UNITED NATIONS
ECONOMIC
AND
SOCIAL COUNCIL

4/132

Distr.
GENERAL

E/CN.14/246
7 January 1964

Original: ENGLISH

ECONOMIC COMMISSION FOR AFRICA
Sixth session
Addis Ababa, 19 February - 3 March 1964
Item 5 of the revised provisional agenda

REPORT OF THE WEST AFRICAN INDUSTRIAL CO-ORDINATION MISSION

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INTRODUCTION

1. A United Nations Economic Commission for Africa mission[1/] visited West Africa from 17 August to 1 November 1963, in accordance with a decision taken by the Standing Committee on Industry, Natural Resources and Transport at its first session held in December 1962, endorsed by the Commission at its fifth session in February 1963. The text of this decision reads as follows:

> "Assistance to governments in promoting sub-regional co-operation in the development of industries on the basis of international specialization and in the harmonization, where appropriate, of industrial development plans through studies and field investigations."

2. The terms of reference of the mission are derived from the decisions referred to above and are summarized below.

3. The principal objective has been to assess in concrete terms possibilities of industrial development over the next decade or so in West Africa, with the primary emphasis on projects serving more than one country. It follows that special emphasis has been given to industries the minimal economic scale of output of which is beyond the likely market of any individual country in the sub-region. But the mission was solely interested in large scale industry. It was also concerned to draw attention to possibilities of import substitution by developing small and medium scale industries, e.g. the processing of food and other agricultural raw materials, including timber, and consumption goods industries. Throughout, the investigations made have been concerned to assess appropriate scales of output for all types of industry in the specific

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1/ The composition of the mission is recorded in Annex I.

conditions of the territory covered and of appropriate technologies. It was not the purpose of the mission to make a general economic or industrial survey. The emphasis throughout has been on specific and concrete possibilities of industrial development. Trade and transport problems have been examined within the context of the promotion of industrial development.

4. It was not a specific objective of the mission to assess the scope for technical assistance or bilateral aid. However, attention has been drawn to further possibilities of action by the UN family and other interested bodies in this general context.

5. A major premise underlying the investigations of the mission has been the development of modern industries strategic for economic development, and the consequent necessity for sub-regional co-ordination of industrial development plans.[1/] This in turn implies international specialization and division of labour at the sub-regional level and a conscious attempt to share out equitably new industries. The mission also fully recognized that development of agriculture or industries based on the processing of agricultural raw materials, small and medium scale industries and large scale industries serving the sub-regional market, must go hand in hand.

6. The countries visited, which were notionally grouped into smaller sub-regions, were as follows:

(a) Nigeria, Niger, Chad, Dahomey
(b) Togo, Ghana, Upper Volta, Ivory Coast
(c) Sierra Leone, Liberia, Senegal, Guinea, Mali and Mauritania[2/]

The last-named country in each group provides the link with the next one.

1/ See Industrial Growth in Africa (E/CN.14/INR/1).

2/ Owing to technical difficulties, the mission did not visit Mauritania. The Government of Gambia also considered a visit inopportune, owing to other UN studies in progress there. The inclusion of Chad, a member of the "Union Douanière Equatoriale", served as a bridge for wider sub-regional co-operation.

7. The mission thus envisaged three sub-regional circles. At the southern end, Nigeria and Chad are in a position to assure liaison with the UDE, and Mali and Mauritania with North Africa. The mission recognizes, however, that for different aspects of development, different groupings are appropriate.

8. A brief preliminary report on the mission's work was presented to the second session of the Standing Committee on Industry, Natural Resources and Transport. The full report is in four parts. The first discusses briefly the economic setting in West Africa. The second deals with industrial development, with the main emphasis on concrete possibilities of developing large scale industries capable of serving more than one country in the sub-region. The third part discusses small and medium scale industries. The fourth part offers some general conclusions and suggestions. To keep this report within reasonable length, additional material is given in annexes. Furthermore, the mission collected an immense amount of data which will be drawn upon for further investigations or to assist individual countries.1/

1/ As a result of decisions taken at the second session of the Standing Committee on Industry, Natural Resources and Transport, a Conference on West African Transport will be held in Niamey in June 1964. The detailed material collected by the mission on transport will be presented to this Conference. Another conference will be held in Bamako, probably in September 1964, to discuss the harmonization of industrial plans in West Africa. Detailed studies will be presented (in amplification of the material in the present report) on iron and steel, basic chemicals and fertilizers, cement and textiles. In addition, this report will be on the agenda for discussion. Detailed comments on it, from the governments of the sub-region, would be greatly welcomed, meantime, as part of the preparation for the Bamako conference.

PART I

THE ECONOMIC SETTING IN WEST AFRICA

9. With a total area of about 30 million sq.km., Africa has the largest number of countries and territories compared with the other underdeveloped continents of Asia and Latin America. The fourteen countries of the West African sub-region are concentrated in an area of about 7.5 million sq km., roughly equal to one and a half times that of Europe, including the USSR. The total population of West Africa is estimated at 78 million, approximately half of which is the population of Nigeria. At the lower end of the scale is Mauritania, with a population of only 800,000.

10. A major factor characterizing the economics of the sub-region is that the majority of the countries are situated on the coast. Only four, Mali, Upper Volta, Niger and Chad, are in the hinterland and therefore have special problems with regard to the transport of goods. Their non-access to the sea has affected them in two ways: they are under-populated and relatively more underdeveloped in comparison to the other countries of the sub-region. Political frontiers generally grew from the coastline towards the interior or from river valleys specially favoured, such as mining areas. The islands of economic progress which exist in the sub-region today amount to a small fraction in favourable environmental situations.

11. In most of West Africa, the recent rate of growth of population has been relatively high, about 2.5 per cent. Population is dense in the coastal rain-forest belt and the grasslands, while areas with low rainfall and poor water resources are thinly populated. Thus, in the north of Chad density averages less than 2 per square kilometre, whereas in

the south-western region it reaches 30 or even 50 per square kilometre. In Mali, population is mostly concentrated in the river valleys. The plateau region in central Upper Volta is also heavily populated.

12. The West African sub-region has a national income of about US$ 8 million, roughly one-third of the total for the whole of Africa. The per capita income of the sub-region, at US$ 110, is some 22 per cent higher than the rest of the Continent.

13. Table 1 shows some major economic indicators for West Africa compared with the rest of Africa. (excluding the Republic of South Africa).

Table 1

Some Major Economic Indicators

	Population		Per capita			Gross Domestic Product a/				
	No. (mill.)	Percentage	Exports	Imports	Nat. Income	Total	Agriculture	Mining	Manufacturing	Rest
			← in US $ →			← in billion US $ →				
West Africa	65	28	22	27	110	7.25	4.35	0.15	0.60	2.15
Rest of Africa exc. West and Rep of South Africa a/	152	66	22	30	90	13.71	4.88	0.73	1.43	6.43
Africa, exc. Rep. of South Africa a/	217	94	22	29	95	20.96	9.23	0.88	2.03	8.58
Africa total a/	231	100	29	35	110	26.01	9.85	1.50	3.25	11.20

Source: Tables 1, 5 and 7 of Industrial Growth in Africa (E/CN.14/INR/1). South Africa is excluded throughout.

a/ Income of Rwanda-Burundi not distributed by sector of origin.

14. Within West Africa there are wide disparities as regards national income and living conditions. Ghana, Senegal and Liberia are in the highest income ranges but the living conditions of their populations differ significantly. In Ghana, average income is high, because the cocoa farmers are prosperous. In Senegal, it is high because of trade and distribution services and a large government sector centred around the port of Dakar originally designed to cover the whole of former French West Africa. The large scale production of groundnuts also contributes to the high income level. In Liberia, two-fifths of the total income accrues to foreign firms. In Gabon, one-third of the income accrues to the non-African population which accounts for a bare 1 per cent of the total.

15. The economy of the West African countries is based on the extraction and export of their natural resources, in which minerals play a leading role. Ghana and Sierra Leone occupy second and third places amongst the world's diamond producers. Guinea, with its important bauxite deposits, is one of the world's main producers of aluminium. Ghana is the largest manganese producer in tropical Africa. Liberia occupies a leading place amongst the iron ore exporting countries.

Trade

16. The pattern of trade in the three main sub-regions of Africa is basically the same. Two-thirds of Africa's trade is with Western Europe and only one-tenth among African countries.[1/] One of the characteristic features of intra-African trade is its marked concentration according to economic and monetary groupings. The West African countries account for about 50 per cent of the total intra-African trade[2/] among themselves.

1/ This is based on recorded trade figures. It is generally assumed that a significant volume of trade across the long frontiers goes unrecorded due to lack of complete customs control and statistical check points. See Background paper on the Establishment of an African Market, ECA, (E/CN.14/STC/20).

2/ See Annex II for intra-West African trade in 1961 and 1962.

17. There are two indicators of the trade pattern of West Africa. The first relates to the tendency to increase trade between neighbouring countries due to the general inadequacy of the transport system. An example of this is the trade between Upper Volta and Ghana which accounts for the bulk of the former's total exports.[1] Secondly, due to balance of payments difficulties, trade tends to increase between countries of the same monetary zone. An illustration of this can be found in the imports of Nigeria[2] in 1961. Nigeria imported more from Ghana than the rest of the West African countries put together. Similarly, trade between Ivory Coast and Senegal increased in 1961, amounting to over US$ 20 million.[3]

18. Goods traded among African countries in general show a marked concentration on primary products. The same is true of the West African sub region. Most of the commodities exchanged consist of food products. Only recently a significant proportion of this trade included raw materials and manufactured goods.[4] An example from Ghana underlines this trend. In the past, Ghana's exports included mainly kolanuts and other food products. Now, however, a considerable proportion of exports consists of manufactured products. In 1961, exports of manufactured products amounted to US$ 88,000; in 1962, this total reached US$ 217,000.

19. The commodity structure of West African exports is typical of an underdeveloped area. But within West Africa there are equally wide disparities in the degree of industrialization affecting trade. Senegal, the most industrialized country in the sub-region, exports wholly manufactured products in return for foodstuffs and raw materials. Dahomey, on the

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1/ According to 1961 import statistics, trade between the two countries amounted to US$ 14.7 million, of which Ghana imported goods worth US$ 9.4 million.

2/ Both Nigeria and Ghana belong to the sterling area.

3/ Ivory Coast and Senegal are members of the West African Monetary Union and the Customs Union.

4/ Considering the commodity structure of total intra-African trade, manufactured goods account for 43 per cent.

other hand, exports primary commodities (with the exception of beer) particularly to Senegal and Ivory Coast, in exchange for manufactured products.

20. An examination of the commodities imported and exported shows clearly that unless a deliberate effort is made to change the present structure, some countries are bound to remain with little industry. Sierra Leone's imports from other West African countries consist of semi-processed raw materials and manufactured goods. Exports from Sierra Leone, on the other hand, consist wholly of kolanuts (averaging 80 per cent of over-all exports to other West African countries). A minor proportion of scrap iron and steel is also exported to Ghana and to some other countries of the sub-region.

21. Guinea provides yet another example of a similar trend. A high percentage of Guinea's imports is in the form of manufactured products such as cigarettes, soap and palm oil (the latter mainly from Dahomey). Exports[1/] from Guinea consist of bananas, coffee, raw tobacco and aluminium (the last two items are destined for processing elsewhere).

22. Upper Volta, Mauritania and Mali (members of the West African Customs Union) rely very heavily upon African destinations for their over-all export earning. Their sales to the sub-region, particularly to Ghana in 1961, were close to 50 to 80 per cent of the total.

23. Trade within the West African region for 1961 and 1962 is shown in Annex II. Thus a very small percentage of trade is conducted within the sub-region. This is a reflection of the heavy trade dependence of the West African countries on overseas trade. Ghana and Nigeria conduct a very small proportion of their external trade with other African countries, barely exceeding 2 to 3 per cent in respect of exports, and a somewhat higher figure for imports.

1/ The 1962 figures indicate a drop in Guinea's exports to West African countries, which may be due to lower production.

24. Almost all the statistical data available for the member countries of the West African Customs Union relate to cabotage or coastal trade. Cabotage trade, however, includes locally manufactured goods and re-exported items. Therefore this type of trade data does not indicate either the volume or value of goods moving between countries. Furthermore, coastal trade does not define destinations, since goods imported by Ivory Coast could in fact be in transit to an inland country such as Upper Volta.

25. Despite these difficulties of assessment, intra-trade within the West Africa sub-region broadly indicates the type of commodities exported and imported and an approximate share of this in comparison to the total trade of the region as a whole.

26. There is an additional difficulty in examining the trade pattern of West Africa and this relates to the imposition of heavy duties on goods originating in the area. There do not exist any customs agreements in the form of preferential tariffs (excluding the relationship of the membership of the West African Customs Union).

27. In the French-speaking countries (except Guinea), there are four types of duties:

(i) The French preferential, under which French goods are completely free of all customs duties ("droit des douanes") although the internal duties such as the "taxe forfaitaire", the "taxe de chiffre d'affaires", etc., are imposed.

(ii) The Common Market preferential, under which reduced rates of duties (normally 40 per cent less than the general tax) are imposed on goods from the Common Market countries. In addition the internal taxies are levied.

(iii) Goods imported from member countries of the West African Customs Union are completely free of all duties. In the case of manufactured goods, duties are imposed on the raw materials if they are known to have been imported from outside the Customs Union.

(iv) General duties imposed on goods from all other countries, African and non-African. These are divided into maximum and minimum duties. Under a Convention signed between France and Britain in 1950, the former British territories in West Africa are accorded a most-favoured-nation treatment and therefore pay only the minimum duties.

28. The monetary situation is equally complicated since two unions (Equatorial African and West African) exist in the franc zone. As far as the British ex-colonies are concerned, the position is beginning to become a little clearer. There was until recently a West African Currency Board, but with the withdrawal of Ghana and Nigeria, only Sierra Leone and Gambia remain as members. Sierra Leone is now planning to issue in 1964 its own currency.

