenous fluids. There is also a small private pharmaceutical factory (Mansoor Daya) in Dar-es-Salaam.

492. The present output of the pharmaceutical industry in Tanzania is only 1.5 million US dollars and covers no more than 5 per cent of the countries requirements.

493. A new pharmaceutical plant has been constructed in Arusha. The production programme includes a wide range of medicines in the form of tablets, capsules, liquids and dry injectibles, syrups and veterinary specialities. The plant cost 10 million US dollars and is expected to produce (at full capacity) 15 million US dollars worth of pharmaceutical which should considerably increase the share of locally produced pharmaceuticals in the Tanzanian market.

494. No pharmaceutical production, even in a preliminary stage exists in Gabon, Cameroon, and Upper Volta. All requirements of pharmaceuticals are imported in these countries from Europe, including distilled water and Interavenous Solutions.

E. PHARMACEUTICAL PROJECTS IN SELECTED AFRICAN COUNTRIES

495. The pharmaceutical industry in Africa is presently in an infant stage, but the need to develop it is widely recognized. In most African countries, high priority is given to the development of this industrial sector. In Tanzania, e.g. one third of the total investment expenditures allotted to the chemical industry in the Third Five year Plan (1976-1980) is envisaged for the pharmaceutical project in Arusha. Also the development of the pharmaceutical industry in some North African Arab countries such as Algeria, appear to have been given priority.

496. The recognition of the need for closer co-operation on the subregional scale is growing gradually. Evidence of this trend is the planned co-operation among the UDEAC countries or within the CEAO community. However, the most notable and comprehensive co-operation on the subregional scale is that of the Arab Company for Drug Industries and Medical Appliances (ACDIMA) in Cairo.

497. The Arab Council for Economic Unity decided (1970) that the pharmaceutical industry should be coordinated among the member States. In 1975 ACDIMA was established and its capital was fixed at fifty million Kuwaiti Dinars (about 130 million US dollars). The Company's deed of partnership was signed by twelve Arab States, including four African countries-Egypt, Sudan, Libya and Tunisia. In 1976, with the coming of Saudi Arabia, the company's capital was brought to 60 million Kuwaiti Dinars (about 210 millions US dollars). The company undertook programming of the following projects for which the feasibility studies have been carried out:

- (a) Fermentation products (penicillin, streptomycine, tetracycline, other antibiotics, vitamin C, citric and tartaric acid);
- (b) Synthetic products (chloramphenicol, salicylates, sulphamides, antihelminthic, antiparasitic, anti-tuberculosis, anti-amoebias bulk pharmaceuticals);
- (c) Sera and vaccines, plasma substitutes and blood derivatives;
- (d) Extracts of medicinal and aromatic plants, animal hormones, biological tissue extracts; and
- (e) Other (hard gelatine capsules, ampoules and injection vials, production of neutral galss, etc.).

498. From the industrial projects considered the following investment are planned by ACDIMA in the African countries in the near future:

- (a) Hard gelatine capsules with a capacity of 1,000 millions units, in Alexandria, Egypt;
- (b) Neutral glass manufacture for ampoules and injections vials, in Egypt or Syria;
- (c) Processing of animal by-products in the Sudan; and
- (d) Antibiotics by fermentation route, in Egypt or Iraq.

499. ACDIMA will also concentrate on purchasing input materials and in the marketing of products produced by the Company. Scientific studies and research with the aim of developing new active substances or improving existing processes, as well as extensive training of cadres, would also be carried out. ACDIMA's statute and approach to the problem of co-operation on the subregional level should serve as an excellent example of model for enterprise by other groups of African countries.

500. The UDEAC countries summit held in Baugui in 1975 had decided to allocate the development of pharmaceuticals to Central African Empire with the objective of satisfying the needs of all members States. The establishment of the "UDEAC Pharmaceutical Center" with the function of marketing and purchasing; production and quality control; research, development and training, has been suggested by UNIDO as a consequence of this Summit decision. It seems, however, that the implementation of this project remains still in a very preliminary stage. It was reported that some negotiations between the Central African representatives and Yugoslavian pharmaceutical company took place recently with the purpose of negotiating assistance in organizing the Pharmaceutical Center.

501. A joint action programme of UNIDO and CEAO was agreed in May 1978 for establishment of a pharmaceutical production unit and training center of a sub-regional character. The project would be financed by UNIDO (450 thousands US dollars) and by the voluntary contribution of Belgian Government (600 thousands US dollars during four years).

502. A UNIDO expert was expected in August 1978 to visit seven countries: Niger, Mali, Mauretania, Gabon, Cameroon, Senegal and Upper Volta to collect information to serve as basis for selecting the location of the Center. The start-up of the Center is planned for the second-half of 1979. Upper Volta authorities are hoping that the Center will be located in Babo-Dioulasso, where some facilities like buildings and a group of staff are available within the Pharmacie d'Approvisionnement. In Tanzania, a major pharmaceutical facility the Arusha Pharmaceutical Factory, is under construction in Arusha. The feasibility study for this projections prepared by a Finish Company at the request of the parastatal National Development Corporation(NDC). The Company provided NDC with the detailed design for the factory and the technical know-how of essential pharmaceutical formulations in forms such as tablets, capsules, liquids and dry injections, syrups and veterinary specialities.

503. The plant is expected to go in to operation beginning 1979 and production at full capacity should be achieved in the fifth-year of production. The value of output in the sixth year was estimated at 115,7 million T.Shs. (about 15 million US dollars) and the total investment costs at 85,9 million T.Shs. (10.7 million US dollars). The manpower requirements (at full production) would be 263 persons.

504. An UNIDO pharmaceutical expert was assigned to the NDC starting January 1978. He elaborated a range of relevant recommendations aimed at better selection of equipments and their lay-out in the plant. It seems necessary to reduce the planned gestation period from 5 to say 2½-3 years, and to reach full capacity earlier.

505. The output of the plant along with some additional relatively small investment and improvements in existing factories, which fortunately have a considerable expansion potential, will increase the share of domestic pharmaceutical production in Tanzania's total consumption, by about 50 per cent or more.

506. In other countries visited here about the development of pharmaceutical industry. In Nigeria, the Ministry of Health had commissioned in 1976 one of the foreign pharmaceutical companies operating in the country to carry out a preliminary study for the development of pharmaceutical industry on the federal scale with the objective of supplying the basic needs of the Nation. The objective, as defined by the government was to extend the medical treatment to a target of 60 per cent of the population in the Federation (i.e. for 52 million people in 1981).

507. On the basis of analysis of the disease conditions in the country and their corresponding during therapies, thirty essential formulations were selected for manufacture in Nigeria. The total requirements of individual pharmaceutical forms have been determined as follows:

Tablets	3.4 billion units
Syrups	1.5 million litres
Powder for suspensions	3.0 million bottles
Dry powders for injection	123 million vials
Water for injection	123 million ampoules, 10 ml
Ointments	700 ton
Intravenous infusions	4.3 million litres
Intravenous injections	520 thousand ampoules, 20 ml

508. To manufacture the above, it has been envisaged to build four general purpose pharmaceutical factories, two of them in the Northern Region (Kano and Kaduna), one in South West Region (Ibadan) and one in South East Region (Enugu). Also one Intravenous Fluids manufacturing unit has been proposed to be located in Lagos.

509. Initial investment was estimated at 53 million US dollars. It seems, however, that no further action has been taken after the preliminary study was submitted beginning 1977. The Federal Ministry of Industry has recently commissioned, the Nigerian Institute of Social and Economic Research (NISER) to undertake comprehensive study for the development of the pharmaceutical industry in the country. The study is expected to be completed at the beginning of 1979. However, in the current Five-Year Development Plan (1975-1980) the development of the pharmaceutical industry in Nigeria is not relected.

510. In Gabon, Cameroon and Upper Volta all countries with rather limited internal market - no plans for the establishment of pharmaceutical manufacture have been included within the Five-Year Development Plans ending in 1980/81. As mentioned before, these countries should participate in the subregional projects promoted within the UDEAC, or CEA0 framework.

511. The Institute for Traditional Medicine in Gabon has submitted to the Government a proposal to establish a Galenic Section, as part of the Institute with the purpose of manufacturing interavenous solutions and essential formulations of common use in forms of tablets, capsules, ampulles, syrups, ointments, suppositories, etc. The investment cost has been estimated at US\$100,000, which seems to be underestimated. Also the range of the proposed production programme considerably exceeds the scale of a research unit.

512. In Upper Volta, hopes are set on the UNIDO/CEAO project (SI/RAF/73/801) for a pharmaceutical center, for which existing modest facilities in Bobo-Dioulasso could be utilized.

513. The United Republic of Cameroon has, in recent years, taken steps to establish a pharmaceutical factory as a joint venture with foreign companies. The proposal was submitted, in 1974 by a French subsidiary of G.H. Boehringer G. Sohn of Ingelheim (W.Germany) for a formulations production unit. The investment costs have been initially estimated to be US\$1,5 million, but recently have been increased to about US\$4 million. The project was abandoned in 1973.

514. A French Company has presented a proposal to establish a production unit with initial investment of about US\$2 million. It emphasized the necessity to increase the prices of the pharmaceuticals to be produced locally so as to ensure the profitability of the project. The production programme proposed by the foreign counterpart seems to be more oriented for marketing the company's products than to satisfy the needs of the National Health Service in Cameroon. The proposal is still under consideration of the Cameroonian authorities.

515. Thus, the prospects for increased self-sufficiency in pharmaceuticals within the next 4-5 years in the countries visited, except Egypt and Tanzania, are rather limited. It would for these countries mean growing expenditures for importation of ready made pharmaceuticals, even those such as intravenous solutions whose compositions is not sophisticated and/or which are relatively costly to transport.

516. Except in Algeria and Morocco seems to be the situation in the most of African countries. This opinion was confirmed also by members of two other missions on pharmaceuticals which visited the ECA/UNIDO Industry Division in Addis Ababa. They are:

- (a) The Inter-disciplinary Team (Task Force) organized by the Guyana Government as the Executing Agency of the resolution passed at Colombo Summit Conference on Non-Aligned Countries in 1976; and
- (b) The representative of the firm: "Consultants for Trade and Industry", Sweden, appointed by the African Development Bank in Abidjan in co-operation with WHO Regional Office for Africa in Brazzaville.

517. The Inter-disciplinary Team was organized by the Guyana Government in its capacity as a co-ordinator of the Trade, Transport and Industry Sector (TTI) of the Action Programme for Economic Co-operation among Non-Aligned and Other Developing Countries (APEC) within the framework of UNDP project "Economic and Technical Co-operation among developing countries in the pharmaceutical sector" (INT/77/009/A/01/99. The projects long term objectives are "to develop economic and technical co-operation among developing countries, to facilitate the adaption of integrated policies in health, and in trade and production of pharmaceuticals, in order to ensure the supply of essential drugs of quality at reasonable cost, to meet basic health needs of their peoples". It is envisaged in the project also that regional and interregional

co-operation among developing countries will become institutionalized through the creation of regional co-operative pharmaceutical production and technology centres (COPPTEC's).

513. The immediate objectives of the project have been outlined as follows (responsible agencies in paranthesis)

- (a) product selection to meet health needs, rationalization of drug nomenclature, appropriate drug control legislation, quality assurance procedures, product information (WHO);
- (b) establishment of procurement agencies with appropriate procedures, pricing and price control, intercountry exchange of market information, feasibility of pooled procurement and appropriate policies on transfer of technology and on patents and trademarks (UNCTAD);
- (c) establishment and expansion of local production and intercountry transfer of pharmaceutical technology, recourse to medicinal plants and animal by-products or other raw materials for pharmaceutical production (UNIDO);
- (d) arrangements for regional and interregional co-operation among developing countries, including the establishment of formulation plants, bulk purchases, production units and the institutionalization of these arrangements through Regional Production and Technology Centres (COPPTEC'S) (ADEC); and
- (e) manpower needs, especially the training of pharmacists, storekeepers and managerial staff through regional and interregional collaboration among the developing countries.

519. The Task Force appointed in co-operation with WHO, UNIDO, UNCTAD, ADEC visited a number of countries in Asia, Latin America and Africa, including Algeria, Chad, Egypt, Ethiopia and Tanzania in the last. During their Ethiopian visit the Task Force exchanged information with the Joint ECA/UNIDO Industry Division in E.C.A. The Task Force is expected to finalize its report in October 1979.

520. In 1974, the African Development Bank (ADB) confirmed its interest in collaborating with WHO and UNIDO in setting up pharmaceutical industries in the African Region on a subregional basis. The subject was raised during the ADB/WHO meeting held in Brazzaville in July 1976 when it was decided to undertake a study to define concrete projects which might be financed by the ADB.

521. The terms of reference for the consultants were prepared in April 1977 defining the following objectives of the study:

- (a) determination of demographic and health situation of different African regions;
- (b) identification of essential drug requirements;
- (c) examination of the availability of raw materials;
- (d) determination of the advancement in production and distribution of pharmaceuticals; and
- (e) determination of economical situation of individual countries, and identification of principal economic constraints (type of economy, resources, possibilities of marketing, etc.).

522. Canada and Sweden are participating in funding the study through the ADB. ADB appointed the firm Consultants for Trade and Industry of Sweden to undertake the feasibility study in six selected African countries: Congo, Mozambique, Ghana, Togo, Tunisia, Sudan. The firm started the work in August 1973 and is expected to finalize the report in one year. A preliminary report was, in the mean time, to have been prepared at the end of September 1973. The project leader G. Tornquist visited the Joint ECA/UNIDO Industry Division in August 1973 when an exchange of views and information took place.

F. STRATEGY OF THE FUTURE DEVELOPMENT OF THE PHARMACEUTICAL INDUSTRY IN AFRICAN COUNTRIES

523. The major constraints in the development of pharmaceutical industry in most of African countries are:

- (a) inability to plan ahead the development of various types of pharmaceutical production, mainly due to inadequate industrial experience;
- (b) real or seeming obstacles in obtaining know-how and technical assistance from industrialised countries;
- (c) financial problems, particularly lack of foreign exchange; and
- (d) staff shortage for planning, promoting or managing pharmaceuticals production units.

524. Although International organisations, especially UNIDO and WHO have in the past years put considerable effort, in the form of mission and studies (see ANNEX IV.4), the situation is still unsatisfactory. At present, in no African country does a well established pharmaceutical industry which capable of producing essential pharmaceuticals based on local natural resources exist. The list in the ANNEX also shows that some activities were not sufficiently co-ordinated, resulting in some cases, in duplicating of work.

525. For planning of the development of the pharmaceutical industry, it is necessary to start with approximate needs, especially for essential products. To identify estimated and quantify such products information on the predominant diseases, their distribution and the preferred treatment is required. Based on available statistical data and opinions of general practitioners, specialists and other health professionals, scheme on the major disease conditions treatable by pharmaceutical therapy and their estimated number of occurrences per 1000 head of population per year should be worked out.

526. By major disease conditions here meant diseases considered to be most prevalent in the country or in the sub-region resulting in death, discomforts and debilitating conditions including those having serious economic effects or potential for becoming epidemic.

527. Information on major disease conditions treatable by pharmaceutical therapy in Nigeria are shown in Table IV. 19. They were taken from a preliminary study by a small team of a foreign company on request from the Federal Commissioner of Health in Nigeria. The table was included here to serve as an example for similar conditions in other African countries.

Table IV.19: Major disease Conditions Treatable by Pharmaceutical Therapy in Nigeria.

No	Incidence Ranking	Disease	Incidence per 1,000 of population per year
1	1	Malaria	1000
2	1	Castro enteritis, diarrhoea, cholera	1000
3	3	Cough, respiratory problems, whooping cough	570
4	4	Intestinal parasistes	200
5	4	Dermatological complaints	200
6	6	Iron deficiency and other anemia	120
7	7	Eye infection	100
8	8	Accident involving surgery	90
9	9	Anxiety/insomnia	70
10	10	Dietary anemia	40
11	10	Polio-myelitis	40
12	10	Sickle-cell anemia	40
13	13	Measles	30
14	14	Gonorrhoea, syphilis	25
15	14	Otitis	25
16	16	Headache, hypertension	20
17	16	Malnutrition	20
18	16	Pneumonia	20
19	16	Tuberculosis	20
20	20	Leprsy	15
21	21	Asthma	10
22	21	Congestive heart failure	10
23	21	Epilepsy/	10
24	21	Peptic ulcers	10
25	21	Schistosomiasis	10
26	26	Diabetes melitus	2
27	26	Fihariasis	2
28	26	Meningitis	2
29	29	Tetanus	1

Source: R.W. Trauter: Preliminary Study for a Drug Manufacturing Industry to Supply the Basic Needs of the Nation, December 1976.

529. Proposals for the indicating planning of local manufacture of the major pharmaceutical therapies including their preferred presentations and required quantities per 1,000 head of population per year) presented in Table IV. 20 were based on the normal treatment regimes taking into account the following:

- (a) combining, as far as possible, pharmaceuticals of the equivalent therapeutic action and substituting a number of similarly acting products by a single drug;

- (b) selecting a single pharmaceutical substance capable of efficacy over a wide range of disease conditions; and
- (c) selecting those in the greatest demand for severely debilitating or life-threatening conditions.

Table IV. 20: Proposals for Essential pharmaceutical Formulations for the Planning of local manufacturing Facilities.

Product	Form	Quantity per 1,000 of Population
Aspirin, 300 mg	Tablets	6,600 units
Paracetamol, 500 mg	"	5,500 "
Chloroquine, 250 mg	"	6,400 "
Chloroquine	Syrup	3,000 ml
Chloroquine, 1 ml, 5 ml	Ampoules	300 "
Ambilhar	Tablets	1,000 Units
Levinsol (anthelmintic) 40 mg	"	500 "
Antacid	"	600 "
Calamine	Lotion	8,000 ml
Dapsone	Tablets	6,000 units
Chloramphenicol	Capsules	750 "
Chloramphenicol	Syrup	2,500 ml
Tetracycline	Capsules	3,000 units
Tetracycline	Syrup	3,000 ml
Tetracycline eye/ear 5 g	Ointment, tubes	1,600 g
Griseofulvin	Tablets	1,000 units
Penicillin Sodium-G for inject.	Vials	1,660 x 1 mega
Penicillin Procaine for inject.	"	3,000 x 4 mega
Streptomycin 1 g, for inject.	"	700 units
Ampicillin 250 mg.	Capsules	300 "
Metronidazole	Tablets	500 "
Idochlorhydroxyquinoline	"	2,000 "
Phenobarbitone	"	150 "
Sulphadiazine	"	3,600 "
Sulphadiazine	"	1,100 "
Phthalysulphathiazole	"	1,000 "
Sulphadiazine	Ampoules	500 "
Diethylcarbamazine, 50 mg	Tablets	1,000 "
Anti-cough	Syrup	25,000 ml
Folic acid	Tablets	1,000 units
Ferrous sulphate/gluconate	"	1,000 "
Multivitamine	"	500 "
Vitamin C	"	500 "
Vitamine B complex	"	500 "
P.A.S./I.N.R.	"	1,000 "
Whitfield's 2.5 g	Ointment, tubes	12,000 g
Methyl salicylate	"	5,000 g
Water for injection, 2.5 ml.	Ampoules	1,645 units

Product	From	Quantity per 1,000 of Population
Dextrose infusion	bottle, bag	15,000 ml
Darrow's solution	"	67,000 ml
Dextrose 20% solution	"	200 ml
Normal saline	"	5,000 ml
Dextrose/saline	"	10,000 ml

Source: Derived from R.W. Trauter, op.cit.,

529. The demand patterns per 1000 of population (Table IV.20) provide means for estimating the global needs for individual formulations, taking into account a realistic proportion of population having access to pharmaceuticals produced. Such estimates covering a period of 5-8 years could be adopted as a basis for the planning of pharmaceutical projects.

530. The pharmaceutical industry based on intermediate inputs needs relatively less than other industrial sector. This coupled with the need to provide the population with the needed pharmaceuticals, a basic need, would force government to give priority: to investments in the pharmaceutical subsector.

531. Depending on the specific features of each country, investment in pharmaceuticals may be carried out at the following levels:

- (a) Repacking of Pharmaceuticals is seldom an independent activity. Frequently it is combined with galenic or formulation manufacture. It could bring some saving in foreign exchange substituting the high labor cost in exporting countries by domestic manpower and sophisticated packing materials by more modest packing sufficient for direct distribution of pharmaceuticals to hospitals and dispensaries. No special skills are necessary, except that technical management should be experienced in the packing.
- (b) Galenic laboratory produces solutions, drops, ointments, powders, granulis etc., that is simple pharmaceutical forms of common use for hospitals as well as pharmacies. The manufacturing processes and equipment are simple and not expensive. For practical purposes repacking and galenic units could be combined and located within the Central distribution agency, e.g. Central Medical Stores, Pharmacie d'Approvisionnement etc.
- (c) Intravenous Fluids (I.V. Fluids) unit could exist as an independent laboratory, or more often as a section in a formulation plant where utilities and general services can be shared. Technically, manufacturing is simple; but requires high sterile condition and reliable quality control (pyrogenes) system. Considering the voluminous transport of water solutions, the general tendency to establish I.V. Fluids units in the consumption centres should prevail. Anyhow, it is advisable to establish, at least, one

I.V. Fluids unit in each African country. For this purpose a reproducible model unit should be designed (with assistance from ECA/UNIDO) and then implemented in African countries.

- (d) Formulation is manufacturing of medicaments in various forms and dosages from bulk pharmaceuticals and various ancillary materials. Production processes require strict observance of technological procedures and high degree of accuracy and exactitude. The required skills could be acquired easily under proper supervision and training. Formulation production should start with making tablets coated and uncoated capsules and solution (syrups, suspensions), all of them major pharmaceutical forms in disease treatment. The manufacture of injection forms (ampoules, drypowder vials etc.) require additional skills, strict sterile conditions and sophisticated quality control, therefore could be developed successively. In higher populated countries (15-20 millions and above) two or more formulation plants will be required to meet the growing national demand. As Egyptian experience shows, a country with a well planned and developed formulation facilities could attain self-sufficiency up to 80-90 per cent of the total consumption. In the event that more than one formulation plant is justified in a country or a sub-region, specialization of individual factories in specific formulations and forms would be advisable.
- (e) Simple chemical processing is usually a single or double step forward operation, starting with crude products or advanced intermediates and producing products: i.e. bulk pharmaceuticals it may bring saving in foreign exchange since import of finish products is usually more expensive than import of intermediates. This stage includes the transformation of one finish product into different derivatives; e.g. obtaining stearate or palmitate derivatives from chloramphenicol, converting tetracycline hydrochloride into tetracycline base etc. It should be noted that the simple chemical processing also offers the necessary experience required for advanced chemical synthesis.
- (f) Advanced chemical synthesis a multi-step chemical process, starting from basic organic and inorganic chemicals or from basic intermediates and producing bulk pharmaceuticals as final products basic products such as salicylates (e.g. acetylsalicylic acid), sulphamides, chloroquine, vitamins etc. should be considered as priority items for manufacture in some African countries, especially in those countries with well established formulations manufacture (e.g. Egypt) or those with intensively developing chemical (particularly petrochemical) or those with big internal or sub-regional market.
- (g) Antibiotics manufacture, particularly the classical penicillin, Streptomycin, Tetracyclines etc. produced by fermentation route should be started in some African countries for internal or subregional market. At present the first antibiotic plant in Africa is under construction in Algeria. It should be noted, however, that 4-5 more units should be established in the region within the next 5-10 years. The raw materials for antibiotic

production are mainly of agriculture origin and most of them are available in some African countries. The process know-how, equipment and efficient strains could be contracted from leading producers and specialized engineering companies.

- (h) Medicinal plant processing transforms botanical materials into extracts or pure active substances. As contents of individual chemicals in the material are rather low, hundreds of thousands of tons have to be processed yielding quantities measured in kilograms or tons respectively large units are usually designed to process a single medicinal plant, while smaller installations could be designed as multipurpose units to process more than one medicinal plant. The processing unit usually requires considerable quantity of good quality water. To avoid unnecessary transport, the unit should be located near the collection centers of the medicinal plants. The processing unit is sometimes forward integrated with crude substances transformed into pure finished products or intermediates or derivatives.
- (i) Animal by-products processing unit must be located within or close to the slaughter house, where animal organs are isolated, collected and stored in cold storage. The active substances are extracted and then purified. Considering the small weights of individual organs obtained from a single carcass, a processing unit is justified only based on a slaughter - house capacity of several thousand tons.

532. Approximate inputs (machinery, materials, manpower and investment) for the preceding manufacturing stages of the pharmaceutical industry are presented in Table IV. 21.