29. The associate membership of the eight ex-French territories to the European Economic Community further enhances the problems of the sub-region. This alignment has to some extent strengthened the customs regimes which existed in pre-independence days. The present position is that the countries associated with the Common Market[1/] receive tariff preferences in the markets of the Six, while the Commonwealth group receive preferences in the United Kingdom and other countries of the Commonwealth. Sierra Leone is the only country in the sub-region which grants reciprocity.

1/ According to a new agreement between the Common Market and the associated countries, the system of support prices will be abolished progressively and will cease in 1967. At present France spends an estimated US$ 65 million a year in guaranteeing markets and prices well above world levels for the produce of former colonies. Economic Bulletin for Africa, Vol. III, No. 1, page 90.

30. In the absence of a customs union and other economic institutions for the whole sub-region, reciprocal trade and (in certain cases) payment agreements have been concluded. Since most countries have continuous balance of payment difficulties, the ability to import depends on credit facilities and the possibility of earning convertible currencies. But existing bilateral agreements grant mainly swing credits. In certain cases the agreement inserts a clause which makes it obligatory to pay in convertible currencies.[1/] Though these swing credits place obvious limitations on the value of trade between the countries, they do promote actual trade within the area.

31. There are visible signs, however, of a shift in the type of goods being produced in the sub-region. In some countries where the rate of growth is higher and the economy diversified, the point of departure can be traced. An increasing share of Ghana's exports is being taken over by manufactured products such as clothing, veneers and plywood, and chemical and pharmaceutical products. Equally, in Senegal and Ivory Coast, where industrial planning is fairly well advanced, manufactured goods constitute a significant proportion of exports. The latter is beginning to export assembled cars while the former's main export item of manufactured products is cigarettes.

Characteristics of the sub-region

32. All countries of the sub-region have recently formulated development plans. Like the structure of their economies, they all differ in form and content. But the common factor in all is emphasis on industrial development.

33. Senegal, the most industrialized country in the sub-region, has provided in its four-year plan (1961-64) that its industrial production

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1/ See Annex III.

should increase at an annual rate of about 13 per cent. The over-all effect of the plan appears to be that the economy becomes more industrialized as industry's contribution to national income goes up from 14.7 per cent to 18 per cent. Nigeria's approach towards industrial development, both federal and regional, also indicates that a large part of the country's resources are to be devoted to establishing new industries. In the industrial sector, Guinea's plan is equally well advanced.

34. These plans are naturally based on both the existing and potential resources of the sub-region.[1] Like other parts of Africa, the sub-region has been only partially surveyed.[2] But even this is ample ground for optimism. For some major minerals, the quality of ore is remarkably high and the reserves, although only partially estimated, are very large. Some illustrations may be given.

35. Some of the iron ore samples from Liberia are very high grade, while the Mokomambo deposit in Gabon, which is one of the three largest deposits in the world (exceeding 1,000 million tons) has a 63 per cent ore content. Tchibanga, in Mauritania, and Sierre Leone also have high-grade iron ore. These reserves are so located that the transport costs are reasonable. In Guinea, for instance, deposits are located by the sea at Conakry. In Gabon, where they are inland, they would require the construction of a 400 mile railway track, the cost of which would be borne by large scale shipments. The bauxite deposits of Ghana alone have been assessed at 400 million tons or approximately one-fifth of the known world reserves. Yet at the present time tropical Africa's contribution to the world supply of bauxite is only about 3 per cent.

36. The process of industrialization and development of natural resources is also reflected in a wide range of construction activities such as industrial and public buildings, dams, roads, bridges, reservoirs, harbours,

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1/ See Annex IV.

2/ See Annex V.

etc. Cement is the basic material and the West African sub-region as a whole has a pronounced shortage. Domestic production at present satisfies less than 25 per cent of demand.

37. The origins of the inland transport network are well known. Much remains to be done, but further industrial development could proceed within existing facilities. Feeder roads will have to be extended and improved and some new links established to dovetail with the scheme of sub-regional industrial development put forward in this report.

38. Facilities for air transport are fairly adequate and new links are being established. In spite of its higher costs, air transport can be depended upon for the movement of perishable goods. Port facilities have been significantly enlarged and indeed there will be surplus capacity for some time to come. Coastal shipping is the cheapest form of transport, and the setting up of an additional shipping line is under consideration.

39. Hydro-power is another essential component of industrialization. Potential sites for the development of hydro-power can be found on the main rivers and on the tributaries in Guinea and Mali, south of Koulikoro and along the Niger river. Nigeria is planning to build a large hydro-power station at Karinji, in the neighbourhood of Gemma. The Volta River project, when fully completed, should, according to plans, generate a total 768,000 kW continuous power. Work is already in hand on the development of major West African river basins from west to east: the Senegal river, the Niger river and the Lake Chad basin.

40. The development of electric energy provides a definite impetus to industrial progress. In West Africa the less industrialized a country, the higher is the percentage increase of electric energy production

recorded.[1] This fact is important for the reason that in future when these countries are more industrialized, the position will be reversed.

41. At present there is one oil refinery, at Tema (Ghana), with a capacity of 1.25 million tons a year. When working at full capacity this refinery will be able to supply not only the Ghanaian market but also some neighbouring countries. Three other refineries are being constructed, at Dakar, Abidjan and Port Harcourt. When these come into operation in 1965, there is likely to be excess capacity for some time. It should be noted that all the refineries will be at coastal sites, and that in due course there will be a case for one to serve the countries in the interior, particularly Mali and Niger.

42. West Africa has not only an intricate pattern of natural resources and disparities of income, it also reveals an interesting factor in relation to an adjustment of labour to the unequal distribution of population. For instance, important movements of labour from Central Upper Volta to the coastal belts in Ivory Coast and Ghana take place regularly. It is estimated that 200,000 people leave the country every year. These movements are usually in plantations, mines and to the farms producing export crops.[2]

1/ From 1956 to 1962, the production and consumption of energy in the West African sub-region shows the following increases:

	%		%
Chad	83.3	Mali	46.2
Dahomey	85.7	Niger	116.7
Ghana	27.7	Nigeria	54.9
Guinea	273.7	Senegal	62.2
Ivory Coast	133.3	Sierra Leone (1959-1961)	16.3
Liberia	19.0	Togo	204.3
		Upper Volta	133.3

2/ Much needs to be done to improve facilities for training at all levels. This problem is discussed in Annex VI.

The approach to industrialization

43. In the foregoing paragraphs the characteristics of the countries of the sub-region have been reviewed briefly. These countries, like almost all others in Africa, and indeed most underdeveloped countries, are faced with a basic economic dilemma so far as industrialization is concerned. Despite pockets of industry, the economies in the countries of the sub-region are overwhelmingly agricultural. Apart from subsistence agriculture, there is typically a heavy dependence on exports to unstable world markets of primary commodities. Incomes per head are low. Large numbers are living at the subsistence level and poverty is widespread. Although population is increasing rapidly, the land in most countries is far from being densely populated. Yet the annual increment in the prospective labour force is considerable. With independence attained virtually throughout the sub-region, there is naturally and inevitably a demand for higher standards of living, also associated with the spread of literacy and technical training.

44. The crucial problem, therefore, is how to increase the pace of economic development. Expansion of the agricultural sector, particularly in terms of a higher output per head, is vital and will naturally raise national incomes and purchasing power. But it will do little to solve the employment problem, since agricultural advance means a rapid increase in the productivity of labour.

45. There is another problem. Commodity exports, which are the main source of foreign exchange earnings, are subject to great fluctuations in world markets, both in the quantities which can be sold and in price levels. There are temporary exceptions, but in the longer run markets are approaching saturation for most commodities. In general, the prices of the export commodities of developing countries tend to be stable or move downwards, while the prices of imported manufactured goods are moving upwards.

46. There is a dual impetus to industrialization. First, it is natural to turn to import substitution to save foreign exchange. Secondly, the manufactures which can replace imports tend to be small and medium scale industries producing in particular consumer goods, which create new employment opportunities. Some of these industries are of appreciable size and the income elasticities of demand for their products are generally high. As incomes rise, people tend to spend a greater proportion of their income on newly available consumer goods provided by such industries. But this is not a process which continues indefinitely. One of the earliest sizeable consumer goods industries to be established in a developing country is textiles. Yet despite the considerable growth possibilities still to be explored, the market for African textiles is no longer expanding rapidly. The nature of income elasticities of demand is such as to put a limit on the market opportunities for small and medium scale industries. The same restraints do not apply to the products of larger scale industries.

47. Inevitably, as history shows, industrial growth proceeds from the manufacture of consumer goods through intermediate goods to capital goods such as machinery and equipment. This process is not pre-ordained, automatic or continuous. Growth points are necessary, industries which themselves stimulate the growth of other industries as users of their products. Such a role is beyond the scope of most small and medium scale industries. It is for this reason that the present enquiry has been largely concerned with the establishment of large scale modern industries, strategic for economic development. The necessary conditions for the establishment of such industries are discussed at the beginning of the next part of this report.

48. Almost all the development plans in West Africa attach importance to industrial development. In the next phase, a higher proportion of available resources is likely to be devoted to industry. There are

naturally initial difficulties to be overcome in planning industrial development on a co-ordinated sub-regional basis. Some countries which have had the benefit of sizeable capital inflows are better equipped with infrastructure than others. Some are well equipped with natural resources but remain almost totally without industry. Yet, despite the disparities in resources, human and natural, and in levels of development, there is a discernible trend towards the pooling of efforts. This is most clearly recognized in Senegal's development plan, which states explicitly that the Government intends to foster co-operation in the field of development with other West African states, and particularly co-ordination of industrial policy.

49. With certain exceptions, it has not yet been possible to make detailed estimates of the likely growth of markets for the industries considered. Broadly speaking, however, the new industries suggested are envisaged in terms of the likely market foreseen in 1970 or thereabouts, assessed both by reference to over-all growth possibilities and the prospective markets for certain key products.

PART II

INDUSTRIAL DEVELOPMENT: LARGE SCALE INDUSTRIES

50. In part I of this report, in the course of the discussion of the economic setting of West Africa, there is a brief sketch of the present industrial situation in the countries of the sub-region. In this part, suggestions are made for industrial development over the next few years, within the framework of a conscious policy of sub-regional co-ordination. These suggestions are made in the light of two basic economic principles: international specialization and division of labour and the economies of scale appropriate for each industry. They are put foward in the light of economic and technical feasibility. No assumptions are made concerning the kind of political arrangements which may eventually emerge in West Africa. Clearly a network of inter-governmental agreements is required. The essential point is that what is put forward is economically and technically rational. Needless to say, variations in these schemes are possible. In applying the principles of the economies of scale, account has been taken of the trend in technological advance which in some industries now makes possible smaller scale production at lower capital cost than is current practice in the industrially advanced countries. But there should be no illusion that it is possible to produce economically at significantly lower scales of output than those envisaged and therefore to install new plants in all the territories. Great stress is laid on the importance of a fair distribution of industry throughout the sub-region and therefore on the importance of the country which it is agreed should undertake one large industry to serve the bulk of the sub-regional market, abstaining from attempting to lay down another large scale industry which it is agreed should be located elsewhere. Technically it is of course perfectly feasible for some of the industries considered to be located in more than one country. Economically, for a number of industries, if too many countries try to produce, all will fail.

Iron and steel[1/]

51. The total consumption of iron and steel in the West African sub-region in 1962 was 1,080,000 metric tons, of which 480,000 was indirect and 600,000 direct. It is estimated that the total consumption will grow to 1,770,000 in 1970, of which 1,100,000 is direct consumption. The breakdown of estimated consumption in 1970 by finished steel products is shown in Table 2.

Table 2

Estimated Consumption of Finished Steel Products in West Africa in 1970

(in thousand metric tons)

	West Africa		
	Total demand	On present types	On engineering types
Total:	1,100	980	120
Rails, etc.	150	150	-
Bars and rod	260	255	5
Sections	125	106	18
Wire rod	60	36	24
Wire	20	22	-
Strip	20	8	12
Sheets plain	65	34	30
galvanized	210	208	-
Tinplate	30	20	10
Plate	45	30	14
Tubes	110	106	4
Forgings and castings	10	5	3

Source: The Development of the Iron and Steel Industry in Africa, E/CN.14/INR/27, page 26. The methods of estimating used are fully described in this report.

1/ In this report iron and steel are considered briefly, since iron and steel in West Africa have been studied separately (E/CN.14/IS/2). In addition a full report on The Development of the Iron and Steel Industry in Africa has recently been prepared (E/CN.14/INR/27). The figures given here are taken from these two documents.

52. West Africa is particularly well endowed with iron ore deposits and has in fact some of the richest in the world. However, the minimum scale of output required to produce iron and steel economically on an integrated basis is such as to be beyond the market possibilities of almost all individual West African markets for some time to come. The consumption of steel per head in the whole sub-region averages only about 6 kg. However, the estimated growth of demand referred to above, even making allowances for the fact that at least one-third of the finished steel products consumed will continue to be imported in 1970, e.g. heavy sections and wide strip, is such as to justify the laying down now of two iron and steel plants. One of these should be a coastal plant with an initial output of about 400,000 ingot tons, and the other an inland plant with a capacity of about 100 to 150,000 ingot tons.

53. The initial scale of output of the coastal plant is sufficient to justify using the conventional blast furnace; probably oxygen-blown steel and continuous casting would be the most suitable process for the next two stages, followed by conventional rolling of a variety of light steel products. A second, smaller, inland plant appears to be justified, owing to heavy transport costs. In this case, electric power for smelting and refining is envisaged.