Table IV. 21: Approximate inputs for the different manufacturing stages of the pharmaceutical industry

Level	Type of production, know-how requirement	Basic equipment machines, installations, order of magnitude of investment cost	Inputs	Final product	Order of magnitude of manpower and skill requirement
1	REPACKING OF BULK PHARMACEUTICALS	<p>(i) Manual, semi-automatic or automatic counters for tablets, capsules</p> <p>(ii) Dosage and filling machines for liquids suspensions, pulvers, ointments</p> <p>(iii) Quality control laboratory equipment</p> <p>Investment: 100-300 thousand US dollars</p>	<p>(i) Ready made pharmaceutical forms purchased (imported) in bulk containers</p> <p>(ii) Packing materials (glass or plastic containers, bags, tubes etc.)</p>	Medicaments in packings for individual use, under generic names	50-200 persons inc. 1-3 pharmacists.
	Know-how, not indispensable				
2	GALENIC LABORATORY	<p>(i) Mixers, blending equipment, granulators, dryers,</p> <p>(ii) Water purification and de-ionisation unit,</p> <p>(iii) Vessels for solutions and liquids</p> <p>(iv) Tableting presses, coating pans,</p> <p>(v) Filling and counter equipment</p> <p>(vi) Quality control laboratory equipment</p> <p>Investment: 300-500 thousand US dollars</p>	<p>(i) Medicinal plants (roots, rhisomes, barks, leaves, flowering tops, flowers, fruits, seeds).</p> <p>(ii) Some pharmaceuticals of common use or chemicals of pharmacopeian quality,</p> <p>(iii) ancillary materials e.g. starch, talcum, sugar, alcohol, lanoline, glycerine etc.</p>	Powders, granulates, tinctures, drops, syrups, Tablets ointments suppositories	50-200 persons incl. 1-3 pharmacists with good manufacturing practice
	Know-how not indispensable could be substituted by experience of supervisory personnel				

3. INTRA-VENOUS
FLUIDS

Know-how or good
manufacturing
practice of tech-
nical management

(i) Water purification
and distillation unit,
(ii) Glass vessels,
filter, pumps,
(iii) Sterilizer
(iv) Filling machine
(v) Quality control
equipment,
(vi) moulding machine
if plastic packing
manufactured on the
spot

Investment
300-600 thousand
US dollars

(i) Distilled
water
(ii) Pharmaco-
paein grade
chemicals (small
quantities),
(iii) Glass or
plastic bottles
plastic bags
(iv) Pollethy-
lene or PVC
compound if
packing manu-
factured on the
spot

I.V. Fluids
250 ml or
500 ml
bottles or
bags contain-
ing up to
10 per cent
dissolved
substances

10-30
persons,
incl.
1-2
pharmacist
with ex-
perience
in pro-
duction of
sterile
products

4. FORMULATION PLANT

-Tablets, coated
tablets,
capsules,
-Injection forms
(ampoules,
vials)
-Suspensions
liquids, drops,
-Ointments,
-Suppositories,

Good manufacturing
practice and know-
how for some form-
ulations indis-
pensable

(i) Weighing equipment,
(ii) Mixers, granula-
tors, dryers,
(iii) Tableting presses
and coating pans,
(iv) Glass washing
and drying machine
(v) Filling machines,
(vi) Sterilizers,
(vii) Liofilizers,
(viii) Counting, packing
labeling machines
(ix) Water purification
and distillation
unit,
(x) Quality control
and laboratory
equipment

Investment:
8-25 million
US dollars
(See also appendix
3)

(i) Bulk phar-
maceutical
(substances
aspirin,
chloroquine,
sulphamides,
vitamines etc).
(ii) Ancillary
substances (e.g.
starch, lactose,
sucrose,
clatine
capsules, lano-
line, eucerine,
celulose esters,
talcum,
stearates etc.)
(iii) Packing
materials of
glass, plastic,
paper

Medicaments
in various
pharma-
ceutical
forms and
dosages

500-2000
persons,
incl,
10-20
pharmacist
biologist
chemists
physi-
cians

5	SIMPLE CHEMICAL PROCESSING	(i) Weighing and dosage equipment, (ii) Reactor vessels, mixers, precipitators (iii) Filters, sedimentators, (iv) Dryers (v) Laboratory equipment,	(i) crude pharmaceuticals, (ii) intermediates, (iii) basic chemicals	Bulk pharmaceuticals, various salts and derivatives	100-200 persons, incl. 3-8 chemists
	Know-how or good manufacturing practice indispensable				
		Investment: 200-1,500 thousand US dollars			

6	ADVANCED CHEMICAL SYNTHESIS	(i) Storage, weighing and dosage equipment (ii) Reactor vessels for chlorination, nitration, reduction oxidation, sulphonation, acetylation etc. (iii) Crystallizers, Sedimentation, equip. fillers, (iv) Dryers (v) Grinders, mills, micronizers, (vi) Laboratory, (vii) Equipment, measurement apparatus	Basic Chemicals (organic and inorganic) and intermediates, benzene, phenol, aniline, acetic acid or anhydride, chlorine, chlorosulphonic acid, etc.)	Bulk Pharmaceuticals (Salicylates, sulphamides, anti-malarials, anti-parasitics, anti-tuberculosis etc).	500-2000 persons, incl. 20-50 chemists and other technicians
	Know-how indispensable				
		Investment: 5-25 million US dollars			

7	ANTIBIOTICS (Fermentation process)	(i) Fermentors and other fermentation equipment, (ii) Vacuum filters centrifuges. (iii) Absorption equipment (iv) Vacuum dryers, (v) Crystalizers, (vi) Pulverisation equipment (vii) Packing machines (viii) Solvent recovery equipment (ix) water purification and de-ionisation unit (x) measurements apparatus (xi) laboratory equipment Investment 50-70 million US dollars	(i) Corn steep liquor, (ii) SoyafLOUR (iii) Sugar (iv) Lard and oils (maize, soya peanut) (v) Dextrin, glucose (vi) Ammonium, potassium and phosphate salts, (vii) Silicones, defoamers, (ix) Ion-exchange resins (x) Filter aid materials	Bulk antibiotics (penicillin, streptomycin tetracycline oxytetracycline, erythromycin etc.)	300-800 persons incl. 50-80 chemist microbiologist pharmacist and other technicians
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8	PROCESSING OF MEDICINAL PLANTS: -EXTRACTION -PURIFICATION CHEMICAL TRANSFORMATIONS	(i) Grinding equipment mixers (ii) Extractors (iii) Concentration and drying equip. (iv) Filters (v) Reactors (vi) Solvent recovery unit (vii) Laboratory equipment (viii) Water purification unit Investment: 1-10 million US dollars	(i) Medicinal plants (roots rhizomes, barks leaves, flowering tops, flowers, fruits, seeds) (ii) Solvents and auxiliary chemicals	Pharmacopoeian grade active substances or intermediates for pharmaceutical synthesis	50-250 persons incl. 2-5 chemists with experience in production
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9	PROCESSING OF ANIMAL BY PRO- DUCT	(i)Cooling storage equipment, (ii)grinding machine (iii)Extractors. (iv) Filters, (v) Reactors, concen- tration and drying equipment, (vi)Solvent recovery (vii)Laboratory equipment	Animal by-pro- ducts of com- pletely healthy animals such as pancreas, liver bile, hypophysis etc.)	Active sub- stances from animal organs, (insulin, hormones, hepatitis	50-100 persons, incl. 3-5 chemists, veterinary doctor etc.
	Know-how indispen- sable				
		Investment: 500-2000 thousand US dollars			

533. Depending on the stage of pharmaceutical production and plant location it is necessary to ensure availability of:

- (a) sufficient quantity of water of proper quality
- (b) electric and thermal energy, and
- (c) qualified workers and technician.

534. Considering the present stage of development and planned projects in some countries, tentative proposals are made for the specialization in pharmaceutical production in Africa for the next 5-10 years (Table IV. 22).

Table IV. 22: Tentative proposals for specialization in various types of pharmaceutical production in Africa

Stage	Type of production activity (new projects or extension)	Countries recommended for implementation
1	Repacking of Bulk pharmaceuticals	All countries with no manufacturing facilities
2	Galenic laboratory	
3	Intra-venous Fluids	
4	Formulation	Algeria, Ethiopia, Ghana, Ivory Coast Kenya, Mali, Mauritania, Nigeria, Senegal, Sudan, Uganda, Tanzania, Zaire, etc.
5	Simple chemical processing	Ethiopia, Ghana, Ivory Coast, Kenya, Morocco, Nigeria, Tanzania, Zaire, etc.
6	Advanced chemical synthesis	Algeria, Egypt, Ethiopia, Kenya Nigeria, Tanzania, Zaire
7	Antibiotics	
8	Processing of medicinal plants	Algeria, Angola, Cameroon, Ethiopia, Gabon, Kenya, Mali, Mozambique, Madagascar, Morocco, Nigeria, Sudan, Uganda, Tanzania, Tunisia, Zaire, Zambia, etc.
9	Processing of animal by-products and waste products	Angola, Cameroon, Egypt, Ethiopia, Nigeria, Sudan, Zaire, etc.

535. Manpower requirement for pharmaceutical production is not that high and depends on the type of manufacturing unit. Order of magnitude of such requirements could be determined with the help of a composition of the required personnel given in Table IV.23:

Table IV, 23: The Composition of Manpower Requirements in the Pharmaceutical Industry (percentage)

	Production stage			
	-Repacking	-Simple chemical	-Advanced chemical synthesis	
	-Galenic -I.V Fluids	-Formu- lation	-Medicinal plants -Animal by- products	-Antibiotics
Total	100	100	100	100
1. Managerial Staff	7 - 8	8 - 9	6 - 7	4 - 5
2. Technical Staff:	2 - 3	6	5	10 - 15
of which:	-			
pharmacists	1-2	4	1	2.5
chemists	1	1	3	7.12
mechanical & electrical	-	-	0.5	0.5
others	-	-	0.5	0.2
3. Foremen and Technicians	10	12	10	10
4. Skilled workmen	40	30	25	20
5. Clerks	10	12	10	9
6. Unskilled workmen	30-31	31-32	43-44	33-39

536. In the relatively advanced countries (Egypt) or in subregional or regional organizations such as Arab Company for drug Industries and medical appliances (ACDIMA), institutions specialized in pharmaceutical design (Engineering firm) should be set up. Such units could participate in the preparation of feasibility studies or projects undertaken by foreign contractors. Gradually, it should, by itself be able to undertake engineering and design work of or local investors as well as foreign customers.

537. The staff of the engineering firm could be recruited from among the experienced technical personnel of existing pharmaceutical companies. The engineering firm could also participate in the execution of projects in related industries, e.g. processing of food and agricultural products, formulation of pesticides, cosmetics, etc. This could create a sound economical basis for the company.

538. Assistance of international organizations (ECA, UNIDO, WHO) is indispensable for the promotion and implementation of pharmaceutical projects in Africa at the country and subregional level. Assistance to be provided by these organizations should include:

- (a) Elaboration of long-term plans for the development of the pharmaceutical industry in individual countries or subregions;
- (b) Preparation and/or evaluation of pre-feasibility and feasibility studies for individual projects;
- (c) Elaboration of projects which could be easily adopted in individual countries, e.g. model projects for Intra-venous Fluids manufacturing unit, for formulation plant etc.;
- (d) Financing of pilot plant projects of essential importance for the pharmaceutical supply in African countries, e.g. galenic or medicinal plants processing units; and
- (e) Creation and strengthening of training Centres, with emphasis on training on manufacturing practices.

539. Concrete programme for ECA/UNIDO assistance for the six countries visited are included in the country reports.

G. MEDICINAL PLANTS AND TRADITIONAL MEDICINES IN AFRICA

540. African countries are rich in medicinal plants. In Tanzania for example, a Chinese team had identified occurrence of about 1,000 herbs of medicinal interests, Tanzania and Cameroon are traditional exporters of a range of medicinal plants to the industrialized world.

541. Medicinal plants continue to play an important role in traditional medicine. They are widely used by African countries where the majority of population seeks the assistance of traditional healers as the only means of assistance.

542. They also represent an important raw materials source for the pharmaceutical industry. World production of pharmaceuticals based on medicinal plants amounts to more than 1 billion US dollars per year and shows a constant growth ^{31/}. In the United States of America, a survey has shown that 25 per cent of all prescriptions dispensed between 1959 and 1974 contained crude plant extract or pure active constituent ^{32/}.

543. The majority of medicinal plants are utilized in the form of galenical preparations. Modestly equipped laboratories are capable of extracting or isolating the active substances.

^{31/} Summary of the Draft World-wide Study of the Pharmaceutical Industry (UNIDO IGIS.74), June 1978.

^{32/} An Integrated Approach to Research on Medicinal Plants, by N. Anand, ID/WG.271/3, February 1978.

544. The role of traditional medicine can not be ignored when considering pharmaceutical consumption and manufacture in Africa.

545. Traditional medicine requirement of African countries could be met if traditional medicine were associated or better integrated with modern medicine 33/.

546. A clear perspective of the possible role of traditional medicine in developing countries has been stated by Dr. Halfdan Mahler 34/ "For far too long, traditional systems of medicine and 'modern' medicine have gone their separate ways in mutual antipathy. Yet, are not their goals identical to improve the health of mankind and thereby the quality of life?"

547. Following these considerations many African countries are making offers to elevate traditional medicine through integration and enrichment with modern medicine. According to information received from 19 countries in Africa 35/.