54. All the major raw materials for iron and steel making can be supplied from within the sub-region, with the exception of coking coal. However, modern technology now makes possible great coke economy. Nigerian coal can be used, blended with some imported coke (or coke manufactured from imported coking coal), together with liquid fuel injection. The rich ores from Liberia, Mauritania and Sierra Leone should be drawn upon to the maximum possible extent. There appear to be four possible sites for the location of the coastal plant: Port Harcourt (Nigeria), Tema (Ghana) and Buchanan or Monrovia (Liberia). More detailed studies of relative

costs are now in progress. Alternative possible sites for the second inland plant are also being investigated. One possibility would be to draw on the deposit of high grade ore at Nioro in Western Mali.

55. The building of two iron and steel plants, designed primarily to supply a large part of the needs of the whole sub-region, is not of course inconsistent with a limited number of small re-rolling plants based on scrap which could also subsequently draw on billets produced by the integrated plants.

Other metals and engineering

56. Nigeria is a significant producer of tin, all of which is being smelted and shipped out of the country as metal.[1]

57. Guinea has substantial bauxite deposits and at one of them the ore is transformed into alumina before exportation. Ghana, also, has bauxite deposits, but low-grade and scattered, and will shortly have abundant cheap power from the Volta River project. There is clearly a basis for a joint project whereby Guinea's alumina is transformed into aluminium metal and aluminium manufactures in Ghana.[1]

58. Since there is so far limited production of metals in West Africa, and in particular not yet a significant iron and steel industry, metal working and engineering are less developed than in the other main sub-regions of the Continent.[2] Engineering industries working on a large scale scarcely exist. However, assembly work and finishing are growing. Examples are assembly of motor vehicles in Ivory Coast, Senegal and Nigeria; and assembly of bicycles in Ivory Coast, Ghana and Nigeria, with a further works under construction in Upper Volta.

1/ See Annex IV.

2/ An analysis of the situation is difficult owing to lack of statistical information. A full-scale enquiry into metal working and engineering in Africa is in progress but is not expected to be completed until early 1965. In the present report there is no more than a summary account of certain problems and possibilities of development.

59. There is a need to co-ordinate development plans in the assembly of vehicles and bicycles. The assembly of motor vehicles at Abidjan is based on components imported from France, but the cost of production is higher than in France. This is partly owing to the low productivity of labour, and partly because the daily production capacity is twenty vehicles but the present output only six. Markets in neighbouring countries envisaged when the works was established in 1959 have not materialized. Similarly, the capacity for assembly of bicycles in Ivory Coast is 35,000 a year but the current production only 18,250. It is expected, however, that the assembly works in Upper Volta, which will have an annual capacity of 35,000 bicycles and 5,000 motor scooters will be viable on the basis of the market of the hinterland countries.

60. Another example of a successful assembly industry is sewing machines. There are two centres of production in Nigeria, with a total annual output of more than 10,000 machines.

61. The principal conclusion to be drawn is that there is clearly scope for a steady development of assembly industries in West Africa but that economic operation depends on a degree of specialization, on the harmonization of plans and on a network of commercial agreements between producing countries. A good example is the agreement between Ivory Coast and Senegal in the assembly of vehicles. Senegal has agreed not to produce lorries of certain types and Ivory Coast has renounced production of certain types of light vehicle.

62. General engineering at present consists essentially of sizeable repair and maintenance shops, also carrying out finishing and reconstruction and frequently part of large enterprises, e.g. the railways in Lagos and Dakar. Employment is often considerable and training arrangements and efficiency fairly advanced. In other words, these centres are the nuclei for further development of engineering production.

63. There are a number of shipbuilding installations in the major ports, e.g., Dakar, Abidjan, Lagos. They are engaged in the first instance in repair and maintenance work, but production of small ships is also developing, e.g. of 300 to 500 tons in Abidjan.

64. Metal working, operating normally on a small scale, is widespread. Nigeria has 44 production centres, Ghana 25, Senegal 20 and Ivory Coast 15. In some cases employment is from 250 to 300. All countries, even those in the hinterland, have at least one relatively sizeable production unit. Production of agricultural equipment and tools is developing and also construction material and metal containers.

65. The outlook for expansion of metal working and engineering is favourable, with the growth of economic development and improvement of living standards. This is particularly true of industries which are immediate outlets and which are expanding, e.g. the agricultural industries, the food processing industries, building and a growing variety of consumer goods. At the present stage expansion is likely to be mainly in terms of small scale operations where investment is low and amortization rapid. A further impetus will be the availability of locally produced iron and steel products and aluminium metal. Except in the case of assembly industries, already discussed, the problem of harmonization of development plans in the metal working and engineering field has not yet arisen in West Africa in an acute form. However, the time is not far distant when problems of this kind will arise. More detailed studies would not, therefore, be premature.

Chemicals and fertilizers

66. The starting point of developing chemical complexes in Africa can be the production of fertilizers. To produce fertilizers basic chemicals are required which can be produced in the first instance more economically as units of fertilizer plants. The approach of integrating basic chemicals with fertilizers has been adopted in this report.

67. The need for fertilizers: The nutrients that plants get from the soil are exhaustible and have to be replenished. This has been proved to be so all over the world by the increased yield obtained as a result of fertilizer application. The West African sub-region is no exception.1/

68. Almost all governments in West Africa (and also FAO through its Fertilizer Programme under the Freedom from Hunger Campaign) have been trying to make farmers aware of the benefits to be derived from the use of fertilizers. Giving subsidies, organizing field demonstrations and analyzing soils have been some of the means used in recent years and are still being used. Such efforts cannot be expected to bear fruit immediately but farmers have been found to be more receptive than expected if approached in the correct way. This was confirmed in a number of countries. In Liberia, for example, where there is no subsidy, farmers working in the experimental settlement of Kpeir were, owing to lack of an organized system of distribution, unable to buy fertilizers for the 1963 season. This and other similar situations may be taken as indications that more and more farmers understand the advantages to be derived from the application of fertilizers.

69. Fertilizer requirements for West Africa should be considered both from the short and the long term. Plantations and co-operative farms are the first practical targets but are by no means numerous at present.

1/ Two quotations from the FAO Regional Soil Fertility Expert, Dr. Hanck: Fertilizers in Progressive Agriculture, will clearly demonstrate why a considerable increase in fertilizer use should be expected: "... the average increase in West Africa on all crops included in the FAO Fertilizer Program in 1962 was 65 per cent over non-fertilized plots". This compares favourably with 42 per cent for the Near East. As for net returns "... in the economic results of the field experiments carried out under farmers' conditions in Ghana the crops - maize, groundnuts, rice and yams - give a net return of 170 - 770 per cent over an investment of about £3 in fertilizer per acre". In other words, for every dollar spent on fertilizer the net return is 1.7 to 7.7 dollars.

It is to be expected that they will increase in number since the present tendency is towards such farming organizations. Next come individual farmers, who are more difficult to convince. Educating them takes time. This is why the application of fertilizers at the farm level is considered a long term project.

70. Attempts have been made to collect data on areas under plantation and under farmers' holdings. The idea was that such areas, together with appropriate available recommended fertilizer rates of application, would give some indication of fertilizer requirement, in both the short and the long term. Unfortunately the information at hand is meagre and to some extent unreliable. Some organizations have, however, done detailed fertilizer consumption estimates for the sub-region as a whole and for some individual countries. Some of these estimates are based on the total potential cultivable area or on the area which could be under cultivation in 1970. The study prepared for the Nismey Conference on Harmonization of Industrial Plans is an example of the former and that of the "Société Sénégalaise d'Engrais et de Produits Chimiques" (SSEPC) of the latter. The estimates made by this organization are to be found in table 3.

71. The final 1970 estimates and consequently the recommended capacities are 41,000 and 46,000 tons of N and P_2O_5 respectively.[1/] These figures may well be conservative. Local production will be partly supplemented by imports of certain types of fertilizers which will not be produced locally by 1970.

72. Plant nutrients appear in the market in different forms according to the kind of weather, soil and plant requirement. It would not be feasible to produce them all, hence the question of choosing the most appropriate types arises.

1/ The former includes provision for purposes other than fertilizer.

Table 3

Fertilizer Requirements in 1970

Country	N	P_2O_5	K_2O**	Total ($N+P_2O_5+K_2O$)
Nigeria*	2,000	1,500	...	
Cameroon	4,000	1,000	...	
Chad	1,000	500	...	
Niger	50	50	...	
Dahomey	500	500	...	
Togo	200	200	...	
Total I	7,750	3,750	(5,000)	16,500
Ivory Coast	5,500	5,500	...	
Ghana*	2,000	1,500		
Upper Volta	250	250	...	
Liberia	...	...	...	
Sierra Leone*				
Total II	7,750	7,250	(21,500)	36,500
Senegal	22,000	32,000	...	
Mauretania	350	75	...	
Mali	250	100	...	00
Guinea	2,500	1,800	...	
Portuguese Guinea	50	50	...	
Gambia*				
Total III	25,150	34,025	(18,500)	77,675
Grand Total	40,650	45,025	(45,000)	130,675

Notes:

* The 4,000 tons N and 3,000 tons P_2O_5 estimates for Nigeria, Ghana Sierra Leone and Gambia have, for convenience, been distributed equally between Nigeria and Ghana.

** Figures in parenthesis were arrived at by assuming a total K_2O consumption of 45,000 tons. They are very rough indications based mainly on some existing estimates for K_2O. They are here included to give some idea of the order of magnitude of the capacities of mixing plants proposed for Port Harcourt, Abidjan and Dakar.

Source: $N+P_2O_5$ estimates by Société Sénégalaise d'Engrais et de Produits Chimiques

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Source: $N+P_2O_5$ estimates by Société Sénégalaise d'Engrais et de Produits Chimiques

73. From the nitrogenous group, ammonium sulphate has been found to give excellent results, partly due to its sulphur content which is generally lacking in the West African soil. Unlike ammonium nitrate it is not adversely affected by the humid climate of the sub-region. It is easier and cheaper to manufacture than urea. The only disadvantage is its low N content and consequently its high transport cost. However, the low content does away with filler material during mixing and makes it easier to apply it or its mixture to the soil more evenly. It therefore seems that ammonium sulphate is the first choice.

74. Like ammonium sulphate single superphosphate has a low nutrient content and is consequently more expensive to transport than the more concentrated triple superphosphate. The latter does not contain calcium and sulphur in the form of calcium sulphate. As was stated above, a large part of the sub-region is said to be deficient in suplhur. Single superphosphate is one of the means of solving this problem. This is in factthe only means for groundnut fields where phosphatic fertilizers only are required. As economies of scale in the production of phosphatic fertilizers are greater than in the manufacture of nitrogenous ones, it is possible to produce both kinds, single and triple superphosphates. The production of both is, therefore, considered here.

75. As for potassic fertilizers, the possibility of production in the sub-region is not taken into account for the simple reason that there are no known deposits in the sub-region. It appears that muriate of potash of over 45 per cent K_2O has been used most in the past and may well be the type that will have to be imported in the sub-region. Choice from among the potash fertilizer types is of course not as limited as for the other groups.

76. Production of basic and other chemicals: In descending order, sulphuric acid, soda ash, caustic soda, chlorine and ammonia are the

backbone of the chemical and related industries. In one way or another they are used in producing the thousands of chemicals and related products and are hence known as basic chemicals. They are also used extensively in metallurgy, textiles and other branches of industry. Production of individual basic chemicals, together with fertilizers and certain chemicals derived from them are considered in the remaining part of this section. The integration of facilities into a complex is adhered to whenever possible. The raw materials available are shown in Table 4.

77. The nitrogen complex: It is envisaged that the nitrogen complex will include facilities for the production of ammonia, ammonium sulphate, nitric and sulphuric acids and industrial explosives.

78. The industrial explosives group is one for which adequate information is not available. Present consumption for the majority of the West African countries may be in the neighbourhood of 5,000 tons. It should be noted that this figure is on the low side and represents the sum of a number of explosive types. Dynamite is the most importanttype and accounts for some 90 per cent of imports. Assuming that consumption unaccounted for may balance the quantity of explosives other than dynamite, the figure 5,000 may be taken as the present total consumption of dynamite in the sub-region.

79. Mining is an industry with a big future in West Africa. So is quarrying and the construction of roads, railroads, dams and buildings. All of these are large consumers of industrial explosives and consequently an appreciable increase in the demand for explosives may be expected. Since the real share of dynamite is not known for certain it may not be advisable to assume a high rate of consumption increase for dynamite. A rate of growth of 7 per cent per annum may serve the purpose. At this rate then dynamite consumption in 1970 may rise to 8,000 tons (6,000 tons of nitroglycerine).