- (a) "8 had in their Ministry of Health a unit concerned with traditional medicine;
- (b) 13 were carrying out considerable activities in the field of traditional medicine either in the form applied research or of treatment given by a medical officer in association with traditional medicine or through traditional healers working within the traditional framework, whether integrated into the health team or co-operating more or less closely with it;
- (c) 10 institutes, research centres or herbaria that deal with problems of traditional medicine;
- (d) 6 were carrying out research in that field within universities;
- (e) 5 had appointed national committees to deal with the problems of traditional medicine or had held national symposia, workshops and seminars on this topic;
- (f) 7 possessed officially recognized traditional medicine associations;
- (g) 3 had legislation governing traditional medicine".

548. Plants with pharmaceutical potential occurring in the region include Rauwolfia Serpentina, Strophantus, Vinca Rosea, Voacanga, Aloes, Pygeum Africana, Yohimbe, Agave sisalana. Some of them are collected and commercialized. In Cameroon, a specialized agency, SONACOM, is exporting annually about 300 tons of voacanga grains, 10-15 tons of Rauwolfia, Yohimbe and Straphontus, and 2-5 tons Pygeum Africana. The annual turnover of ONACOM is about 1.3 million US dollars. ONACOM is currently negotiating with a Belgian company for the establishment of a joint venture Company,

33/ Mahler R.H., World Health (1977) 3, cit. from "An integrated approach to research on medicinal plants by N. Anand, IB/WG.271/3, February 1978.

34/ African Traditional Medicine, WHO Regional Office for Africa, Afro Technical Report Series, No.1, Brazzaville 1976.

35/ Summary of the Draft World-wide Study of the Pharmaceutical Industry (UNIDO/ICIS.74), June 1978.

SOCAVO, for the processing the grains of Voacanga into Tabersonine Chlorhydrate, an intermediate for Vincamine production. Investment has been estimated at about 3 million US dollars. The whole output of Tabersonine is to be purchased by the Belgian firm.

549. The Centre d'Etudes des Plantes Medicinales (CEPM) established in 1974 in Yaounde includes botanical, pharmacological and chemical sections. The botanical section has identified and catalogued more than 600 plants by interviewing and cooperating with 55 traditional healers. The therepeutical properties fo individual herbs will be pharmacologically and chemically tested. If satisfactory results are obtained, the chemical isolation of active components will be carried out. The research programme of CEPM for the next five years has been formulated as follow:

(a) Botanical research of medicinal plants:

- (i) Registration, collection and conservation,
- (ii) Identification of species and families,
- (iii) Cultivation of selected species;

(b) Chemical research of medicinal plants:

- (i) Extraction and isolation of active substances,
- (ii) Structural identification of active substances,
- (iii) Total synthesis or semi-synthesis of active substances;

(c) Pharmacological, physiological and biological research:

- (i) Therapeutic activity and toxicity of medicinal substances,
- (ii) Physiology of medicinal substances,
- (iii) Conditioning of medicinal sustances.

550. The cost of the above five year reasearch programme is about 4 million US dollars, including the investment of a small-scale processing unit (pilot plant). However, out of the manpower requirement of 12-14 qualified research workers, the Center has actually only 4 persons.

551. In Tanzania a Traditional Medicine Research Unit has recently been established at the university of Dar-es-Salaam. It carries out surveys on the different aspects of traditional medicine and intends to integrate the approach used by healers with those of doctors by organizing co-operation between them. The real activity of the Unit could however, be developed when adequate facilities are available. The construction of a laboratory project comprising pharmacological, chemical and extrac-tion sections and costing 350 thousand US dollars is expected to start in 1979.

552. Further developments include the establishment of a National Herbarium Center for collecting samples of medicinal plants and a Botanic Garden in Maragora district for the cultivation of commercially viable medicinal plants.

553. At the present Tanzania produces hecogenin as a by-product sisal (*Agava Sisalana*). Hecogenin is an extract from the fleshy waste obtained when separating the fibre. The juice of the pulp is concentrated to a strength of 15-20 per cent. Hecogenin is exported to cortisone manufacturers in Europe (120 t/year) where it is processed and purified into hecogenin acetate, an intermediate in steroids synthesis. It seems advisable that the pruification stage is carried out in Tanzania and pure instead of crude product exported or better still further processed.

554. In Gabon, Institut de Pharmacopées et de Médecine Traditionnelles (I.Pha.Me.Tra) has been established within ONAREST, a governmental organization for scientific research. The Institute intends to undertake census of traditional healers in the country, identify the medicinal plants utilized by them and carry out a systematic research on such plants.

555. The research work aims at indentifying active substances such as alkaloids, cardiotonicals, aromatic flavours, suponicals etc. At this initial stage it is understood that the Institute requires 10 additional graduates and technicians.

556. The future development in the field of medicinal plants in Africa should be directed towards processing medicinal plants locally instead of exporting them as crude materials. Individual governments should therefore support all initiatives and assist enterprises in securing the necessary credit and other facilities needed to establish or develop.

- (a) The cultivation, collection and harvesting of medicinal plants: roots, rhizomes and barks, leaves or flowering tops, flowers, fruits and seeds and related drying, storage and preservation facilities.
- (b) Galenic laboratories for simple processing of indigenous medicinal plants into galenial forms correctly and adqutely mixed, dosed and packed in form of tea mixtures, brews and infusions doses, polvers or granulates and syrups or solutions. Galenic preparations, based on efficacious and proven traditional remedies and adequate guarantees, would provide patient with medicines which not only meet their needs but also are in harmony with tradition;
- (c) Small and medium scale installations for the extraction and processing of plants into intermediate or final products for use in pharmaceutical or other applications. The conversion of hecogenin extract into Hecogenin Acetate and consequently into more sophisticated products referred to earlier might serve as an example of this kind of initiative. Based on the level of progress achieved in the utilization of their medicinal plant resources Governments should restrict and eventually prohibit the exports of crude medicinal plants.

557. International organizations, particularly UNIDO, are helping developing countries to realize that local botanical resources have important potentials as raw materials in industrial pharmaceutical production. UNIDO has been collecting data on available medicinal plants for a number of years and is promoting international co-operation among developing countries to promote the industrial use of such plants. With this in view a meeting on Technical Consultation on Production of Drugs from Medicinal Plants in Developing countries organized by UNIDO was convened in Lucknow, India, 13-20 March 1978. The papers presented at the meeting which were recently published give a comprehensive knowledge about the different aspects of medicinal plants. They are:

- (a) "Plants of the African Pharmacopeaies Used in the Treatment of Tropical Diseases", by J. Kerharo, Professor of Pharmacognosy, Department of Medicine and Pharmacy, University of Dakar, Senegal (ID/WG.271/1, 13 February 1978;

- (b) "Industrial Requirements for Processing Medicinal Plants", by E. Bombardelli, Research Laboratories Invernizzi della Beppa Sp A, Milan, Italy (ID/WG.271/2, 22 February 1973);
- (c) "An integrated Approach to Research on Medicinal Plants", by N. Anand, Director of Central Drug Research Institute, Lucknow, India (ID/WG.271/3, 24 February 1973); and
- (d) "Medicinal Plants for Curing Diseases other than Communicable, Tropical and Infectious", by F. Sandberg, Professor of Pharmacognosy, University of Uppsala, Sweden (ID/WG/271/4, 13 March 1973).

558. WHO is another organization concerned with traditional medicine. WHO has, in recent years, put emphasis on the need for research in and integration of traditional medicine with modern medicine.

559. The Regional Expert Committee on Traditional Medicine in Africa, 36/ held in Brazzaville from 9 to 13 February 1976, gave the following definition of traditional medicine:

"Traditional African medicine might be considered to be the sum total of practices, measures, ingredients and procedures of all kinds, whether material or not, which from time immemorial had enabled the African to guard against disease to alleviate his sufferings and to cure himself".

On possibilities for integration, the report of the Committee stated:

"Having thus noted the impact of traditional medicine on health in Africa, the Committee recognized the necessity and timeliness of integrating the activities of traditional medicine into various types of health care. In view however of the historical relationship between the two systems of medicine, their different basic concepts and the fact that their methods could not readily be superimposed, such as integration of activities could only be planned and effected gradually, special attention being paid to the condition prevailing in each region or country".

The Committee recommended, inter alia that

- (a) the cultivation of certain medicinal plants be encouraged in the villages so as to have available at that level simple, effective and inexpensive means of treatment;
- (b) national herbaria be established, ethnobotanical and pharmaceutical research extended, cultivation of certain medicinal plants on an industrial scale encouraged and a local industry developed for the manufacture of pharmaceutical products, based on the Region's medicinal plants; and
- (c) the export of medicinal plants for commercial purposes be regulated.

36/ African Traditional Medicine, WHO Regional Office for Africa, Brazzaville 1976, Afro Technical Report Series No.1.

560. In view of the above efforts by individual organizations it would be advisable to co-ordinate their activities in assisting member States in research and processing of the medicinal plants. Such assistance should include:

- (a) Financial or material support to research institutes or centers (including those in Tanzania and Cameroon); and
- (b) Manpower: advisors or experts for:
 - (i) Research institutes such as those in Tanzania, Gabon and Cameroon,
 - (ii) Preparation and evaluation of feasibility studies on projects such as those for processing crude hecogenin in Tanzania, Voacanga in Cameroon, etc., and
 - (iii) Establishment of galenic sections or independent laboratories to transform medicinal plants into galenical preparations of guaranteed quality.

Annex II A

Consumption of fertilizers per hectare of land and per capita in 1975 in different regions of the world (in 100 gms)

Region	Consumption of fertilizers per hectare of agricultural land	Consumption of fertilizers per hectare of arable land and permanent crops	Consumption of fertilizers per capita
<u>World</u>			
Nitrogenous fertilizers	95	287	109
Phosphate fertilizers	53	160	60
Potash fertilizers	47	142	54
Total fertilizers	<u>195</u>	<u>589</u>	<u>223</u>
<u>Africa</u>			
Nitrogenous fertilizers	12	59	31
Phosphate fertilizers	8	39	20
Potash fertilizers	3	16	8
Total fertilizers	<u>24</u>	<u>114</u>	<u>60</u>
<u>North-Central America</u>			
Nitrogenous fertilizers	182	382	326
Phosphate fertilizers	92	193	165
Potash fertilizers	85	178	152
Total fertilizers	<u>359</u>	<u>753</u>	<u>643</u>
<u>South America</u>			
Nitrogenous fertilizer	15	79	37
Phosphate fertilizers	21	111	32
Potash fertilizers	13	68	31
Total fertilizers	<u>48</u>	<u>257</u>	<u>120</u>

Region	Consumption of fertilizers per hectare of agricul- tural land	Consumptions of fertilizers per hectare of arable land and permanent pastures	Consumption of fertilizers per capita
<u>Europe</u>			
Nitrogenous fertilizers	533	553	259
Phosphate fertilizers	346	598	168
Potash fertilizers	357	575	173
Total fertilizers	<u>1236</u>	<u>1991</u>	<u>600</u>
<u>Oceania</u>			
Nitrogenous fertilizers	4	39	88
Phosphate fertilizers	17	178	404
Potash fertilizers	4	41	92
Total fertilizers	<u>24</u>	<u>258</u>	<u>584</u>
<u>USSR</u>			
Nitrogenous fertilizer	122	317	288
Phosphate fertilizers	53	165	150
Potash fertilizers	63	215	196
Total fertilizers	<u>258</u>	<u>697</u>	<u>635</u>
<u>Developed world</u>			
Nitrogenous fertilizers	150	450	253
Phosphate fertilizers	95	253	161
Potash fertilizers	82	251	138
Total fertilizers	<u>327</u>	<u>1004</u>	<u>552</u>
<u>Developing World</u>			
Nitrogenous fertilizers	35	113	39
Phosphate fertilizers	17	55	19
Potash fertilizers	9	25	10
Total fertilizers	<u>62</u>	<u>195</u>	<u>68</u>
<u>Centrally Planned Economies</u>			
Nitrogenous fertilizers	142	395	128
Phosphate fertilizers	70	195	63
Potash fertilizers	77	215	70
Total fertilizers	<u>290</u>	<u>805</u>	<u>262</u>

Source: FAO: Annual fertilizer Review 1976.

Application of fertilizers (in 100 grams) per hectare of land and
per capita consumption in different African countries

	Agricultural area				Arable land				Per capita			
	1961-65	1966	1971	1976	1961-65	1966	1971	1976	1961-65	1966	1971	1976
WORLD												
NITROGENOUS FERTILIZERS	34	49	74	99	108	154	228	303	47	65	91	112
PHOSPHATE FERTILIZERS	28	36	46	58	91	114	144	178	40	48	57	66
POTASH FERTILIZERS	24	29	30	51	74	92	120	155	32	39	48	57
TOTAL FERTILIZERS	85	114	159	208	272	360	492	636	120	153	196	235
AFRICA												
NITROGENOUS FERTILIZERS	5	5	9	14	24	28	47	68	15	17	27	35
PHOSPHATE FERTILIZERS	3	4	6	9	17	20	30	43	11	12	17	22
POTASH FERTILIZERS	1	2	3	3	7	9	13	17	4	6	7	9
TOTAL FERTILIZERS	9	11	18	27	47	57	90	128	30	36	51	66
ALGERIA												
NITROGENOUS FERTILIZERS	3	4	15	15	21	25	97	98	14	15	49	43
PHOSPHATE FERTILIZERS	5	5	16	20	30	31	106	130	20	18	54	57
POTASH FERTILIZERS	3	3	5	7	21	20	35	42	14	11	18	19
TOTAL FERTILIZERS	11	12	37	42	72	76	238	270	47	44	121	119
ANGOLA												
NITROGENOUS FERTILIZERS		1	4		7	21	62	5	2	7	19	2
PHOSPHATE FERTILIZERS			3		3	5	43	3	1	2	14	1
POTASH FERTILIZERS			2		1	1	32	3			10	1
TOTAL FERTILIZERS	1	1	6	1	10	27	137	11	3	9	43	3
BENIN												
NITROGENOUS FERTILIZERS			6	3			7	13			8	3
PHOSPHATE FERTILIZERS			4	2		1	4	12		1	4	2
POTASH FERTILIZERS	1	2	6	3	1	2	6	3	2	3	7	3
TOTAL FERTILIZERS	2	3	16	8	2	3	18	9	3	4	19	8
BOTSWANA												
NITROGENOUS FERTILIZERS					13	19	9	7	24	30	17	14
PHOSPHATE FERTILIZERS					1	1	5	7	2	2	10	14
TOTAL FERTILIZERS					14	20	14	15	26	38	26	28
BURUNDI												
NITROGENOUS FERTILIZERS		1	3	2		1	4	2			1	1
PHOSPHATE FERTILIZERS			1	1			1	1			1	
POTASH FERTILIZERS			1	1			1	1			2	1
TOTAL FERTILIZERS		1	5	3		1	7	4				

	Agricultural area				Arable land				Per capita			
	1961-65	1966	1971	1976	1961-65	1966	1971	1976	1961-65	1966	1971	1976
CAMEROON												
NITROGENOUS FERTILIZERS	1	4	6	5	3	9	12	11	4	12	15	13
PHOSPHATE FERTILIZERS			1	2		1	1	5	1	1	2	5
POTASH FERTILIZERS	2	3	3	3	4	7	7	7	6	9	8	8
TOTAL FERTILIZERS	3	7	10	11	8	17	20	24	10	22	25	26
CAPE VERDE												
NITROGENOUS FERTILIZERS				15				25				3
PHOSPHATE FERTILIZERS				5				8				1
POTASH FERTILIZERS				5				8				1
TOTAL FERTILIZERS				25				40				5
CENT AFR EMP												
NITROGENOUS FERTILIZERS		1	2	1		1	2	1	2	5	9	3
PHOSPHATE FERTILIZERS			1				1		1	1	4	1
POTASH FERTILIZERS									1	1	1	1
TOTAL FERTILIZERS	1	2	4	1	1	2	4	2	3	7	13	5
CHAD												
NITROGENOUS FERTILIZERS				1		1	2	4		1	3	8
PHOSPHATE FERTILIZERS							1	3			2	5
POTASH FERTILIZERS								1				1
TOTAL FERTILIZER				1		1	3	8	1	1	6	14
CONGO												
NITROGENOUS FERTILIZERS		1	3		7	12	73	5	4	7	38	2
PHOSPHATE FERTILIZERS							2	5			1	2
POTASH FERTILIZERS	1	1	2	2	12	21	46	38	7	12	24	18
TOTAL FERTILIZERS	1	1	5	2	19	33	120	47	12	19	62	22
EGYPT												
NITROGENOUS FERTILIZERS	911	877	1138	1716	911	877	1138	1716	83	86	101	134
PHOSPHATE FERTILIZERS	183	156	162	372	183	156	162	372	17	15	14	25
POTASH FERTILIZERS	5	2	6	13	5	2	6	13			1	1
TOTAL FERTILIZERS	1099	1035	1306	2101	1099	1035	1306	2101	100	101	115	164
EQ GUINEA												
NITROGENOUS FERTILIZERS	15	15	36	3	23	22	52	4	19	19	41	3
PHOSPHATE FERTILIZERS	12	18			18	27			16	22		
TOTAL FERTILIZERS	28	33	36	3	41	49	52	4	35	41	41	3
ETHIOPIA												
NITROGENOUS FERTILIZERS				1		1	2	8		1	1	4
PHOSPHATE FERTILIZERS				1	1	1	2	7		1	1	3
TOTAL FERTILIZERS			1	3	1	2	4	15	1	1	2	7

	Agricultural area				Arable land				Per capita			
	1961-65	1966	1971	1976	1961-65	1966	1971	1976	1961-65	1966	1971	1976
CABON												
NITROGENOUS FERTILIZERS				1				19				6
PHOSPHATE FERTILIZERS								13				4
TOTAL FERTILIZERS				1				32				10
GAMBIA												
NITROGENOUS FERTILIZERS		1	5	3		3	13	8		1	6	4
PHOSPHATE FERTILIZERS	1	8	2	23	4	24	4	54	2	12	2	27
POTASH FERTILIZERS				15				35				17
TOTAL FERTILIZERS	1	9	7	42	4	26	17	96	2	13	8	48
GHANA												
NITROGENOUS FERTILIZERS			1	9	2	1	4	44	1		1	12
PHOSPHATE FERTILIZERS			1	4	2	2	4	19				
POTASH FERTILIZERS			1	2	2	1	3	12	1	1	1	5
TOTAL FERTILIZERS	1	1	2	15	6	4	11	76	2	2	3	20
GUINEA												
NITROGENOUS FERTILIZERS	1	1	2	1	1	2	4	1	2	3	4	1
PHOSPHATE FERTILIZERS	1	1			1	1		1	1	1		1
POTASH FERTILIZERS	2	3	2	1	3	5	3	1	4	6	3	1
TOTAL FERTILIZERS	3	5	4	2	6	9	7	3	7	10	7	3
GUIN BISSAU												
NITROGENOUS FERTILIZERS				1				4				2
PHOSPHATE FERTILIZERS				1				4				2
TOTAL FERTILIZERS				1				7				4
IVORY COAST												
NITROGENOUS FERTILIZERS	2	2	4	7	3	5	7	13	5	7	11	17
PHOSPHATE FERTILIZERS	1	1	2	5	2	2	4	10	3	4	5	13
POTASH FERTILIZERS	3	4	8	12	6	7	16	22	10	12	23	30
TOTAL FERTILIZERS	5	7	14	24	10	14	27	45	18	23	39	60
KENYA												
NITROGENOUS FERTILIZERS	13	20	31	38	43	63	89	104	8	12	14	16
PHOSPHATE FERTILIZERS	14	29	43	46	47	88	122	126	9	17	22	20
POTASH FERTILIZERS	2	4	5	7	6	12	15	20	1	2	3	3
TOTAL FERTILIZERS	29	53	80	91	96	163	225	250	18	31	41	39
LESOTHO												
NITROGENOUS FERTILIZERS				1	1	1	1	8		1		3
PHOSPHATE FERTILIZERS	1	2	4	4	11	17	29	28	4	6	10	9
TOTAL FERTILIZERS	1	2	4	5	11	18	30	37	4	7	10	11

	Agricultural area				Arable land				Per capita			
	1961-65	1966	1971	1976	1961-65	1966	1971	1976	1961-65	1966	1971	1976
LIBERIA												
NITROGENOUS FERTILIZERS	2	23	23	71	4	38	58	117	1	11	10	27
PHOSPHATE FERTILIZERS			8	20			14	33			4	8
POTASH FERTILIZERS				7				11				3
TOTAL FERTILIZERS	2	23	31	97	4	38	52	161	1	11	13	37
LIBYA												
NITROGENOUS FERTILIZERS	2	3	8	14	7	11	32	51	12	15	38	53
PHOSPHATE FERTILIZERS	2	4	9	29	7	14	36	105	11	20	42	108
POTASH FERTILIZERS		1	1	4	2	2	2	15	3	3	2	15
TOTAL FERTILIZERS	4	7	18	47	16	27	69	171	26	38	83	176
MADAGASCAR												
NITROGENOUS FERTILIZERS		1	2	2	5	9	21	21	3	4	8	7
PHOSPHATE FERTILIZERS		1	1		3	7	9	2	1	3	4	1
POTASH FERTILIZERS			1	1	4	6	14	9	2	3	6	3
TOTAL FERTILIZERS	1	2	3	2	12	22	44	32	6	10	18	11
MALAYI												
NITROGENOUS FERTILIZERS	7	8	26	46	13	15	48	83	7	7	23	38
PHOSPHATE FERTILIZERS	2	3	7	8	5	5	13	14	2	2	6	6
POTASH FERTILIZERS	2	3	5	7		3	9	13	2	2	4	6
TOTAL FERTILIZERS	12	13	38	61	23	25	70	110	12	12	34	50
MALI												
NITROGENOUS FERTILIZERS			1	1		1	3	5		1	6	8
PHOSPHATE FERTILIZERS			1	1		1	4	4		2	8	7
POTASH FERTILIZERS				1				3				5
TOTAL FERTILIZERS			2	3		2	7	12		3	14	20
MAURITANIA												
NITROGENOUS FERTILIZERS								5				
TOTAL FERTILIZERS								5				
MAURITIUS												
NITROGENOUS FERTILIZERS	997	881	818	1009	1072	948	872	1075	138	112	109	126
PHOSPHATE FERTILIZERS	581	299	261	263	625	322	278	280	80	38	35	33
POTASH FERTILIZERS	765	729	845	1254	823	784	901	1336	108	93	113	156
TOTAL FERTILIZERS	2343	1908	1923	2526	2519	2054	2051	2692	324	242	257	315
MOROCCO												
NITROGENOUS FERTILIZERS	7	13	24	40	20	34	64	105	11	19	31	46
PHOSPHATE FERTILIZERS	9	10	19	34	26	27	52	88	15	15	25	50
POTASH FERTILIZERS	4	6	11	16	11	17	29	41	6	9	14	10
TOTAL FERTILIZERS	21	29	54	91	57	78	145	235	32	43	70	106

	Agricultural area				Arable land				Per capita			
	1961-65	1966	1971	1976	1961-65	1966	1971	1976	1961-65	1966	1971	1976
MOZAMBIQUE												
NITROGENOUS FERTILIZERS	1	1	1	1	13	13	22	22	5	5	8	7
PHOSPHATE FERTILIZERS				1	5	2	5	9	1	1	2	3
POTASH FERTILIZERS					2	3	5	5	1	1	2	2
TOTAL FERTILIZERS	1	1	2	2	19	19	33	36	7	7	12	12
NIGER												
NITROGENOUS FERTILIZERS												3
PHOSPHATE FERTILIZERS				1								1
TOTAL FERTILIZERS				1				1				2
NIGERIA												
NITROGENOUS FERTILIZERS			1	1	11		2	2	21		1	8
PHOSPHATE FERTILIZERS				1	10	1	1	2	19		1	7
POTASH FERTILIZERS					4			1	7			3
TOTAL FERTILIZERS	1	2	2	25	1	3	4	47		1	2	17
REUNION												
NITROGENOUS FERTILIZERS	489	714	700	641	553	806	790	732	91	124	107	80
PHOSPHATE FERTILIZERS	177	286	471	578	200	323	532	661	33	50	72	72
POTASH FERTILIZERS	491	1071	729	547	555	1210	823	625	91	186	111	68
TOTAL FERTILIZERS	1156	2071	1900	1766	1308	2339	2145	2018	215	359	290	224
RHODESIA												
NITROGENOUS FERTILIZERS	37	52	98	109	126	170	296	323	61	80	129	123
PHOSPHATE FERTILIZERS	22	29	47	59	76	93	143	173	37	44	63	66
POTASH FERTILIZERS	22	27	39	45	75	87	117	133	37	41	51	51
TOTAL FERTILIZERS	81	107	184	213	277	350	556	629	135	165	243	240
RWANDA												
NITROGENOUS FERTILIZERS			1	1		1	1	2				
PHOSPHATE FERTILIZERS				1				1				
POTASH FERTILIZERS			1	1			1	1				
TOTAL FERTILIZERS			1	2		1	3	3			1	1
SENEGAL												
NITROGENOUS FERTILIZERS	3	7	6	13	12	22	22	45	7	13	11	21
PHOSPHATE FERTILIZERS	5	6	8	17	16	21	16	57	11	12	8	27
POTASH FERTILIZERS	4	7	6	16	13	24	21	53	8	14	11	25
TOTAL FERTILIZERS	12	20	17	46	44	66	59	155	26	40	30	73
SIERRA LEONE												
NITROGENOUS FERTILIZERS			1	1			2	2			1	2
PHOSPHATE FERTILIZERS		1	1	1	1	1	1	1	1	2	2	2
POTASH FERTILIZERS								1			1	1
TOTAL FERTILIZERS		1	3	3	1	1	4	4	1	2	6	6