Table

Availability of Key Materials for Chemical Industries

	Location	Quality	Reserve (tons)	Average Annual Prod.(tons)	Price at source ($/t)
Coal					
Nigeria	Enugu	12,200 BTU(non-coking)	42,000,000	630,000	7.10
	Elsewhere	sub-bituminous	2[illegible],000,000		
Lignite					
Nigeria	Onitsha	11,000 BTU	63,000,000		
S. Leone	30miles east Fr.Town	fair	1,000,000		
Crude Oil					
Nigeria	Niger Delta	29°to 45° API	74,000,000 proved	10000 t/d	14.20
Natural Gas					
Nigeria	Niger Delta	Sulfur free,79-98% CH_4	85x10^9 m^3 proved		0.177/1000ft^3
Senegal	Sebikotane		180,000 m^3/d		
Pyrites & Sulfides					
Senegal	Eastern Senegal	3% sulphur			
S.Leone	Kangari Hills	As_2S_2 assoc.with gold			
Ghana	Obuasi & Prestea	Associated with gold			
	Takoradi	Associated with shale			
	Daboya	" " Limestone			
Gypsum					
Mali	Adrar des Iforas		Occurence known		
Rock salt					
Mali	Taoudeni		Occurence known		
Brine					
Nigeria	Benue Province	dilute			
Sea water					
Ghana		solar evap.possible			
Togo					
Limestone					
Nigeria	Nkalagu & others		36,000,000	800,000	
Dahomey	Pobe & Cove	80.8-83.4% Ca CO_3	9,000,000		
Ghana	Nauli	80% Ca CO_3	13,900,000		
	Asuboni	80% Ca CO_3	2,600,000		
Guinea	Near Siguiri	suitable for cement	50,000,000		
Chad	Adre & Mayo Kebbi				
Togo	Ouigblo	80% Ca CO_3	9,000,000		

Table 4 (continued)

	Location	Quality	Reserve (tons)	Average Annual Prod (tons)	Price at source ($/t)
Up.Volta	Bobo-Dioulasso	contains much MgC			
	Niger boundary	1% MgO			
Mali	Bafoulabe	suitable for cement	a few millions		
Phosphate					
Togo	Hahotoe	72+81% BPL(ENRICHED)	50,000,000 of 81%	500,000	7 and 10
Senegal	Taiba	82% BPL (ENRICHED)	40,000,000 of 82%	450,000	8.3
	Thies	over 28% P_2O_5 in Al PO_4		140,000	6.1
Guinea	Guinea-Senegal boundry		Occurence known		
Mali	North of Gao		Occurence known		
Natron					
Chad	Prefacture de Bol	23%Na_2CO_3+53%$NaHCO_3$			
Niger		salt + natron		4,050	
Mali			Occurence known		
Dissolving Pulp					
Nigeria	Gmelina orborea				

80. To produce 6,000 tons of nitroglycerine 5,700 tons of 100 per cent nitric acid and 2,600 tons of glycerine are required. In fact the glycerine is nitrated with an equal mixture of nitric and sulphuric acids but about 96 per cent of the latter is recovered. As the sub-region exports glycerine the supply should present no problem. Nigeria alone exports over 1,000 tons per year. Recently a large soap factory has been started in Ghana. The glycerine coming from soap plants is, however, crude and needs refining.

81. In order to produce an explosive which is easy and safe to handle the nitroglycerine is absorbed in wood flour or in either ammonium or sodium nitrate. As the former is easier and cheaper to obtain it may well be the choice. Nitroglycerine absorbed in such a medium is known as dynamite.1/

82. The present consumption of nitric acid which is probably not appreciable is not known. The demand is, therefore, difficult to asses. Some 300 tons may be added to the 5,700 tons envisaged for the explosive plant giving a total of 6,000 tons for 1970.

83. The classic method of making nitric acid from sodium nitrate and sulphuric acid is disappearing fast. The modern and economical one is the catalytic oxidation of ammonia. The ammonia required to produce the estimated quantity of nitric acid comes to 1,740 tons.

84. It has been estimated that some 39,000 tons of nutrient (N) may be the nitrogenous fertilizer demand by 1970. In terms of ammonia and ammonium sulphate this amounts to 47,500 and 184,000 tons respectively.

1/ There is, however, a good future for fertilizer grade ammonium nitrate substituting dynamite in quarrying, road building and certain types of construction works. The nitrate when detonated with fuel oil is said to give the same blasting effect as that of dynamite. This has been proved in the USA and its adoption, provided an ammonium nitrate facility is annexed to the complex, may appreciably reduce the cost for part of the industrial explosives.

85. To convert ammonia to ammonium sulphate a large quantity of sulphuric acid is needed. For the intended capacity this comes to 138,000 tons of acid. A sulphuric acid unit of 167,000 tons capacity is envisaged for the complex.[1] Capacities and raw material requirements, expressed in tons, may be recapitulated as follows :

	Nitric Acid	Ammonia	Natural gas (m^3)	Sulphuric Acid	Sulphur
Nitric acid	6,000	1,740		-	-
Ammonium sulphate	-	47,500		138,000	45,000
Ammonia for other purposes	-	360		-	-
Total	6,000	49,600	49.6×10^6	138,000	45,000

86. As has been noted the major raw materials for the complex are sulphur and one of the carbonacious substances. None of the sources of sulphur are known to exist in appreciable quantities in the sub-region.[2] Pyrites with a 3 per cent sulphur content is said to exist in eastern Senegal. The presence of sulphides associated with gold in both Ghana and Sierra Leone and with shale and limestone in Ghana is known. No economic evaluation of all these deposits has been undertaken so far. It is understood that the Ghana Government will start studies of its deposits early next year. Until such a time as an economical source of sulphur is found, the industries which need it as raw material will have to import it.

1/ Capacities of all sulphuric acid facilities are over sized so as to cover requirements for other purposes.

2/ See table 4.

87. Carbonacious materials for hydrogen production and for fuel are varied and abundant: coal, petroleum and natural gas in descending order of importance are the most important. Wherever there is natural gas it is cheaper and easier to use it as a source of hydrogen. The natural gas in Nigeria (Niger Delta) is sulphur free and consequently purification equipment simple. Proven reserves of 85×10^9 m^3 are likely to be enough for virtually any purposes. Annual production has already reached 2 million M^3. In the neighbourhood of the gas fields, natural gas costs about 15 d or £0.178 per 1000 ft^3. This price is competitive with that in the United States. It is, therefore, possible that natural gas will be the sources of hydrogen and Nigeria is the most promising location for thenitrogen complex.

88. The other main factor, especially for nitrogen fixation is electric power. For the complex to be feasible cheap and abundant power should be available (90×10^6 kwhr for nitrogen fixation only). Nigeria is not in a position to supply such a requirement until the realization of the hydro-power scheme on the Niger River (Kainji Dam). This, of course, means that the complex cannot start operation before the hydro-power is commissioned.

89. The phosphate complex: Two plants, one for triple super-phosphate in Senegal and one for single superphosphate in Togo are envisaged. Both countries are now exploiting their phosphate deposits and selling them in world markets enriched to over 81 per cent BPL.

90. A project is at an advanced stage for a triple superphosphate plant with a capacity of 32,600 tons per year for Senegal. According to a report by the Société Industrielle d'Engrais du Sénégal the conversion of imported or locally manufactured ammonia to ammonium sulphate is being seriously considered together with the triple superphosphate plant. It would be more realistic for Senegal to forego the production of nitrogenous fertilizer and concentrate on the production of phosphatic fertilizers, i.e. triple superphosphate.

91. According to the Services de l'Agriculture of Senegal the planned production of 32,600 tons will not satisfy the demand of Senegal after 1968. It is therefore suggested here that the capacity be increased to 62,000 tons. This output is expected to satisfy the extra demand for Senegal and provide an exportable surplus to those countries which prefer to use triple superphosphate.

92. Triple superphosphate is made by reacting phosphatic acid with rock phosphate. About 21,000 tons are required to produce the envisaged output. The acid may be made by the wet method using sulphuric acid or by the electric-furnace method. If the former method were used, a 49,000 tons sulphuric acid unit will have to be integrated in the complex. The electric-furnace method does away with sulphuric acid but consumes about 82 million kwhr of electricity. It is unlikely that sufficiently cheap power will be available in Senegal within the foreseeable future; hence the wet method seems preferable. Phosphoric acid consumption as such is probably negligible. If need for it for use elsewhere arises, it could be met by increasing the number of days worked at the phosphoric acid unit of the complex.

93. After deducting the 27,000 tons P_2O_5 (62,000 tons triple superphosphate) from the 1970 expected consumption of 46,000 tons P_2O_5 (100,000 tons single superphosphate) remains. It is suggested that a single superphosphate plant with this capacity should be established in Togo. A sulphuric acid unit with a capacity of 36,000 tons is needed as part of the plant. Due to the large quantity of sulphur which will have to be imported to the sub-region it may be worthwhile to consider the possibility of using hydrochloric acid from neighbouring Ghana. The salt electrolysis plant proposed for Ghana will have excess of chlorine or hydrochloric acid as a by-product. A method has recently been developed to partly substitute hydrochloric acid for sulphuric acid, that is, to use a mixture of both acids. This would be welcomed.

94. Fertilizer mixing and distribution: In general, (with exceptions such as for groundnuts), fertilizers are applied in the form of mixtures in the sub-region. This naturally implies the need for mixing plants. It would be advisable to consider the location of such plants to serve as distributing centers as well. Port-Harcourt, Abidjan and Dakar seem to be suitably located for these purposes.

95. Though difficult to assign capacities, an attempt was made in Table 5 to arrive at figures which may give some idea on the order of magnitude. The figures obtained are 16,500 tons for Port-Harcourt, 36,500 tons for Abidjan and 78,000 tons for Dakar. In terms of fertilizer materials these are roughly 65,000, 112,000 and 243,000 tons respectively.

96. Fertilizer mixtures are graded according to their content of nitrogen (N), phosphorous pentoxide (P_2O_5) and potassium oxide (K_2O) in that order. Owing to the many possible combinations, formulation of hundreds of fertilizer grades is possible. The more formulas the higher is the cost of mixing, packing, transporting, etc. Thus the number of formulas should be limited in the light of the results obtained from the field.

97. The salt electrolysis complex: Unlike the other basic chemicals dealt with, caustic soda and chlorine are in no way connected with the fertilizer industry. The complex suggested here is based mainly on the requirement of caustic soda for other industries. It should be noted here that contrary to the situation in developed countries, caustic soda is the main and chlorine the by-product.

98. At the moment the processing of bauxite to alumina (in Guinea) is the major consumer of caustic soda (30,000 tons per year). It is understood that the Guinea Government is planning to put up a second alumina plant at Boke. Although it will use imported alumina at the beginning the Tema Aluminium Smelter under construction in Ghana will eventually smelt locally processed alumina. Because capacities of these two alumina plants are not known, their caustic requirement cannot be estimated.

Caustic soda requirements for other purposes are estimated as hereunder:

viscose rayon plant	13,600 tons
petroleum refineries	1,700 tons
present requirement	12,800 tons
Total	28,100 tons

This total together with the 30,000 tons for bauxite conversion suggests that a plant of 60,000 tons capacity is possible. The balance of 1,900 tons is expected to cover, at least partly, the demand (for new soap, textile, pulp and paper, etc. plants) that could not be estimated now. It is understood that such a capacity will not be able to meet the demand by 1970. A second plant to take care of the two new alumina plants and other industries will be a necessity.[1/]

99. As for the location of the first plant Ghana seems the most suitable. In the whole coast of West Africa a large part of the Ghana coast and to some extent that of Togo are the only areas where economic solar evaporation of sea water is said to be feasible: the Ghana Government has already studied solar salt production and has come to the conclusion that some 250,000 tons of salt can be produced per annum. (This is more than twice the salt requirement of the proposed complex). In general this salt will consist of 99.4 per cent or over of sodium chloride. A special reduced rate of $3.92 per ton has already been fixed for industrial establishments using salt as raw material. The other factor favouring the location of the salt electrlysis plant in Ghana is electric power. The hydro-electric power from the Volta Project is expected to supply the plant with its considerable power requirement (21×10^7 kwhr). A special rate of 0.2625/kwhr has

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1/ It is hoped by then that Guinea will be in a position as regards the availability of salt and cheap abundant power to build the second complex.

already been proposed by the IBRD for the Tema aluminium smelter and it is here assumed that a similar rate will apply to the plant in question.

100. Since there is no means of estimating the demand for soda ash no consideration has been given to its production. It should be taken into account while studying the second salt electrolysis complex. If only one unit can produce soda ash economically, Ghana, because of its central location, appears to be the choice. When the second complex starts operation there will necessarily be a readjustment of market coverage. This may mean limitation of the market for caustic soda from the Ghana plant in which case the excess may be converted to soda ash. In case such an excess does not arise the market coverage can be purposely adjusted to create the needed caustic soda for the manufacture of soda ash or the plant expanded to produce more caustic soda.

101. Here again assessing the demand for hydrochloric acid is difficult since no background data indicating its possible trend exists. If it could be used as a substitute for sulphuric acid both in single superphosphate making (partially or totally) and in steel pickling, quite a good part of the chlorine produced may be converted into it. The substitution for the latter is not unrealistic since hydrochloric acid is usually more effective for metal cleaning and since the proposed integrated steel industry will definitely boost up the demand of acid for this purpose.

102. About 800 tons of the acid would be required by the mercury cells of the electrolysis plant itself. The proposed PVC plant, if realized, would take about 3,600 tons. If it can be assumed that about 600 tons may be needed to cover the odd demands for the acid, a facility with 5,000 tons capacity may be integrated. Extra demand for HCl can be met by adding more burners to the rest of the equipment which should be designed with a higher capacity.

103. Although the consumption of chlorine chemicals such as calcium hypochlorite, calcium chloride, bleaching powder etc. is not known and is not expected to be substantial, such chemicals will surely take their proper place in the years to come thereby providing outlets for chlorine. Facilities for their manufacture should be provided as soon as increased consumption warrants production. In other words the profitable disposal of chlorine may be expected to increase with time.

104. The success of this complex will depend upon the economical disposal of the 51,000 tons of by-product chlorine. It is suggested here that, in the final analysis, the feasibility of the complex be determined by assuming that all charges including disposal of the chlorine in the form of hydrochloric acid are absorbed against caustic soda. Of course, chlorine which can be marketed in the form of chlorine or hydrochloric acid should be treated properly.

105. The Viscose rayon complex: Rayon consumption in West Africa is quite substantial. The rate of growth for the 1953 - 1957 period has been high, the 1957 consumption being about three and a half times that of 1953. After 1957, however, the trend seems to have been reversed, especially in the two main consumer countries, namely, Nigeria and Ghana. According to "Industrial Growth in Africa"[1] 1960 consumption of rayon in the sub-region was 187 million yards. This is roughly equivalent to 23,000 tons or less than half of the 1957 consumption. It is understood that high tariff imposed after 1957 is the main reason for the drop. Other possible reasons are the in-roads that synthetics are making into the textile market in the sub-region and not conducive to rayon wearing apparel.

106. From what has been said, rayon should not be expected to ever again enjoy similar popularity as it used to in 1957 and before. This of course

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1/ ECA, Industrial Growth in Africa, A Survey and Outlook (E/CN.14/INR/1).

does not mean that demand for it will disappear. The demand will be there as is the case in other countries. It is, however, difficult to estimate it. From "Industrial Growth in Africa" the total estimated consumption for 1970 for the whole sub-region is 1,360 million yards, of which 340 million yards or 42,000 tons is for the sub-region.

107. The word rayon as used here is generic and includes viscose, acetate and cuperammonium. In the 1950's world production of this group viscose occupied first place with 73.5 per cent. Using this factor the 1970 consumption of viscose rayon comes to 31,000 tons. As the trend is not clear and in order to avoid a possible plant over-capacity it would be advisable to plan for a lower capacity. It is suggested that a 20,000 tons plant may be an economic proposition.

108. For such a capacity the following raw materials will be required:

Raw materials	Per ton	Per 20,000 tons
Dissolving pulp	1.12	22,400
Carbon disulphide	0.35	7,000
Caustic soda	0.68	13,600
Sulphuric acid	1.30	26,000

109. At the moment there is no known established source for dissolving pulp in the sub-region. The Federal Research Institute in Nigeria is currently conducting research on pulp for paper and has so far found out that gmeline orborea has a good future as a source of pulp. The chemical analysis of this pulp suggests that it could be used as a dissolving pulp. Work is continuing to establish its suitability for viscose making. Alternatively cotton linters, if economically available, may be used in

place of pulp. Should the two suggested sources prove impracticable, a converting plant may be set up to use imported dissolving pulp until such time as local pulp is available.

110. Caustic soda from Ghana and sulphuric acid from the nitrogen complex in Nigeria could be used. The other major raw material, carbon disulphide, could be manufactured on the spot, that is, in the same as or adjacent to the viscose rayon plant. Sulphur and charcoal or methane are the raw materials from which carbon disulphide is made. The last two, especially methane, are available in Nigeria. Sulphur will have to be imported, about 6,000 tons being the annual requirement.

111. Most of the factors determining location seem to favour Nigeria. These together with over half of the output destined to the same country suggest that Nigeria (Port Harcourt) will probably be the most suitable country to build the complex.

112. Calcium carbide: Calcium carbide is an intermediate compound for the making of acetylene which is used as fuel in cutting and welding and manufacturing Polyvinylchloride (PVC). Current consumption of calcium carbide is in the neighbourhood of 4,500 tons. This contrats with the 6,000 tons which is the sum of import figures for the years 1962 and earlier. The average of these two, 5,250 tons, was consequently used as a basis for future need estimation.

113. From import statistics for Nigeria the rate of increase for the 1953-62 period was about 6 per cent. Assuming this will apply for the whole sub-region the 1970 consumption estimate works out at 8,000 tons. In view of the faster development that is to be expected in industrialization and construction works this estimate may be taken to be on the low side. The 1970 total expected demand would be :

PVC plant	5,500 tons
Construction and industry	8,000 tons
Total	13,500 tons

114. Limestone and carbon in the form of coal, coke or charcoal are the raw materials required for manufacturing the carbide. Both are available in the sub-region, mostly in countries like Ghana and Nigeria for which new basic industries have been proposed. Dahomey and Guinea have limestone deposits and both may use charcoal or coal imported from Nigeria. Dahomey, however, at this stage does not seem to be able to provide the large quantity of electric power needed. Nigeria or Ghana may supply it. This is merely a possibility. If one or both of them will not be in a position to supply the power needed (41×10^6 kwhr) the carbide plant or plants may have to be located in countries with adequate electric power.

115. Capacities suggested are 6,000 tons (Dahomey) and 7,500 tons (Guinea). Both plants are expected to meet the demand from neighbouring countries around them. The plant in Guinea could also supply the proposed PVC plant in Ivory Coast with its requirements (5,500 tons).

116. PVC (Polyvinylchloride): In advanced countries, among the synthetic plastics and resins, vinyl resins take the lead. This was found to be the case in West Africa with polyethylene coming second. Polyvinylchloride (PVC), the most important of the vinyl group is considered here. Almost all of the PVC consumed in West Africa is in the form of plastic choes and sandals. Many of the countries in the sub-region have one or more moulding establishments which manufacture these from imported ready-for-use plastic powders. Some are planning to expand existing facilities and others to put up new ones.

117. PVC is one of the chemical commodities whose past trend could not be traced. Its present demand appears to be about 4,500 tons. The sandals and shoes made from it are popular and because they are cheap and durable demand for them may be expected to grow fast. They are mainly bought by

low income groups. This obviously implies that as the standards of living of such people improves, sophisticated foot wear, such as rubber and leather shoes, may be wanted. This means that the popularity that plastic shoes and sandals enjoy now will not go on indefinitely. Nevertheless it is not unrealistic to assume that they will increase in popularity for the coming decade or so. In the absence of past trends and taking into account new applications for PVC in sheeting, flooring, wire and fabric coating and tubing, a 10 per cent rate of growth may be considered reasonable. Thus consumption in 1970 works out at 8,800 tons.

118. Import or consumption figures in general refer to moulding compositions containing PVC and one or more of others, i.e., filler, plasticizer, pigments, etc. According to information gathered from existing plants in the sub-region the average content of PVC in imported moulding compositions for shoes and sandals is 60 per cent by weight. Assuming that this applies to other PVC articles as well the pure PVC equivalent to the 1970 demand comes to 5,300 tons. To produce the above quantity of PVC 2,200 and 3,600 tons of acetylene and hydrochloric acid are required respectively. In terms of calcium carbide the former is equivalent to 5,500 tons.

119. Abidjan in Ivory Coast appears to be suitably located to use the calcium carbide from Guinea and hydrochloric acid from Ghana. As this will probably be the only plant for some time its central location, as far as distribution is concerned, would be an advantage.

Capital requirements

120. The figures under the headings fixed, working and total capital shown in Table 5 should be taken as indications of orders of magnitude of capital requirement. The total (excluding the explosive unit) is about 65 million dollars and represents the sum for the individual plants and units incorporated with them. This figure does not include the cost

Table 5

Approximate Capital Requirements for the Proposed Capacities

Chemical products and proposed locations	Annual capacities (tons)	Fixed capital ($)	Working capital ($)	Total Capital ($)
Nigeria (Port Harcourt)				
Nitrogen complex				
Ammonia	50,000	10,000,000	1,500,000	11,500,000
Nitric acid	6,000	600,000	100,000	700,000
Ammonium sulfate	190,000	1,400,000	200,000	1,600,000
Industrial explosive	6,000	....	....	....
Sulfuric acid	167,000	3.200,000	500,000	3,700,000
Fertilizer mixing	65,000	500,000	300,000	800,000
Viscose rayon complex	20,000	19,000,000	2,800,000	21,800,000
Carbon disulfide	7,000	1,000,000	200,000	1,200,000
Total		35,700,000	5,600,000	41,300,000
Ghana (Tema)				
Salt electrolysis complex caustic/chlorine	60,000/51,000	8,000,000	1,200,000	9,200,000
Hydrochloric acid	5,000	140,000	20,000	160,000
Total		8,140,000	1,220,000	9,360,000
Togo (Kpémé)				
Single superphosphate	100,000	600,000	100,000	700,000
Sulfuric acid	41,000	1,400,000	200,000	1,600,000
Total		2,000,000	300,000	2,300,000
Senegal (Dakar)				
Triple superphosphate	62,000	1,400,000	200,000	1,600,000
Sulfuric acid	53,000	1,600,000	230,000	1,830,000
Phosphoric acid	20,500	1,800,000	270,000	2,070,000
Fertilizer mixing	250,000	1,100,000	600,000	1,700,000
Total		5,900,000	1,300,000	7,200,000
Ivory Coast (Abidjan?)				
PVC	5,300	2,000,000	300,000	2,300,000
Fertilizer mixing	111,000	670,000	330,000	1,000,000
Total		2,670,000	630,000	3,300,000
Guinea (Conakry?)				
Calcium carbide	7,500	700,000	100,000	800,000
Dahomey (Cotonnou?)				
Calcium carbide	6,000	600,000	90,000	690,000
Total (all)*		55,810,000	9,240,000	64,950,000

* Does not include investment costs for the explosive plant.

of freight, insurance and handling charges of equipment, building materials and others which should be imported to set up the industries in question. Taking this into account could easily bring the total investment to the neighbourhood of 70 million dollars.[1/] At its best such a figure may be taken as an indication of the order of magnitude of the financial implications.

1/ Factors such as utilities and communications are assumed to be available in an easily developed site.

Cement

121. There are at present three cement plants in operation in West Africa: two in Nigeria (Ewekoro and Nkalagu) with production capacities respectively of 200,000 and 220,000 tons per annum; and one in Senegal (Bargny) with a capacity of 200,000 tons. In addition there are two works in Nigeria, at Port Harcourt and Enugu, grinding clinker imported from Europe.

122. A new cement works is in the course of being erected at Sokoto, in Northern Nigeria, with a capacity of 100,000 tons per annum but capable of being built up later to 200,000 tons. Another works is to be erected at Malbaza, in Niger, with a capacity of 30,000 tons. There are a considerable number of other projects for cement works or clinker grinding which are being studied or which are simply initial ideas.

123. Production capacity in West Africa is thus at present of the order of 700,000 tons per annum and this is likely to be increased to up to 900,000 tons on the basis of more or less firm projects.

124. Present annual consumption of cement in the sub-region can be estimated at about 2 million tons (of which 800,000 tons in Nigeria and 500,000 tons in Ghana). Annual consumption figures fluctuate greatly and are obviously linked with major public works projects, but a figure of 2 million tons is a fair order of magnitude. It is not unreasonable to expect this figure to increase to about 3.2 million tons in 1970.

125. It will be seen that the bulk of the cement consumption in the sub-region is from imports and, taking into account prospects of growth of consumption, there is a clear prima facie case for substantial additional cement capacity. It should be added that the 1.5 million tons of cement imported into West Africa in 1961, mainly from Europe or North America, was valued (c.i.f.) at US$34 million.

126. Despite the insufficiency of local production, a considerable number of the projects under consideration are a long way from the production stage.

Some of the studies have of course been put in hand too recently for it to be reasonable yet to expect results. Others have shown doubtful economic viability, frequently owing to the limitation of national markets. Taking into account also the lack of suitable chalk deposits in some countries, there are strong reasons for approaching the problem of cement production on an integrated sub-regional basis.

127. A policy for the building-up of cement production within a sub-regional framework must distinguish between the hinterland countries, the coastal countries without suitable chalk deposits and the coastal countries with chalk deposits.

128. The hinterland countries enjoy a natural protection against cement imported from Europe or produced at the coast. This means that production can be envisaged economically on a limited scale. All the hinterland countries possess suitable chalk deposits, well located, and since growth of consumption is likely to be relatively slow for some time to come, there is no strong case for a co-ordinated policy. On the contrary, everything should be done to create national cement industries. However, there is considerable scope for the application of new techniques for small scale production (10,000 to 30,000 tons per annum) and thus a common research policy with a view to reducing costs of production to the maximum possible extent. This applies to Mali Niger and Upper Volta. As far as the last country is concerned, the chalk in the Bobo-Dioulasso region has been definitely recognized as unsuitable. Studies should therefore be oriented towards the chalk in the Dori region, which seems capable of feeding a small works which could supply part of the markets of the three countries. In the case of Guinea, a project to set up a sizeable cement works using Siguiri chalk has been abandoned as non-economic. It would seem worthwhile re-examining the problem by studying the possibility of setting up a small works designed to supply the Upper Guinea market and perhaps the frontier regions of Mali.

129. Of the coastal countries, Sierra Leone, Liberia, Ivory Coast, part of Ghana and Togo lack suitable chalk deposits and are considering the setting up of works to grind imported clinker. It would seem more sensible to draw upon clinker produced in neighbouring African countries rather than import from Europe or the United States. Liberia and Togo, however, are thinking of importing clinker as return cargo, on the face of it an economic solution. Nevertheless, it may be expected that some 700,000 tons per annum could be obtained from neighbouring African countries.

130. Apart from Senegal and Nigeria, who are already exploiting their chalk, there are good prospects of drawing upon local deposits in Dahomey (Onigbio), Ghana (Nauli) and perhaps Guinea (if the prospection at present proceeding in the Gaoua region reveals sufficient reserves). Studies of the production of cement in these countries are still at an early stage and there are problems to be solved. The Dahomey project is handicapped by the limitations of the national market (60,000 tons). It would seem reasonable to re-examine the problem on the basis of a 200,000 to 250,000 ton works producing not only for the local market but also clinker to be exported via the new port at Cotonou to Ivory Coast and Ghana.

131. Ghana possesses suitable chalk deposits at Nauli, isolated from the main domestic market. The construction of a cement plant would require either a new railway link or new port installations. Meanwhile, Ghana is examining the possibility of establishing a clinker grinding works at Tema. It would seem useful to examine the possibility of installing a large clinker grinding works at Nauli, together with port facilities, making possible also the supplying of grinding works at Tema and at Abidjan. Finally, if the research in Guinea concerning Gaoua is successful and a cement works is set up, it could supply the coastal centres of Guinea and Sierra Leone. The suggestions made for new channels of intra-West African trade in cement and clinker depend on transport costs, and in particular on the cost of sea transport between West African ports. These costs are at present exhorbitant and indeed

virtually rule out the possibility on an economic basis of exchange of heavy products such as clinker. It would seem essential to examine carefully what would be the real costs of transport for regular and substantial trade in West Africa in cement and clinker.