	Agricultural area				Arable land				Per capita			
	1961-65	1966	1971	1976	1961-65	1966	1971	1976	1961-65	1966	1971	1976
SOMALIA												
nitrogenous fertilizers			1		8	11	19		3	4	7	
phosphate fertilizers							4				1	
potash fertilizers							13				5	
total fertilizers							35		3	4	13	
SOUTH AFRICA												
nitrogenous fertilizers	8	10	21	32	64	76	143	210	46	52	94	120
phosphate fertilizers	16	22	30	38	129	166	202	250	94	114	134	143
potash fertilizers	5	9	11	14	42	66	70	90	30	45	47	52
total fertilizers	30	41	62	83	234	308	415	550	171	210	274	315
SUDAN												
nitrogenous fertilizers	8	10	13	33	37	46	60	140	21	25	28	67
phosphate fertilizers					1	1				1		
total fertilizers	8	10	13	33	37	47	60	140	22	26	28	67
SWAZILAND												
nitrogenous fertilizers	14	20	22	47	159	199	212	347	62	81	77	124
phosphate fertilizers	8	12	16	12	90	119	158	87	33	49	57	31
potash fertilizers	6	7	11	19	63	66	109	139	25	27	40	50
total fertilizers	28	39	49	78	312	384	479	572	121	157	173	205
TANZANIA												
nitrogenous fertilizers		1	2	3	6	12	20	23	2	4	8	9
phosphate fertilizers			1	2	2	3	7	17	1	1	3	7
potash fertilizers		1	1	1	3	6	6	7	1	2	2	3
total fertilizers	1	2	3	6	11	21	33	47	3	7	13	19
TOGO												
nitrogenous fertilizers			1	4			1	4			1	4
phosphate fertilizers			1	4			1	5			1	5
potash fertilizers				3				3				3
total fertilizers			2	11			2	12			2	12
TUNISIA												
nitrogenous fertilizers	6	9	24	33	11	16	42	56	11	15	35	42
phosphate fertilizers	16	19	22	38	27	33	38	66	27	30	31	49
potash fertilizers	4	4	4	3	6	7	6	6	6	6	5	4
total fertilizers	26	32	49	74	45	56	87	128	44	52	71	96

	Agricultural area				Arable land				Per capita			
	1961-65	1966	1971	1976	1961-65	1966	1971	1976	1961-65	1966	1971	1976
UGANDA												
NITROGENOUS FERTILIZERS	2	3	4	1	3	5	9	2	2	3	4	1
PHOSPHATE FERTILIZERS	1	2	2		3	3	5	1	2	2	2	
POTASH FERTILIZERS	1	1	1		1	2	2		1	1	1	
TOTAL FERTILIZERS	3	5	8	2	7	11	16	3	4	6	8	1
UPPER VOLTA												
NITROGENOUS FERTILIZERS				1			1	4			1	4
PHOSPHATE FERTILIZERS				1			1	4			1	4
POTASH FERTILIZERS								1				1
TOTAL FERTILIZERS				2			2	9			2	9
ZAIRE												
NITROGENOUS FERTILIZERS			1	2	1	2	5	10		1	1	2
PHOSPHATE FERTILIZERS				2		1	1	8				2
POTASH FERTILIZERS						1	3	2			1	1
TOTAL FERTILIZERS		1	2	4	2	4	8	21	1	1	2	5
ZAMBIA												
NITROGENOUS FERTILIZERS	2	2	9	11	11	12	66	79	15	16	74	77
PHOSPHATE FERTILIZERS	1	1	4	5	6	8	26	36	8	10	29	35
POTASH FERTILIZERS	1	1	2	2	4	5	15	12	5	6	17	12
TOTAL FERTILIZERS	3	3	15	18	21	25	107	127	28	32	120	123

Source: FAO Annual Fertilizer Review, 1977.

Imports of all chemicals in Africa for the period 1968-1977 in U.S. Dollars

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
NORTH AFRICA	287403	328703	349331	397456	481707	611438	1079837	1536573	1466341	1806985
102 Algeria	80630	95082	102017	111682	145744	155475	300000*	430000*	463000*	477000
106 Egypt	76140	94749	102051	111929	123754	139082	327117	518507	369341	515269
105 Libyan Arab Jamahiriya	33405	35378	31961	42344	50603	70922	100932	149000*	144000*	163593*
101 Morocco	52299	52621	57978	60055	79286	105924	175413	206456	220000*	276304
107 Sudan	25447	28304	32761	40713	43624	60695	83075	119764	122000*	122999
104 Tunisia	19482	22571	22563	30733	38698	49340	93350	112846	148000*	151820
WEST AFRICA	186027	217816	280691	345690	322197	432477	625731	910385	1012234	1538841
116 Benin	4101	5240	5642	6942	8669	9746	15172	11008*	13000*	14784
120 Cape Verde	530*	554*	628	707*	765*	820	790*	830*	1200*	1135
121 Gambia	1505	1400*	1411	1718	2167	3057	4254	5229	5229*	6301*
128 Ghana	47382	53991	65313	70174	47522	77960	106896	110112	120000*	128413
123 Guinea	-	-	-	-	-	-	-	-	-	-
122 Guinea B.	1550	1600*	1800*	2650*	2000*	2500*	1800*	2300*	2713*	2654
114 Ivory Coast	23097	24747	29288	35192	36548	52391	87585	105149	116159	133316
126 Liberia	7633	7781	9640	11549	9915	12785	18534	21961	32000*	34756
113 Mali	2954	3957	4038	4704	7248	8210	10361	21664	8300*	9097
111 Mauritania	1371	2790	3607	3020	4440	4100*	2781	4334	4860*	6161
117 Niger	2210	2516	4059	4087	4472	5588	6298	4310	6100*	7139
131 Nigeria	62866	85098	123838	170741	155957	202760	302992	540896	632190*	1113976
112 Senegal	17344	14070	16983	16828	22744	25706	28600*	35500*	35915	41174
125 Sierra Leone	6512	6767	7394	8136	8525	11215	14190	13615	8673*	88504
130 Togo	4108	4059	4384	4916	6376	8179	14167*	15720	18000*	20163
115 Upper Volta	2864	3246	3566	4326	4849	7459	11931	19215	9415*	10763
CENTRAL AFRICA	100439	115065	139755	150506	175341	227385	286203	354284	365128	352780
153 Angola	30000*	32514	39214	42736	48361	72611	92864	118860*	142552*	126091
152 Burundi	2000*	1500*	1500*	1946*	2463*	1952*	2845*	6000*	5000*	5000
133 Cameroon										
Un. Rep. of	23199	25571	27624	31330	33763	43227	57251	82135	76125*	97248
137 Central Af. Empire	3349	3497	3042	2772	4532	4395	5758	7846	5000*	6712
136 Chad	2213	3296	4813	4917	5332	4868	9220	9028*	9663*	11526
139 Congo	5834	6380	5004	6833	9488	10759	8173	13160	12055	14261*
141 Eq. Guinea	2650*	2600*	2762*	2820*	2990*	2990*	3200*	3525*	4500*	4525
138 Gabon	4348	5437	5560	6890	7987	9693	9000*	11683*	19628*	22310
151 Rwanda	1378	1960	2165	1990	2425	2342	3816	4257	7000*	8048
143 Sao Tome & Principe	1110*	1200*	1510*	1442*	1472*	1500*	1475*	1312*	1600*	1841
145 Zaire	24358	31510	45561	46830	56558	73118	92601	96478	82005	64518

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
EAST AFRICA	178820	192309	215790	246001	256238	322002	512223	539651	487958	558080
157 Botswana	1108	2121	2894	3470	4383	8915	8386	9278	9561	11480
170 Comoros	1550	1585	1420	1548	1512	1700	1600	1775	2500	2398
195 Ethiopia	16886	17403	19932	22278	22124	23000	43303	54256	52816	58260
185 Kenya	31494	33469	41453	51545	53841	72591	145871	101017	104663	130431
158 Lesotho	2000	2144	1761	2548	2888	4001	6177	8632	10954	13409
159 Madagascar	18206	18627	21795	21381	19458	22530	36132	33660	37000	41649
164 Malawi	5110	5908	7152	10501	9799	11650	18723	25042	23000	23490
172 Mauritius	8561	8531	8962	8943	13267	15054	26604	29987	25090	40764
167 Mozambique	15873	20896	24083	15479	17398	21649	31117	21413	18630	18568
173 Seychelles	470	469	501	721	899	1064	1391	1371	1718	2452
187 Somalia	3269	3698	3043	4045	5557	12386	10730	10524	16000	18225
159 Swaziland	3510	3969	4815	6072	7713	8056	15460	15583	21454	25041
160 Tanzania Un. Rep. of	5948	17063	24431	31159	35340	46385	71193	82805	56419	60219
183 Uganda	11410	11393	14613	19115	11881	12949	15690	13435	22687	20822
162 Zambia	32219	31570	36442	44207	46123	53552	75286	120047	799	
Djibouti	4705	3463	3893	3989	4150	4520	4700	4820	5500	
OTHER DEVELOPING AFRICA	46083	46432	51604	61233	67153	87391	104224	110209	115276	7134445
156 Namibia	...	...	...	...	...	...	...	...	...	...
171 Réunion	13893	15463	15085	17388	20866	27340	40804	41919	42276	51445
163 Southern Rhodesia	32190	30969	36519	43845	46287	60051	63420	68290	73000	83000
DEVELOPING AFRICA	791772	890327	1037171	1200886	1302638	1680693	2608268	3451102	3446337	4391111
SOUTH AFRICA	217924	252409	273231	320956	307760	455458	896750	703546	623796	522810
TOTAL AFRICA	1005076	1114502	1300932	1509752	1595406	2115179	3474995	4120157	4034764	4861991

Source: ECA Statistical Division.

----- IN MILLIONS OF DOLLARS DURING 1970-72 IN 1000 US DOLLARS

	1970	1971	1972	1973	1974	1975	1970	1971	1972	1973	1974	1975
World	669641	699835	801784	1177845	1667801	2114131	605507	675967	775047	1076180	1635758	1983617
Africa	91559	99007	108070	142800	219165	281508	10491	10273	12924	16710	25472	31439
Algeria	4558	3642	3575	2229	3766	4000						
Angola	1532	1743	1356	1865	4329	3000					246	
Benin	797	1082	1402	2000	3000	4169	95	94	39	52	47	50
Botswana	150	160	180	200	243	400						
Cameroon	2012	2200	2500	3444	4552	4296	11	28	50	112	305	100
Cape Verde	24	32	40	44	52	60						
Cent Afr Emp	560	141	974	643	1163	2331						
Chad	1109	256	436	420	1406	6377						
Comoros	30	20	23	25	20	20						
Congo	165	179	249	229	250	507						
Egypt	14665	16806	23550	31344	55210	85181	5	9	5		4	54
Ethiopia	1287	1164	1614	2758	1890	2000						
Gabon	218	209	300	400	600	810						
Gambia	95	88	97	152	95	172						
Ghana	2139	2207	1476	2119	2854	3622			14		11	631
Guine Bissau	92	100	64	179	120	27						
Ivory Coast	1559	1993	2125	2602	5404	6060			2089	2666	5167	9658
Kenya	2746	5053	5324	10826	16077	8795	1342	1451	2089	2666	5167	9658
Lesotho	35	46	38	27	52	60	2586	2121	2733	4791	6954	6511
Liberia	416	450	422	414	714	640						
Libya	1943	2934	2716	4705	5076	5000	2					20
Madagascar	1528	1271	983	1526	2239	2300						
Malawi	660	663	870	947	1713	3428		4		3	17	15
Mali	545	622	612	630	650	670	1	7	12	1		5
Mauritius	694	782	967	1163	1881	4158						
Morocco	3860	3817	4177	5853	9607	11597	1	1	2	5	9	1
Mozambique	2449	3764	3267	4847	5507	2750	154	25	10	32	20	651
Niger	253	132	128	227	250	250	109	40	80	92	207	200
Nigeria	8997	11214	9982	10248	16609	17000						
Reunion	734	592	1098	1151	1604	1819	13	8	10	40	18	20