Textiles

132. The West African textile market in 1963 may be approximately assessed at 1,100 million square yards, or roughly one-fifth of the total market in Africa for apparel textiles. The trend in the past fifteen years may be seen from the figures given below.1/

	1948	1955	1960	1963
Estimated market in West Africa (million sq. yards)	421	885	1,008	1,100
Approximate per capita availability (sq. yards)	7.7	14.3	15.0	15.5

133. Between 1948 and 1955 the total textile market recorded its most impressive growth, namely 110 per cent over 1948 levels. On the other hand, in the subsequent years, 1955-1963, the market increased only by 23 per cent. The average annual rate of growth during 1948-1955 was 15 per cent, and only 2.8 per cent during the succeeding years up to 1963. The latter rate, as is indicated by the per capita calculations of availability, is more a function of the growth in the populations to be clothed than of the previous tendency to consume more cloth per person.

1/ Figures of fibre consumption, exports and imports are regularly published by the FAO. These figures are available, in varying coverage, up to 1960 and 1961. Regional totals are available up to 1960. For present purposes, the FAO figures were converted into yardage by applying the standard FAO ratios, ignoring the small quantity (in Africa) of fibres going into non-cloth uses. With this as the basis, all other statistical material has been worked out independently at the ECA, and in part, derived from an earlier ECA study: Industrial Growth in Africa, A Survey and Outlook, 1962 (E/CN.14/INR/1). The application of standard ratios, it is realized, is not entirely satisfactory. This seems to be particularly true of Ghana where fabrics in use are heavier and the use of FAO ratios yields market and per capita data which are higher than actuals. Estimates for 1963 are based on extrapolation of fragmentary data, but care has been taken to avoid over-estimation. Population figures up to 1960 were derived from FAO publications, but the figures for 1963, 1970 and 1975 are crude projections made for present purposes.

134. The factors involved in this slowing down are several - and are discussed later- but it should be recognized that the slowing down in the quantitative aspects of increase has been accompanied by a shift to fabrics of higher per yard values. The shift is still of moderate size, but it nonetheless limits the importance to be attached to quantitative trends.

135. Nigeria and Ghana, between them, account for three-fifths of the West African consumption. In a broad sense, this situation has remained more or less constant over the years since 1948. Ivory Coast is the third largest market although it is a much smaller market than Ghana. Sierra Leone, and possibly some of the former French West African countries for whom it has not been possible to work out individual data, fall in the same broad group of market size as Ivory Coast, namely 40 to 60 million square yards. Other markets, such as Togo, Liberia, Portuguese Guinea, Gambia and some of the former French West African countries form the third group with markets smaller than 25 million yards per year.

136. Details of the textile market by countries are brought together below both for the latest year for which data could be worked out and for some earlier years (in million square yards):

	1948	1955	1960
Nigeria	194	406	429
Ghana	74	195	185
Sierra Leone	15	33	41
Gambia	5	8	14
Liberia	4	8	12
Portuguese Guinea	10	8	•
Togoland	4	•	8
Former French West Africa,	115	218	310
of which Ivory Coast	..	..	50

137. In 1948, the West African textile market was for all practical purposes a single-fibre market, a market for cotton goods. By 1955, rayon had made very considerable inroads into the earlier predominance of cotton, and commanded about 26 per cent of the textile market. It would appear that in the present condition of rayon technology, given the warm, humid climates in most West African countries, this was about the maximum proportion of the market that rayon could command, because the proportion of rayon declined moderately by 1960 to 24 per cent. Of course, in part, this process was aided by the imposition of higher import tariffs on rayon goods in several countries. It is also interesting to observe that in many of the smaller countries the predominance of cotton is greater than in the larger textile markets.

138. Wool, in the climatic conditions of West Africa, is statistically insignificant. Another group of fibres, namely synthetics (mainly nylon) has at present the same statistical lack of importance as wool. But basically, the situation here is similar to that of rayon in 1948, although on a lower scale of probable expansion in absolute terms than rayon commanded in 1948.

139. The West African textile market according to fibres has evolved as follows (in million square yards):

	1948	1955	1960
Cotton	408	653	755
Rayon	12	229	239
Wool	8	9	10
Synthetics	-	1	7

140. The distribution of country markets according to fibres in 1960 (in million square yards) was:

	Cotton	Rayon	Wool	Synthetics
Nigeria	317	106	4	2
Ghana	139	44	2	-
Sierra Leone	35	6	-	-
Gambia	10	4	-	-
Liberia	11	1	-	-
Portuguese Guinea	9	-	-	-
Togoland	8	-	-	-
Former French West Africa	226	78	-	5

141. The bulk of the West African requirements of textiles - perhaps some 80 per cent - is met by imports. In the case of cotton textiles, dependence on imports is the least; yet well over 70 per cent of the supplies needed came from abroad in 1963. (In the production of grey bafts, the proportion of West African production is much higher.) In the case of rayon goods, dependence on imports is perhaps as high as 90 to 95 per cent. Finally, dependence on imports of wool and synthetics is total. The dependence on imports overwhelmingly takes the form of imports of piece goods, or ready-made clothing or hosiery rather than the import of the intermediate material, yarn. In short, out of the approximate market of 1,100 million square yards in 1963, less than 220 million square yards are likely to have been made in West Africa, after making some arbitrary allowance for the small scale (in terms of absolute production) handloom industries in several West African countries.

142. Manufacturing industries on any significant scale exist mainly in Nigeria and two or three other countries, and typically take one of three forms: composite spinning and weaving mills for cotton textiles; purely weaving units (generally using imported yarns) for cotton and/or rayon goods; and hosiery factories, again generally using imported yarns. The growth of non-apparel textile industries, such as fishing nets or tyre cord, is very limited.

143. Much growth is now envisaged. Indeed, one estimate is that nearly a score of cotton textile mills are in the process of being planned. A development of significance, in this connexion, is the erection of a major finishing plant with a capacity of several million yards, some fifty miles out of Accra, in Ghana. This plant will depend upon imports of grey cloth. Nonetheless, it is clear that the projected scale of expansion, either in terms of the agreements negotiated or in terms of the targets laid down in some of the national plans, do not imply more than marginal lowering of the present import dependence. In this context, a first view is offered of the potential scale of growth that could be envisaged on a seven to twelve year basis.

144. Present West African levels of *per capita* consumption are a compounded result of many factors - habits and the lack of them, climatic considerations, income levels and so on. In any case these levels are considerably lower than would seem to be warranted by countries with similar or lower income levels. At the same time, it is clear that a number of factors are tending to limit the size of the market. First of all, there is the tendency to buy better (i.e. more expensive) cloth rather than more yardage. Secondly, there is the pressure of rival demands on the consumer's shilling or franc of which the most tell-tale sign is the small transister radio and of which the most pervasive and more genuine example is the rise in expenditure on children's education. Thirdly, there is the frequent cumulative effect of adopting western modes of dress which are more economical of cloth per 'dress', as it were, than the more elaborate traditional costumes. The latter, in turn, is supplemented by a less formal approach to the basic western modes of clothing necessitated by climate and sponsored by the easier informality of the new political elites.

145. Viewed in the foreground of this complex of factors, the quantitative response of cloth consumption to future sizes in income does not appear, in the short run at any rate, to have implicit in it anything like the 1948-55 jump in per capita levels. On the other hand, it is equally significant to note that if income sizes do move in the direction of those strata of population which to-day consume perhaps less than one-tenth of the national per capita levels, the quantitative response could become overwhelming. That this would happen at some stage in development is beyond reasonable doubt, but whatever advance movements occur in this direction, the main thrust of such an overwhelming response may well be beyond the immediate perspective of seven to twelve years, with which the projections below deal.

	Estimates of textile market - 1963	Projections of textile market - 1970	Projections of textile market - 1975
Population	71 million	80 million	90 million
per capita availability	15.5 yards	17.0 yards	20.0 yards
Total market	1,100 m.yds.	1,360 m.yds.	1,800 m.yds.

146. These admittedly tentative projections are based on the belief that the quantitative response to income changes will be slower in the immediate short-run, less slow later but exclusive until after 1975 of the kind of major change in trends which could make figures like 35 and 40 yards per head a reasonable perspective.

147. Leaving out of account the 1975 projections as not being relevant in the context of the erection time-spans of textile mills, the investment implications of a programme based on the fullest measure of import-substitution are given below. The first step is to break up the market projection for 1970 into different fibres.

Total Market	Estimates 1963 1,100 m.yds.	Projections 1970 1,360 m. yds	Basis for the break-up (per cent)
Cotton	825	950	70
Rayon	259	340	25
Wool	6	15	1
Synthetics	10	55	4

The basis used is naturally tentative, but does arise from the logic of the trends in the present textile situation.

148. Step two is to determine, however arbitrarily (because to a very large extent this would be the result of a basic planning approach), the proportion of the future market requirements that perhaps could not be or (for cost and skill considerations) should not be produced within West Africa but imported.

Fibre	Estimates for 1963 (million yards)	Projections for 1970 (million yards)
Cotton:		
Market	825	950
Estimated production in West Africa	200	855
Imports (1-2)	625	95 1/

1/ On the arbitrary assumption that 10 per cent of the needs will have to be imported because of cost or/and skill considerations.

	Estimates for 1963 (million yards)	Projections for 1970
Rayon:		
Market	259	340
Estimated production in West Africa	20	270
Imports (1-2)	239	70 2/

149. For the two small categories, wool and synthetics, no figures are being offered, although logically a much higher proportion of imports to needs would appear likely.

150. By removing the present estimates of West African output from the feasible output projections for 1970, an estimate is arrived at of the output for which industrial capacity will be needed, if it is desired to import-substitute on the scale indicated. This is done below (in million yards):

	1963 output	1970 projections of output	Additional production for which capacity will be needed by 1970
Cotton	200	855	655
Rayon	20	270	250

151. It is difficult to arrive at precise nations of investment required to achieve these additional production capacities. But judging from current African experience, the amounts involved in fixed capital alone would come to US $450 million, and this figure may be conservative.

1/ On the arbitrary assumption that 20 per cent of the needs will have to be imported because of cost or/and skill considerations.

152. One last point should be made. It would seem appropriate, within the framework of an over-all sub-regional policy of co-ordinated industrial development, to envisage that the hinterland countries should become major suppliers of textile goods not only for their own markets but also those of their coastal neighbours.[1/]

1/ These countries are also natural suppliers of meat products. A recognition that they should specialize in textile goods and meat products would go some way to achieve an equilibrium in sub-regional development.

PART III

THE DEVELOPMENT OF MEDIUM AND SMALL SCALE INDUSTRIES

153. Possibilities of further development of medium and small scale industries were included in the terms of reference of the mission. In this part of the report there is first a discussion of forest industries. No attempt is made to specify where the industries considered might be located. However, Annex VII sets out in some detail data on the manufacture of paper (based on imported pulp), composition board, furniture and plywood. Profitability profiles are also included for these four industries. This part of the report then goes on to discuss small scale industries by three groups of countries in the sub-region. Data relevant to the setting up of some of the industries suggested, together with profitability profiles, are also included in Annex VII.1/

Forest industries

154. West Africa's forest resources are among the most valuable in the world. The beautiful fine-grained hardwoods are exceptionally decorative in furniture, wall paneling and other uses. In terms of technical properties several African timber species, particularly in the areas of dimensional and structural stability, are outstandingly high by accepted world standards. The world supply of African-type timber is rapidly diminishing and the remaining resources are increasing in value at a high rate. It is a universally accepted judgment that timber processed into products at or near the source of supply has a dollar yield ten to sixteen times that of timber sold as logs.

155. It is not the objective of this part of the report to discuss or project timber volumes, value or marketing statistics. The objective is to indicate and demonstrate how the nucleus of a forest products industry

1/ The mission also collected considerable data on food processing industries. Unfortunately, its FAO/ECA agricultural expert fell ill towards the end of the mission's visits. His report will be issued later as an addendum.

can be established through the manufacture of ordinary wood-based products which could be readily sold in West Africa.

156. From the analysis of the data collected on sub-regional industrial possibilities in West Africa, the following four forest-based industries with sub-regional possibilities have been selected:

(a) Paper manufacture (based on imported pulp)
(b) Composition board manufacture
(c) Furniture manufacture
(d) Plywood manufacture.

157. Annex VII presents four tentative feasibility analyses of these industries. The data on paper and composition board manufacture are based on similar projects planned for other parts of Africa. Those on furniture and plywood manufacture are based on United States standards.

158. By accepted world standards, in order to be viable a paper pulp plant of economic size would have to produce 100 to 150 tons per day or 30,000 to 45,000 tons annually. Most basic paper pulps are produced and exported throughout the world, and the market is considered to be approaching saturation. In order to compete in terms of quality as well as price, a pulp manufacturing plant in Africa would have to have the advantages of low power cost, good water supply, a dependable supply of good quality raw materials, and economical transport. An economic sized paper manufacturing industry based on imported pulps would seem to be viable and a suitable beginning for eventual development of integrated production of pulp, paper and paperboard products.

159. Paper consumption is one of the most highly leveraged items in a developing economy. For example, consumption in the United States is over 400 lb. per capita; in Western Germany it is about 100 lb., in Venezuela it is a little more than 40 lb., in Kenya about 6 lb., and in some parts of Africa about 0.3 lb. A likely view of the growth of

Africa's economy can be readily converted into a forecast for a substantial expansion in its consumption of paper products.

160. For estimating the market potential of the projected typical manufacturing plant, it has been necessary to make several judgments and assumptions. Most important of these have been the choice of a line of products which would be compatible in the output of a single plant. The following standard products are envisaged:

Writing paper
Wrapping paper
School exercise paper
Kraft bag paper
Liner board
Corrugating medium for boxes
Chipboard
Pigmented board.

The above products have an increasing market demand and are compatible in production; they involve similar production technology, change-over in production is comparatively easy and none are coated products. Such products as printing papers, bond papers, ledger stock, cigarette papers, food container board and other speciality items that usually have a relatively large local usage, are excluded from consideration owing to special technological requirements in their production.

161. Composition board is a generic term that includes such specific products as fibreboard, chipboard, particleboard and flakeboard. Official commercial standards describe these products technically as formed panels consisting of fibres or particles of wood bonded together with a synthetic resin or other added binder. Appendix VII describes the design, processing and marketing of a highly developed and widely used panel product called flakeboard and the industrial processing opportunity it offers in Africa.