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	2101	2102	2103	2104	2105	2106	2107	2108	2109	2110	2111	2112	2113	2114	2115	2116	2117	2118	2119	2120	2121	2122	2123	2124	2125	2126	2127	2128	2129	2130	2131	2132	2133	2134	2135	2136	2137	2138	2139	2140	2141	2142	2143	2144	2145	2146	2147	2148	2149	2150	2151	2152	2153	2154	2155	2156	2157	2158	2159	2160	2161	2162	2163	2164	2165	2166	2167	2168	2169	2170	2171	2172	2173	2174	2175	2176	2177	2178	2179	2180	2181	2182	2183	2184	2185	2186	2187	2188	2189	2190	2191	2192	2193	2194	2195	2196	2197	2198	2199	2200	2201	2202	2203	2204	2205	2206	2207	2208	2209	2210	2211	2212	2213	2214	2215	2216	2217	2218	2219	2220	2221	2222	2223	2224	2225	2226	2227	2228	2229	2230	2231	2232	2233	2234	2235	2236	2237	2238	2239	2240	2241	2242	2243	2244	2245	2246	2247	2248	2249	2250	2251	2252	2253	2254	2255	2256	2257	2258	2259	2260	2261	2262	2263	2264	2265	2266	2267	2268	2269	2270	2271	2272	2273	2274	2275	2276	2277	2278	2279	2280	2281	2282	2283	2284	2285	2286	2287	2288	2289	2290	2291	2292	2293	2294	2295	2296	2297	2298	2299	2300	2301	2302	2303	2304	2305	2306	2307	2308	2309	2310	2311	2312	2313	2314	2315	2316	2317	2318	2319	2320	2321	2322	2323	2324	2325	2326	2327	2328	2329	2330	2331	2332	2333	2334	2335	2336	2337	2338	2339	2340	2341	2342	2343	2344	2345	2346	2347	2348	2349	2350	2351	2352	2353	2354	2355	2356	2357	2358	2359	2360	2361	2362	2363	2364	2365	2366	2367	2368	2369	2370	2371	2372	2373	2374	2375	2376	2377	2378	2379	2380	2381	2382	2383	2384	2385	2386	2387	2388	2389	2390	2391	2392	2393	2394	2395	2396	2397	2398	2399	2400	2401	2402	2403	2404	2405	2406	2407	2408	2409	2410	2411	2412	2413	2414	2415	2416	2417	2418	2419	2420	2421	2422	2423	2424	2425	2426	2427	2428	2429	2430	2431	2432	2433	2434	2435	2436	2437	2438	2439	2440	2441	2442	2443	2444	2445	2446	2447	2448	2449	2450	2451	2452	2453	2454	2455	2456	2457	2458	2459	2460	2461	2462	2463	2464	2465	2466	2467	2468	2469	2470	2471	2472	2473	2474	2475	2476	2477	2478	2479	2480	2481	2482	2483	2484	2485	2486	2487	2488	2489	2490	2491	2492	2493	2494	2495	2496	2497	2498	2499	2500	2501	2502	2503	2504	2505	2506	2507	2508	2509	2510	2511	2512	2513	2514	2515	2516	2517	2518	2519	2520	2521	2522	2523	2524	2525	2526	2527	2528	2529	2530	2531	2532	2533	2534	2535	2536	2537	2538	2539	2540	2541	2542	2543	2544	2545	2546	2547	2548	2549	2550	2551	2552	2553	2554	2555	2556	2557	2558	2559	2560	2561	2562	2563	2564	2565	2566	2567	2568	2569	2570	2571	2572	2573	2574	2575	2576	2577	2578	2579	2580	2581	2582	2583	2584	2585	2586	2587	2588	2589	2590	2591	2592	2593	2594	2595	2596	2597	2598	2599	2600	2601	2602	2603	2604	2605	2606	2607	2608	2609	2610	2611	2612	2613	2614	2615	2616	2617	2618	2619	2620	2621	2622	2623	2624	2625	2626	2627	2628	2629	2630	2631	2632	2633	2634	2635	2636	2637	2638	2639	2640	2641	2642	2643	2644	2645	2646	2647	2648	2649	2650	2651	2652	2653	2654	2655	2656	2657	2658	2659	2660	2661	2662	2663	2664	2665	2666	2667	2668	2669	2670	2671	2672	2673	2674	2675	2676	2677	2678	2679	2680	2681	2682	2683	2684	2685	2686	2687	2688	2689	2690	2691	2692	2693	2694	2695	2696	2697	2698	2699	2700	2701	2702	2703	2704	2705	2706	2707	2708	2709	2710	2711	2712	2713	2714	2715	2716	2717	2718	2719	2720	2721	2722	2723	2724	2725	2726	2727	2728	2729	2730	2731	2732	2733	2734	2735	2736	2737	2738	2739	2740	2741	2742	2743	2744	2745	2746	2747	2748	2749	2750	2751	2752	2753	2754	2755	2756	2757	2758	2759	2760	2761	2762	2763	2764	2765	2766	2767	2768	2769	2770	2771	2772	2773	2774	2775	2776	2777	2778	2779	2780	2781	2782	2783	2784	2785	2786	2787	2788	2789	2790	2791	2792	2793	2794	2795	2796	2797	2798	2799	2800	2801	2802	2803	2804	2805	2806	2807	2808	2809	2810	2811	2812	2813	2814	2815	2816	2817	2818	2819	2820	2821	2822	2823	2824	2825	2826	2827	2828	2829	2830	2831	2832	2833	2834	2835	2836	2837	2838	2839	2840	2841	2842	2843	2844	2845	2846	2847	2848	2849	2850	2851	2852	2853	2854	2855	2856	2857	2858	2859	2860	2861	2862	2863	2864	2865	2866	2867	2868	2869	2870	2871	2872	2873	2874	2875	2876	2877	2878	2879	2880	2881	2882	2883	2884	2885	2886	2887	2888	2889	2890	2891	2892	2893	2894	2895	2896	2897	2898	2899	2900	2901	2902	2903	2904	2905	2906	2907	2908	2909	2910	2911	2912	2913	2914	2915	2916	2917	2918	2919	2920	2921	2922	2923	2924	2925	2926	2927	2928	2929	2930	2931	2932	2933	2934	2935	2936	2937	2938	2939	2940	2941	2942	2943	2944	2945	2946	2947	2948	2949	2950	2951	2952	2953	2954	2955	2956	2957	2958	2959	2960	2961	2962	2963	2964	2965	2966	2967	2968	2969	2970	2971	2972	2973	2974	2975	2976	2977	2978	2979	2980	2981	2982	2983	2984	2985	2986	2987	2988	2989	2990	2991	2992	2993	2994	2995	2996	2997	2998	2999	3000
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Petroleum refining capacity in Africa (1978)(in barrels per day)

<u>Country</u>	<u>Existing</u>	<u>Under construction</u>	<u>Proposed</u>
Algeria	663,300	562,000	
Angola	35,000		
Cameroon			
Egypt	175,000	47,000	
Ethiopia	14,790		
Gabon	38,000 <u>a/</u>		
Ghana	28,000		
Ivory Coast	39,000		
Kenya	95,000		
Liberia	15,000		
Libya	9,000	60,000	130,000
Malagasy	11,440		
Morocco	78,000		
Mozambique	16,000		
Nigeria	60,000	200,000 <u>a/</u>	
Rhodesia	20,000		
Senegal	18,000		
Sierra Leone	10,000		
South Africa	440,500	50,000	
Sudan	26,000		
Tanzania	17,000		20,000 <u>a/</u>
Togo		20,000	
Tunisia	25,000		
Zaire (Kinshasa)	16,700		6,500
Zambia	25,000		
Total	875,730	965,500	130,000

Sources: Petroleum Times, March 17, 1978.

a/ Information obtained during the field mission.

Deficit/Surplus of Basic and Intermediate Petrochemicals in Africa (in c. region) in 1985

(1000 Tons)

	North Africa			West Africa			Central Africa			East Africa			Total Africa
	a/ Demand	b/ Production	Deficit/Surplus	a/ Demand	b/ Production	Deficit/Surplus	a/ Demand	b/ Production	Deficit/Surplus	a/ Demand	b/ Production	Deficit/Surplus	
Petrochemicals													
Basic Petrochemicals													
Ethylene	661	1,150	+489	356	350	-6	181		-181	300	15	-285	+17
Propylene	245		-245	121		-121	51		-51	87		-87	-504
Butadiene	97		-97	75		-75	23.6		-23.6	70		-70	-266
Benzene	290	290		173		-173	56		-56	121		-121	-350
Plastics	1,090	387	-703	575	270	-305	295	45	-250	490	12	-478	-1736
Other End-product Petrochemicals													
Synthetic fibres	270	56	-214	168	33	-135	29		-29	75		-75	-453
Synthetic rubber	129		-129	100		-100	31		-31	95		-95	-355
Synthetic detergents	290		-290	110		-110	50		-50	90		-90	-540

a/ UNIDO's ICIS estimates.

b/ Information obtained during the field mission and from international publications.

Consultants/Experts Staff Recruitments for Assistance to
Petrochemical Industry in Africa

Project No.	Project Title	Post description	1979		1980		1981		Total No. m
			No.	m/m	No.	m/m	No.	m/m	
<u>SUBREGION</u>									
<u>North Africa</u>									
1.	Market survey and future demand upto 1990 for different types of plastics, synthetic fibres, rubber and detergents in North African countries, as well as export possibilities	Industrial economist/ or chemical engineer/ or industrial chemist with wide experience in the use and pro- duction of the petro- chemicals and market surveys	1	12					1 12
2.	Identification of projects and pre- paration of pre- feasibility studies relating to plastics, synthetic fibres, rubber and detergents in North African countries	Chemical engineer/ or industrial chemist with wide experience in petro- chemical industry and the preparation of feasibility studies	1	12					1 12
3.	<u>West and Central Africa</u>								
	Market survey and future demand upto 1990 for different types of plastics, synthetic fibres, and detergents in West and Central African countries as well as export possibilities	Industrial economist/ or chemical engineer/ or industrial chemist with wide experience in the use and pro- duction of the petro- chemicals and market surveys	1	15					1 15

Project No.	Project Title	Post Description	1979		1980		1981		Total	
			No.	m/m	No.	m/m	No.	m/m	No.	m/m
4.	Identification of projects and preparation of pre-feasibility studies relating to plastics, synthetic fibres, rubber and detergents in West and Central African countries	Chemical engineer/or industrial chemist with wide experience in petrochemical industry and the preparation of feasibility studies			1	15			1	15
	<u>East Africa</u>									
5.	Market survey and future demand upto 1990 for different types of plastics, synthetic fibres, rubber and detergents in East African countries, as well as export possibilities	Industrial economist/or chemical engineer/or industrial chemist with wide experience in the use and production of the petrochemicals and market surveys			1	12			1	12
6.	Identification of projects and preparation of pre-feasibility studies relating to plastics, synthetic fibres, rubber in East African countries	Chemical engineer/or industrial chemist with wide experience in petrochemical industry and the preparation of feasibility studies					1	12		
Total Subregions			2	27	3	39	1	12	6	78

Project No.	Project title	Post Description	1979		1980		1981		Total	
			No.	m/m	No.	m/m	No.	m/m	No.	m/m
COUNTRIES VISITED										
9	country projects	As detailed in country reports	3	20	2	12	12	32	17	64
ECA HEADQUARTERS										
	Development of petro- chemical industry (co-ordination and follow-up)	Senior chemical engineer/or industrial chemist with wide experience in planning and in the preparation of feasibility studies of petrochemical project acquainted with the use of petrochemicals	1	12	1	12	1	12	3	36
Grand total			6	59	6	63	14	56	28	178

Health facilities in Africa

Country	Year	Population per physician	Population per pharmacist	Population per hospital bed
Algeria	1969	7,860	50,380	340
Angola	1973	15,170	66,800	320
Burundi	1974	45,430	334,550	810
Central African Empire	1975	27,810	190,710	520
Chad	1975 ^G	47,980	806,000	1,140
Congo	1975	6,310	.....	190
Egypt	1975 ^G	4,630	14,480	470
Ethiopia	1972	69,340	231,540	3,080
Gabon	1971	5,210	33,330	100
Ghana	1975	10,510	21,450	600
Ivory Coast	1975	15,220	108,560	660
Kenya	1973	16,300	76,500	760
Libya	1975	950	5,360	240
Madagascar	1975	10,770	89,010	410
Mali	1974	42,770	370,670	1,350
Morocco	1971	13,980	34,610	750
Mozambique	1971	16,680	60,770	770
Nigeria	1975	14,810	42,460	1,170
Sudan	1975	12,680	35,090	1,110
Uganda	1975	27,110	824,930	640
United Republic of Cameroon	1974	17,790	64,080	380
United Republic of Tanzania	1975	18,490	409,280	700
Upper Volta	1976	56,480	554,550	1,170
Zaire	1972	27,950	174,500	330
Zambia	1975	10,370	38,860	250
Yugoslavia	1974	850	5,050	170
Finland	1975	700	960	70
United Kingdom	1974	760	3,610	120

Source: World Health Statistics - Annual WHO General, Volume III, 1977.

G - Personnel in Government Service.