162. Of the many types and varieties of furniture products that are produced and sold in world markets, the manufacture of wooden tables, chairs and arm chairs of simple design have been selected for projection purposes. The wood and other raw materials required to produce these

products should be available in sufficient supply and at reasonable cost in the areas recommended as possible plant locations.

163. The establishment of plywood manufacturing operations of economic size at strategic locations in West Africa has definite sub-regional development possibilities. The processing of the valuable timber - at present exported as logs - into much-needed materials and products, would provide a dollar yield many times that realized at present. The unusually attractive fine-grained African hardwood veneers should find a ready place in world markets as decorative materials and products. Other species of timber would produce much needed construction materials and industrial parts. The typical plywood manufacturing plant of economic size suggested in Annex VII is designed to produce hot-pressed hardwood and softwood panels in the standard 4 ft. by 8 ft. size and in almost any required thickness.

Small scale industry possibilities in Nigeria, Chad, Dahomey and Niger

164. Nigeria is developing fast and a broad planning programme is under way and is implemented by detailed feasibility analysis of selected industries.

165. Fertilizer mixing, glass container manufacture, composition board manufacture, paper bag manufacture, corrugated boxes, tannin extract, wire nail and screw manufacture and plastic moulding are some of the industrial development opportunities which are being investigated.

166. Chad seems to have made a good start in the cattle industry and meat canning, fruit and vegetable canning, leather tanning and glass container manufacture should fit in naturally as possible industrial development opportunities.

167. Dahomey's best opportunities for industrial expansion for both medium and small scale industries seem to be initially in the food processing line; canned and smoked fish as well as edible oil processing appear to be prime opportunities.

Her Forestry Division has been investigating the growing of cashew nuts and the possibilities appear good. Annex VII outlines some general details of this industry.

168. Niger's cotton production is expanding rapidly. Some processing into yarn initially, then advancement to weaving, bleaching and printing, should be analysed for feasibility.

169. The capital investment, annual capacity and employment of some of these industries is as follows:

Industry	Annual Production	Capital investment in US$	Labour requirements	
Fertilizer mixing 1/	22,500 tons	386,000	13	1 shift
Corrugated fibre boxes	5.4 million boxes	613,600	37	1 shift
Paper bags	100,000,000 bags	208,000	13	1 shift
Tannin extracts	4,000 tons	330,000	42	1 shift
Wire nails	500 tons	43,900	4	1 shift
Plastic mouldings	648,000 lbs.	183,000	16	1 shift
Leather tanning	3,375,000 sq.ft.	298,000	53	1 shift
Leather tannery, small	92,500 sq.ft.	9,600	2	
Fish meal and fish oil	2,300 tons - meal 2,000 tons - oil	360,400	9	

Small scale industry possibilities in Ghana, Upper Volta, Ivory Coast and Togo

170. While several of Ghana's industrial plants are not at present utilized to full capacity, consideration should be given to analyzing new industries which do not require highly skilled labour and would provide a broader base for industry as a whole. It is suggested that consideration be given to ceramic dinner-ware manufacture, corrugated box manufacture, fish meal and fish oil processing and a small leather tannery . Some

data are given below.

Industry	Annual production	Capital investment in US$	Labour required
Ceramic dinner-ware	75,000 doz.pieces	175,610	31 1 shift
Corrugated fibre boxes	5.4 million boxes	613,600	37 1 shift
Fish meal and fish oil	2,300 tons - meal) 2,000 tons - oil)	360,400	9
Leather tannery, small	92,500 sq.ft.	9,600	2 1 shift

Includes working capital.

171. Upper Volta's industrial development potential is at present along agricultural lines, main crops being cotton and peanuts. Long-range plans under discussion indicate animal husbandry as a future main industry. Consideration should be given to feasibility analyses of insecticide and fungicide production, fertilizer mixing and a small leather tanner. Some data are given below.

Industry	Annual production	Capital investment in US$	Labour required
Insecticide production	200,000 gallons	48,200	6 1 shift
Fertilizer mixing	22,500 tons	386,000	13 1 shift
Leather tannery, small	92,500 sq.ft.	9,600	2 1 shift

Includes working capital.

172. Ivory Coast's industrial potential in medium and light industries lies first in the field of industries based on agriculture and animal husbandry and secondly in the field of building materials and other industries. Consideration should be given to feasibility analyses of a small leather tannery, ceramic dinner-ware, building brick manufacture, furniture manufacture, plastic moulding manufacture, composition board

manufacture and mechanical shops for light fabrication and maintenance of equipment. Some details are given below.

Industry	Annual production	Capital investment in US$	Labour required
Leather tannery, small	92,500 sq.ft.	9,600	2 1 shift
Ceramic dinner-ware	75,000 doz.pieces	175,610	31 1 shift
Furniture manufacture	29,750 pieces	57,990	22 1 shift
Plastic mouldings	648,000 lbs.	183,000	16 3 shift
Brick manufacture	6,250,000	240,000	32 1 shift

Includes working capital.

173. Togo's industrial potential in medium and small scale industries by comparison is somewhat limited. Probably the combining of some of its 825 existing handicraft industries into co-operatives would result in developing small scale industries. Insecticide manufacture and fertilizer mixing should be considered for feasibility analysis. Some data are given below.

Industry	Annual production	Capital investment in US$	Labour required
Insecticide production	200,000 gallons	48,200	6 1 shift
Fertilizer mixing	22,500 tons	386,000	13 1 shift

Includes working capital.

Small scale industry possibilities in Sierra Leone, Liberia, Senegal, Guinea and Mali

174. Analysis of the mission's field data indicates that medium scale industry in Sierra Leone should comprise the manufacture of composition board and plywood as a natural extension of the existing successful forest

industries operation. Additional medium scale industries would be tannin extract, fish meal and fish oil processing, jute bag manufacture and edible oil processing, on which some data are given. Small scale or cottage industry opportunities should include brown sugar production, handicraft weaving and fibre brooms.

Industry	Annual production	Capital investment in US$	Labour required
Tannin extracts	4,000 tons	330,000	42 1 shift
Fish meal and fish oil	2,300 tons - meal 2,000 tons - oil	360,400	9

Includes working capital.

175. Liberia's medium and small scale industrial potential is mainly agriculture based. However, the Federal Planning Agency is naturally examining other industrial possibilities. Analysis of the information gathered by the mission suggests that consideration should be given to moulded plastics, ceramic dinner-ware and fruit and vegetable canning and some data are given below.

Industry	Annual production	Capital investment in US$	Labour required
Plastic mouldings	648,000 lbs.	183,000	16 3 shift
Ceramic dinner-ware	75,000 doz.pieces	175,610	31 1 shift

Includes working capital.

176. Senegal's medium scale industry potential lies in the agricultural and food processing field and to a certain extent in other industries to supply growing population needs. Feasibility studies should be made of

plastic mouldings, clay products, building bricks manufacture, fish meal and fish oil production. Basic data are as follows:

Industry	Annual production	Capital investment in US$	Labour required
Plastic mouldings	648,000 lbs.	183,000	16 3 shift
Brick manufacture	6,250,000	240,000	32 1 shift
Fish meal and fish oil	2,300 tons - meal) 2,000 tons - oil)	360,400	9

Includes working capital.

177. Guinea's medium and small scale industry potential, on the basis of the information gathered in the limited time available, should include for feasibility determination: fish meal and fish oil production, plastic mouldings, soap manufacture, edible oil production and fruit and vegetable canning; some data are presented.

Industry	Annual production	Capital investment in US$	Labour required
Fish meal and fish oil	2,300 tons - meal) 2,000 tons - oil)	360,400	9
Plastic mouldings	648,000 lbs.	183,000	16 3 shift

Includes working capital.

178. Mali's medium and small scale industries potential for feasibility determination should include meat processing and canning, fish meal and fish oil production, a small leather tannery operation and ceramic dinner-ware manufacture. Basic data are as follows:

Industry	Annual production	Capital investment in US$	Labour required
Meat processing and canning plant	350,000 No. 2½ size cans	98,000	21
Fish meal and fish oil	2,300 tons - meal) 2,000 tons - oil)	360,400	9
Ceramic dinner-ware	75,000 doz. pieces	175,610	31 1 shift

PART IV

SOME GENERAL CONCLUSIONS

179. The essence of this report is to be found in Part II, which propounds an outline of a scheme for industrial development for the sub-region on a co-ordinated basis. In this final part some general considerations or conclusions are set out. Many of them have wider implications, and a full discussion would be beyond the scope of the present report.

180. There is danger of duplication of investment, which is particularly wasteful when domestic capital or public foreign aid is involved. pro-motion of competition is desirable, but for some time to come the primary consideration is efficient utilization of scarce investment funds of all kinds.

181. Real industrial growth deponds primarily on stimulating activity at a number of key growth points. This means the installing now of modern industries strategic for economic development, with their growth effects.

182. It has been shown that such industries are mainly large scale with a minimum size which, although smaller than is the case in the industrialized countries, is still considerable and beyond the scope of existing or immediately foreseeable national markets. Hence there is an imperative case for sub-regional co-ordination of industrial development.

183. The main proposals put forward need be referred to here only briefly: a substantial iron and steel plant on the coast supplemented by a smaller plant serving the hinterland countries; large scale production of aluminium metal in Ghana based on alumina derived from Guinea; a complex of basic chemicals and fertilizers on a carefully workedout sub-regional basis - perhaps one of the major industrial development possibilities of the sub-region; a fully worked out scheme to take advantage of the possibilities of supplying the expanding cement require-ments of the sub-region, and a comprehensive scheme, again on a sub-regionally co-ordinated basis for the development of textile production,

with special emphasis on the possibilities of specialization in the hinterland countries.

184. The implementation of this programme requires further development of transport facilities of all kinds. It also requires a co-ordinated energy development policy, particularly electric power.

185. Given this large scale industrial development programme and related growth of infrastructure facilities, the direction of expansion of trade follows logically, and is indeed a counterpart of the whole approach. Following decisions by the Economic Commission for Africa and the Organization for African Unity, there is a real impetus now towards a step-by-step development of an African common market and a payments union. The development of each sub-regional industry requires precise agreements between the countries concerned for free trade in the appropriate products and a common external tariff; full success depends on the simultaneous negotiation of a series of such agreements.

186. The mission noted a real desire on the part of almost all the governments of the sub-region to tackle industrial development along the co-ordinated basis suggested, and a realization, indeed, that without such an approach real industrial development would be impossible. But it would be wrong to underestimate the political problems which have to be solved. In any common market there is a natural tendency for development to proceed fastest at the most developed points and for the poorer areas to stagnate, or at best to grow slowly. A natural reaction is for the poorer countries to try to set up new industries, even though their national markets are too limited. In the West African sub-region there are substantial inequalities between individual countries. The absence of proved natural resources, coupled with marked geographical disabilities, means that the four countries of the hinterland (Mali, Upper Volta, Nigor and Chad) should have special consideration. Equally, Togo, Dahomey and Mauritania, although geographically more favourably placed, have a claim

to preferential treatment. Put in another way, this means that the detailed working out of a comprehensive plan for sub-regional industrial development, based primarily on the setting up of large scale industries, must mean a conscious and sustained effort to push industrialization wherever reasonably economic in the poorer countries of the sub-region. The mission sought and obtained in principle agreement from the more industrialized coastal states to support development in the hinterland countries, not only by opening their markets to goods manufactured there but also by subsidizing to a reasonable extent higher costs. This in turn means that industrial products manufactured throughout the sub-region should be sold in such a manner that buyers make some contribution to price equalization.

187. Throughout the sub-region there are mixed economies. It is public policy and there is clearly scope for a combination of government and private enterprise, including foreign enterprise. Much can be done to develop appropriate government policies, and above all the co-ordination of such policies. Throughout the sub-region, economic planning, both the drawing up of over-all development plans and their execution, is in its infancy. All governments have enacted legislation to encourage and protect private capital. Much remains to be done to harmonize this legislation to avoid wasteful competition. Some of the concessions offered appear to be unnecessarily generous, thereby depriving governments of much-needed revenue.

188. Capital is scarce, yet the real bottleneck is really well worked out investment projects, and this means particularly projects of sub-regional interest. Moreover, foreign financial participation in the larger scale projects is essential, but the governments of the sub-region are rightly concerned that such enterprises should not be under outside control. Hence it is important to attract more and more African capital, public and private. In some of the sub-regional schemes it would seem desirable for several governments to subscribe to the equity and to be represented on the boards of management.

189. There is no conflict between a policy of setting up large scale industries on a sub-regional basis and pushing hard the development of both agriculture and small and medium industries mainly for national markets. Furthermore, the smaller industries have the additional value of stimulating African entrepreneurship. Encouragement to entrepreneurship is important.

190. The whole process of industrialization advocated in this report implies a steady movement towards the harmonization of development plans and eventually a common market for the whole sub-region. Moreover, the concept of a common market for the whole sub-region is not inconsistent with the wider aim of an all-African common market.

191. The facilities offered by the United Nations, and in particular the Economic Commission for Africa, are available, if the governments concerned so wish, to follow up the proposals made in this report. These facilities take a number of forms:

(i) If there is agreement on the general principles underlying the proposals for the establishment of large scale sub-regional industries, the next step must be detailed feasibility studies. One possibility would be applications by the governments directly concerned to the United Nations Special Fund. A second would be to endeavour to interest, through the governments concerned and the ECA secretariat, teams from potential investors outside Africa. A third which might be applicable where rapid action is required, would be for the ECA secretariat to endeavour, with the aid of outside consultants as required, to carry out the work.