Imports of Pharmaceuticals by African Countries

(in billion US dollars)

Country	Import						
	1970	1971	1972	1973	1974	1975	1976
Algeria	36.2	35.2	39.6	66.7	..	..	..
Angola	..	19.7	..	19.4	23.1	..	..
Benin	..	2.2	2.5	3.8	3.9	..	..
Burundi	..	0.6	1.1	0.7	0.9	..	..
Central African Empire	1.0	1.2	1.4	1.7	..
Chad	..	0.9	1.2	1.7	1.4	..	..
Congo	3.0	3.3	2.9	4.0	..
Egypt	6.9	9.0	18.5	21.3
Ethiopia	5.9	7.2	9.0	..
Gabon	1.0	1.1	0.9	1.3	..	..	..
Gambia	0.6	0.7	0.8	1.1	..
Ghana	3.9	11.3	15.4	12.0	..
Ivory Coast	12.9	14.0	19.2	20.0
Kenya	7.3	8.4	13.3	13.7	..
Liberia	1.7	3.0	3.1	5.5	..
Libya	18.8	22.2	28.5	26.6	..
Madagascar	..	5.0	5.7	6.7	9.2	..	..
Malawi	..	1.7	1.2	1.4	1.9	..	..
Mali	..	1.6	2.1	..	2.9	..	..
Mauritania	0.5	0.5	0.7	..	..	..	..
Mauritius	1.6	1.8	..	..	..
Morocco	..	48.9	53.9	60.3	67.7	..	..
Mozambique	..	6.8	8.3	11.9	12.7	..	..
Niger	1.1	1.1	1.4	1.0	..
Nigeria	39.0	52.3	67.0	123.8	..
Union	8.6	10.8	15.0	12.9
Rwanda	0.7	0.6	1.4	1.5	..
Senegal	4.5	5.3	5.3	8.4	..
Sierra Leone	..	2.4	2.6	3.3	4.0	..	..
Somalia	..	0.8	1.1	4.4	3.4	..	..
Sudan	12.6	14.8	14.9	27.8	..
Togo	2.0	2.5	2.6	4.0	..
Tunisia	15.2	19.4	26.1	25.3
Uganda	2.5	2.4	4.1	4.3	..
United Republic of Cameroon	6.1	9.2	9.6	11.5	..
United Republic of Tanzania	6.6	7.4	12.9	23.7	..
Upper Volta	1.3	1.8	2.9	4.4	..
Zaire	17.4	21.1	26.2	20.4	..
Zambia	8.7	8.2	9.8	11.8	..

Source: Yearbook of International Trade Statistics 1976, Volume I.

Approximate Investments for Formulation Units

The following are examples of investment costs for formulation units as estimated by UNIDO ^{a/}:

- (a) Tableting machinery unit, with a capacity of 350,000 tablets/8 hours:
US\$25,000 - 40,000;
- (b) Tableting machinery unit, with a capacity of 2.4 million tablets/8 hours:
US\$300,000 - 400,000;
- (c) Injections (60,000/8 hours) and vials (25,000/8 hours):
US\$650,000 - 750,000;
- (d) Solutions (64,000 units/8 hours, 50% thereof syrups):
US\$500,000 - 600,000;
- (e) Ointments, 24,000 unit/8 hours (500 kg): US\$150,000 - 250,000;
- (f) Suppositories, 30,000/8 hours: US\$300,000 - 400,000;
- (g) Packing machinery unit for all the above products: US\$300,000 - 400,000;
- (h) Quality control facilities and laboratory for the above production:
US\$250,000 - 350,000.

Land requirements for the above formulation plant: 10-20,000 sq. meters.
Construction costs: about US\$25 millions.

Minimum yearly production of the above formulation plant may be estimated as follow:

- 500 million tablets (coated and uncoated),
- 13 million injections,
- 5.5 million vials,
- 10 million units of solutions and syrups,
- 5 million units of ointments, and
- 12 million suppositories.

^{a/} Summary of the Draft World-wide Study of the Pharmaceutical Industry,
UNIDO/ICIS.74, June 1978.

Activities undertaken by International Organizations in the Field of
Pharmaceutical Industry in Developing Countries, particularly in Africa

No.	International organization	Country(ies)	Year	Description and publication
1.	UNIDO	Developing Countries	1969	Establishment of Pharmaceutical Industries in Developing Countries, Report on the proceedings of Expert Working Group Meeting, Budapest, May 1969, UN, New York 1970, ID/35 (ID/WG.37/3)
2.	UNIDO	Tanzania	1969	Mission for the Assessment of Pharmaceutical Industry in the East African Community -- Present Position in Tanzania, Report by V.R. Iyer, November 1969
3.	WHO	Senegal	1969	Contrôle de la Qualité des Médicaments au Sénégal, Rapport de mission 1-22, Juillet 1969, par le D.M.A. Attiso, OMS/AFR/PHARM/3, Avril 1970
4.	WHO	Developing Countries	1969	Good Practices in the Manufacture and Quality Control of Drugs, Report of Expert Meeting on Specifications for Pharmaceutical Preparations, Technical Report Series, No. 418, Gene 1969
5.	WHO	Ghana	1970	Pharmacy and Medical Supplies Management, Report on mission 9 August - 28 September 1970, by F.S. Bisharah, WHO/AFR/PHA/71, April 1971
6.	WHO	Ghana	1970	Quality Control of Drugs in Ghana, Report on mission 1-27 February 1970, by Dr. M.A. Attiso, WHO/AFR/PHARM/4, Rev. 1, March 1972
7.	WHO	Kenya	1971	Present Situation Regarding Pharmacy Drugs in Kenya, Report on mission 9 February- 4 March 1971 by Dr. M.A. Attiso, WHO/AFR/PHARM/5/12, August 1972
8.	WHO	Uganda	1971	Present Situation Regarding Pharmacy and Drugs in Uganda, Report on Mission February-March 1971, by Dr. M.A. Attiso, WHO/AFR/PHARM/8, April 1972
9.	UNITAR	Developing Countries	1971	Technology Transfer in the Pharmaceutical Industry, by L.H. Wortzel, UN Institute for Training and Research, Report No. 14, New York, 1979
10.	WHO	Uganda	1972	Manufacture and Quality Control of Drugs and Training of Personnel in Uganda, Report on Mission June-September 1972 G. Osuico, WHO/AFR/PHARM/9, January 1973

No.	International Organization	Country(ies)	Year	Description and Publication
11	WHO	Chad	1972	Problems d'approvisionnement et de d'Objets de Pensement en Republique du Tchad, Rapport de mission 21 Septembre - 11 November 1972, par le Dr. F. Johnson-Romuald, CMS/AFR/PHARM/10, Janvier 1973
12	WHO	Zambia	1973	Drug Control Legislation in Zambia, Report on mission 17 April - 28 June 1973 by J.G. Fisher, WHO/AFR/PHARM/12, September 1973
13	WHO	Liberia	1974	Pharmaceutical and Medical Supply Services in Liberia, Report on mission 28 July - 27 September, by Dr. F.S. Bishara, WHO/AFR/PHARM/13, November 1974
14	UNIDO	Developing Countries	1975	International Consultation Meeting in the Field of Pharmaceutical Industries, Budapest
15	UNIDO	Developing Countries	1974-1980	Annual training courses on pharmaceutical technology held in Belgium
16	UNCTAD	Developing Countries	1975	Major Issues in Transfer of Technology to Developing Countries, A case of the pharmaceutical industry, TB/B/C.6/4, October 1975
17	WHO Regional Office for Africa	Africa	1976	African Traditional Medicine, Report of the Regional Expert Committee, Brazzaville, 9-13 February 1976((Technical Report Studies
18	ECA	Africa	1976	Pharmaceuticals in Africa (E/CN.14/INF/21/1). August 1976
19	UNIDO/ECA	UDEAC (Central African Empire, Congo, Gabon, Cameroon)	1976	Identification of Chemical Products with Potential for Integrated Development in the UDEAC countries, IND-115/MR-103, 1976 (pharmaceuticals included)
20	UNIDO	Upper Volta	1976	Faisabilité d'une Industrie locale de Fabrication et Conditionnement de Produits Pharmaceutiques et vétérinaires par J. Blomet, IS/UPV/72/025, II-01/07, Janvier 1976
21	UNIDO/ECA	UDEAC	1976	Pharmaceutical Industry in UDEAC, Terms of Reference for Consultants for a pre-feasibility study
22	ORION/NDC	Tanzania	1976	Feasibility Study on the Establishment of a Pharmaceutical Industry in Tanzania, 1975, followed by Proposal to Establish a Pharmaceutical Factory at Arusha, February 1976

No.	International Organization	Country(ies)	Year	Description and Publication
23	MAT & BAKER	Nigeria	1976	Feasibility Study for a Federal Drug Manufacturing Industry to Supply the Basic Drug Needs on the Nation, December 1976
24	WHO	Developing Countries	1977	The Selection of Essential Drugs, Report of a WHO Expert Committee, Geneva 17-21 October 1977 (Technical Report Services 615)
25	ECA	Africa	1977	Appropriate Technology for Small-scale Industries, by D.L. Wright, ECA Regional Advisor, paper presented to the Workshop organized by the African Association of Development Finance Institutions, Mauritius, April 1977
26	ADB (African	Africa	1977	Industries Pharmaceutiques on Afrique, Etude exhaustive de faisabilité, Termes de Référence, Avril 1977, Abidjan
27	UNIDO	Burundi, Uganda, Botswana, Tanzania		Exploratory Mission on Medicinal Plants, RP/RAF/77/015
28	UNIDO	Tanzania	1978	Development of Pharmaceutical Industry - Pharmaceutical Adviser Tanzania, SI/URT/77/803, Dr. M. Alaudin - appointment in progress
29	UNIDO	Developing Countries	1978	Guidelines for the Preparation of a National List of Drugs and National Formulary, ID/WG.267/1, January 1978
30	UNIDO	Africa	1978	Plants of the African Pharmacopoeias Used in the Treatment of Tropical Diseases by J. Kerharo, ID/WG.271/1, February 1978
31	UNIDO	Developing Countries	1978	Industrial Requirements for Processing Medicinal Plants by E. Bombardelli, ID/WG.271/2, February 1978
32	UNIDO	Developing Countries	1978	An Integrated Approach to Research on Medicinal Plants by M. Anand, ID/WG.271/3, February 1978
33	UNIDO	Developing Countries	1978	Medicinal Plants for Curing Diseases other than Communicable, Tropical and Infectious, by F. Sandberg, ID/WG.271/4, March 1978
34	UNDP, Executing Agency Guyana	Algeria, Chad, Egypt, Ethiopia, Tanzania	1978	Economic and Technical Co-operation among Developing Countries in the Pharmaceutical Sector, INT/77/009/A/01/99 by a Task Force organized as a result of a resolution of Colombo Summit Conference on Non-Aligned Countries 1976 (12 months mission in progress)

No.	International Organization	Country (ies)	Year	Description and Publication
35	XXXI World Health Association	Developing Countries	1978	Action Programme on Essential Drugs, WHA 31-32/May 1978, Drug Policies and Management, Medicinal Plants, WHA 31-33/May 1978
36	UNIDO	Developing Countries	1978	The Growth of Pharmaceutical Industry in Developing Countries: Problems and Prospects
37	UNIDO	All countries	1978	Summary of the Draft World-wide Study of the Pharmaceutical Industry, ID/ICIS/74, June 1978
38	UNIDO	Developing Countries	1978	The Steps Involved in Establishing a Pharmaceutical Industry Developing Countries, ID/WG.267/3, February 1978
39	UNIDO	Developing Countries	1978	Ways of Ensuring Adequate Supplies of Chemical Intermediates Required for the Production of Drugs in Developing Countries, ID/WG.267/2, February 1978
40	ECA/UNIDO	Tanzania, Gabon, Cameroon, Nigeria, Upper Volta, Egypt	1978	ECA/UNIDO Chemical Industry Development Programme Mission, May-October 1978 (including pharmaceutical industry)

Indian Government Details new Pharmaceutical Policy
(European Chemical News, April 21, 1978)

Under the new drugs policy announced recently by the Indian Government, the public sector has been assigned a leading role in the production and distribution in pharmaceuticals. Twenty-five drugs have been earmarked for production exclusively in the public sector and 23 for production by Indian-owned firms while a further 66 will be left open for licensing to all-comers.

All foreign companies, with the exception of those involved in the production of "high technology" drugs, have been requested to reduce their equity holdings in the country's pharmaceutical concerns to 40 per cent. Sixty-six per cent of the balance equity currently held by producers not in the high technology category will be divested in favour of government financial and public sector institutions and the rest in favour of Indian investors.

In addition, the foreign companies will be given formulation licences only for production linked to high technology bulk drugs and granting of licences will be subject to the company concerned agreeing to supply 50 per cent of production of such bulk drugs to non-associated formulators and to limit the value of formulation to five times the value of total bulk production.

The Government also intends to do away with drug selling agencies and where loader prices are based on agency commissions of more than 5 per cent, such prices will be reviewed by the Bureau of Industrial Costs and Prices and reduced appropriately. Post-tax return on essential and life-saving drugs will be held at 14 per cent of net worth and at 12 per cent for other bulk drugs.

The new ruling, which allays earlier fears that the government would nationalize foreign drugs interests, is expected to give a much-needed boost to the country's production figures.