(ii) In other cases a government may well feel able to develop a project with some outside assistance from the United Nations. In such cases, the appropriate approach would be a request for an expert under the United Nations Expanded Technical Assistance

Programme. Sometimes, where short-term immediate assistance is required, a request for the services of an expert from the ECA secretariat or its regional advisers, or from the United Nations Industrial Development Centre, might be more appropriate. Where food or timber processing are involved, the Food and Agriculture Organization is the appropriate body, and in the case of handicraft industries, the International Labour Organization.

(iii) In other cases a government may require advice on a range of industries, in which case the appropriate approach would be a request either for experts on a short-term basis or, preferably, a small team from the ECA secretariat and the Industrial Development Centre (or the FAO and ILO in their fields of competence) or, on a longer term basis, through the United Nations Expanded Technical Assistance Programme.

ANNEX I

COMPOSITION OF MISSION

P.A. MORAWETZ	ECA consultant	Chief of mission
D. ALAGOMA	ECA	Transport
K. AWERE-KYERE	ECA	Trade
I. FALL	ECA	Statistician
J. GIRI	OAMCE	Engineering
L. GELINEAU	ECA	Transport
A. MAKONNEN	ECA	Chemicals
W.J. McCUDDEN	FAO	Agricultural industries
J.L. POINSOT	ILO	Small scale industries
L. ZIEGIE	UNESCO	Eduoation and training
M.T. ZWANENHUISEN	ECA/FAO	Agricultural industries
F.F. MEIWALD	IFC	Took part in the mission in an observer capacity

To / From	Nigeria					per Volta			Ivory Coast				
	Imports (c.i.f.)		Exports (f.o.b.)		Impor (c.i.	Imports (c.i.f.)		Exports (f.o.b.)	Imports (c.i.f.)		Exports (f.o.b.)		
	1961	1962	1961	1962	1961	962	1961	1962	1961	1962	1961	1962	
Nigeria					2,128	14		1	6	225	60	711	26
Niger		17		2,544		160		12	1	233			4
Dahomey		14	574	522	225	31		3	825	126	617	120	
Togo		1	20	46		21		3	8	1	24	167	10
Ghana	1,697	468	3,118	2,697	175	,812	4,024	5,863	214	18	101	50	7,23
Upper Volta				1					7	5	75	1,762	
Ivory Coast	169	18	4	9	982	,455	2,994	2,184					
Sierra Leone	31	8	83	57					-				
Liberia	24	22							12	3	4		
Senegal	82	45	2	44	1,611	,043	902		14,486	8,770	9,984		16
Mali					182	543		359	32	457		2,155	1,89
									17		56		

	Mali				Guinea				Total			
	Imports (c.i.f.)		Exports (f.o.b.)		Imports (c.i.f.)		Exports (f.o.b.)		Imports (c.i.f.)		Exports (f.o.b.)	
2	1961	1962	1961	1962	1961	1962	1961	1962	1961	1962	1961	1962
5	1					-			5,490	5,302	4,321	4,743
2	211	278				-			434	1,071		3,235
4	13				54	70	64		1,801	1,062	1,897	1,777
5			8				1		719	6,011	914	932
2	254	296	159	620	9	-	73		9,204	4,225	8,143	9,945
5	134	197	15	87		-	1		9,803	9,775	2,857	5,625
5	2,073	3,112	1,457	1,101	24	6	38		15,625	8,777	14,741	12,228
						12	42		217	39	150	87
		19			5	26	37		47	77	106	
	101		30		806	886	382		19,869	17,330	11,548	636
					29	75			671	1,559		3,904
9	266		206	5		-			784		814	184
9	3,053	3,902	1,875	1,723	927	1,075	638		- 64,664	55,228	45,491	43,294

ANNEX III

BILATERAL AGREEMENTS BETWEEN
WEST AFRICAN COUNTRIES

Contracting Parties	Credit facilities	Remarks
1. GHANA - DAHOMEY	Swing Credit of £500,000.	Excess over swing credit to be paid in goods or convertible currencies.
2. GHANA - GUINEA	Swing credit of $1 million.	Excess over swing credit to be paid in goods or convertible currencies.
3. GHANA - MALI	Swing credit $1 million.	Excess to be paid in convertible currencies.
4. GHANA - UPPER VOLTA	Swing credit of £9.5 million.	Excess to be settled in pound sterling or any convertible currency approved by both parties.
5. GUINEA - LIBERIA	Credit available up to $500,000.	Excess to be paid in convertible currencies.
6. GUINEA - MALI	Credit available up to 250 million Guinea or Mali francs.	Excess over credit to be paid in Guinea or Mali francs.
7. GUINEA - SENEGAL	Credit available up to $1 million.	Excess payable in convertible currencies.
8. SIERRA LEONE - GUINEA	Credit available up to £500,000.	Excess payable in pound sterling.
9. IVORY COAST - MALI	No fixed credit facilities.	Payments to be made in convertible currencies.
10. LIBERIA - GUINEA) MALI) SENEGAL)	No fixed credit facilities.	Payments to be made in $ or other convertible currencies.
11. SENEGAL - SIERRA LEONE	No fixed credit facilities.	Payments to be made in convertible currencies.
12. SENEGAL - MALI	Credit up to 2 million N.F.	

ANNEX IV

MINERAL RESOURCES OF THE SUB-REGION

Ivory Coast

The Ivory Coast is not noted for its mineral resources. The present production is limited to diamonds, manganese and a minute tonnage of colombo-tantalite.

Diamond production is by far the most important activity. The Seguela deposits produced 414,000 carats in 1962 : the production rate has decreased for the first six months of 1963 to around 100,000 carats for that period. It is thought that diamond exploration offers the most immediate benefits; apart from SODEMI, a Government agency, seven organizations of international repute are presently engaged in this work.

The country's second export is manganese. The 1962 production amounted to 107,000 tons of concentrates from the Grand Lahou, which is situated near the coast and has estimated reserves of 1 million tons averaging 46 per cent million. A new deposit with potential reserves of 750,000 tons has recently been found at Ziemoulaga in the north-west.

A small deposit of colombo-tantalite is being worked near Bouake; the annual production is of the order of several tons.

The remaining mineral resources are still in the exploration stage. A small gold deposit near ITY is quite promising and another potential gold operation is being investigated in the south-west at Issia.

The known iron ore deposits are of lesser immediate interest. A substantial occurrence is located on the eastern slopes of the Nimba range and may contain several hundred million tons of 42 per cent ore. The Sassandra ironstone deposit has been studied in detail because of its favourable location on the coast. The reserves are estimated at 200 million tons averaging 40 per cent Fe.

There are no known limestone occurrences of economic value in the territory. As regards other industrial minerals, a gravel bed has just been discovered some 25 km. from Abidjan and a big clay deposit is being examined for potential use in brick making and/or ceramics.

Dahomey

The country's mineral production is at present limited to the extraction of granite, gravel and sand for building purposes.

The only known limestone deposit of commercial interest is at Arlhan, 60 miles north of Cotonou, where the installation of a cement plant is under study. The deposit is estimated at 9 million tons, with a calcium carbonate content exceeding 80 per cent. The area is affected by seasonal flooding. The Kandi iron ore deposit in northern Dahomey contains workable reserves of 250 million tons. The mineral essays around 50 per cent Fe. with a high phosphorous content and has no economic value at present.

Ghana

Ghana has four main mineral products which are at present being exported in their entirety.

Gold production is fairly steady at around 900,000 ozs. per year representing approximately US$ 30 million. The gold mines are being managed by the State Mining Corporation which requires an annual subsidy of around US$ 5 million, with the exception of the Ashanti gold fields which accounts for nearly half the country's production.

Ghana is the second largest world producer of industrial diamonds and the third for gem stones. In 1962 the exports amounted to 3,112,000 carats.

The manganese deposits at Nsuta produced 373,000 tons of high grade ore in 1962. The reserves are considerable, but mostly low grade material:

It is expected that Ghana will not be able to maintain its position in the manganese world market much longer, unless some method can be devised to up-grade such ore. The country's fourth main export is bauxite of which 240,000 tons were produced last yeqr. A recent country survey by Kaiser Aluminium gives the total reserves as 200 million tons, of which only a 3 million ton deposit can be considered truly high grade.

The only known iron ore occurrence is a low grade deposit at Sheine in the northern region. Estimates speak of 100 million tons averaging 46-51 per cent. The country's limestone resources are considerable, but unfavourably located at Nauli: their extraction would involve serious transportation problems.

Ghana is a country of great mineral wealth which may form the basis of several industries, when cheap power from the Volta River Project becomes available. The most obvious activity would then be the transformation of alumina from Guinea, into aluminium metal and fabrications. This would appear preferable to the transformation of Ghana's own low grade and dispersed bauxite deposits. Similarly, a future national steel industry would be better served by high grade ore from Sierra Leone or Liberia, than the country's own iron ore resources of very doubtful value.

Guinea

Guinea's mineral exports amounted to US$ 31 million in 1962. The country's principal resources are iron ore, bauxite and diamonds.

The Conakry iron ore deposit is at present producing at the rate of 500,000 tons per annum. The ore averages 56 per cent Fe. together with some chromium and nickel which restricts its market. The total reserves of the Kaloum peninsula are of the order of 1,000 million tons. Several other iron ore deposits are known in Guinea and the most important one by far is the Nimba-Simandou occurrence. Exploration has hardly begun, but the tonnage is known to be considerable and estimates vary from several hundred to 1,000 million. The exposed ore is high grade, averaging 65 per cent Fe. It is estimated that US$ 200 million would be required to

put this project into the production stage, and such an investment is unlikely under present world market conditions. Furthermore, the ore will have to be exported through Liberia, using the existing Limba-Buchanan railroad and port facilities. This would require inter-governmental arrangements.

Diamond mining has declined considerably in the last few years and the production for 1962 had decreased to a value of about US$ 2 million.

Guinea has substantial bauxite deposits. One of them is worked by the FRIA Company which transforms the ore into alumina prior to exportation. This amounted to over 400,000 tons in 1962.

Bauxite was also produced at Kassa on the Laos islands. This property had been expropriated from an international group together with the Boké concession which is said to contain 600 million tons of high grade ore. An agreement has just been signed between the Government and Harvey Aluminium to work the latter deposit on a partnership basis. It would probably be advantageous to ship alumina rather than bauxite but it is doubtful whether this transformation should be advanced one more step and yet be economically profitable. The Guinean authorities are interested in eventual aluminium metal production; it is very uncertain whether the country's water resources lend themselves to the generation of cheap electric power required for this process.

Limestone exploration has been given preference in recent years but the results have been discouraging. No deposit is known which could be used economically for cement manufacture.

The prospects of Guinea's mining industry are based on its iron ore and bauxite deposits. In co-operation with Liberia and international financing, the Nimba deposit could give rise to a major industrial undertaking. As regards bauxite, the country could double its production of alumina by working the Boké deposit; the production of aluminium, however,

should not be undertaken without further studies. Last but not least, it would be in the country's interest to give a management contract to a foreign group for the extraction and export of the high grade Kassa ore.

Upper Volta

The country's one mineral producer is the Poura gold mine which produced US$ 1.5 million worth in 1962 and has limited reserves.

A titaniferous iron ore deposit is located north-east of the capital; it has a possible tonnage of 50 million averaging 53 per cent Fe. and around 10 per cent TiO_2. In the same region is a manganese deposit averaging 50 per cent Mn. with a probable tonnage of 5-10 million.

Limestone is found in the extreme north of the country near the Mali border. The isolated location and the apparent lack of water have so far discouraged a systematic exploration programme. The country is well supplied with building material. Deposits of quartzite clay abound around Bobo-Dioulasso. The dolomite deposit of Samandeni, north of Bobo-Dioulasso, has probable reserves in excess of 15 million tons of dolomite.

Upper Volta's industrialization of mineral resources might well be based on building material and the manufacture of refractories.

Liberia

The country's mineral industry is so far restricted to iron ore, all of which is being exported. This amounted to 3,100,000 tons in 1962, but is likely to increase in the present year to around 6 million tons. There are now three producers: Bomé Hill, Mano River and Nimba. The production from the first two has to be up-graded prior to shipping, whereas the Numba ore is at present high grade. Other substantial

deposits have been explored, and the fourth producer at Bong is expected to start operations in 1965.

Apart from iron ore, very little is known of Liberia's mineral resources as practically no exploration or mapping has been carried out to-date. There is recent information on two deposits which might help local industrial projects: the first is mica near Brewerville and the second consists of a substantial tonnage of very pure silica sands near Monrovia, which might serve for the manufacture of high grade glass and lenses.

Mali

The only known production is that of rock salt from Taoudeni, which is being shipped by camel to neighbouring countries, e.g.,Upper Volta and Niger. No detailed information is available regarding the deposits and the output which is probably of the order of 10,000 tons per year.

Amongst the known mineral deposits, the most promising appears to be the phosphates of Tilemsi in eastern Mali. The probable reserves are 2,500,000 tons.

Bauxite and iron ore occur in western Mali. The first is a 150 million ton deposit in the Kenieba district, while 10 million tons of magnetite averaging 63 per cent have been proved at Nioro.

Mali's known mineral resources have potential value for local industries. If hydro-electric power is developed in western Mali, then both the iron ore and the bauxite might be economically extracted and be transformed locally into more valuable products.

Mauritania

The country's best known resources are its iron ore. Fort Gouraud is a leading high grade producer but several other deposits have also been explored and might be worked at some future date. Amongst them is

the Akjoujit copper mine, which could yield several million tons of magnetite concentrates as a by-product from the treatment of the oxide and sulphide copper minerals. This project is under study at present.

A substantial gypsum deposit has recently been reported near Nouakchott. It could become an important source of this material for the sub-region.

Niger

The country produces at present a small amount of tin ore from the Air mountains. Approximately 5 tons per month are hauled to Joss, Nigeria, for smelting and shipping. The region is being prospected quite thoroughly and it does not seem likely that any substantial tin deposits will be found. Rock salt is another mineral product which at present serves local markets, as well as parts of northern Nigeria. The most important deposit is that at Kaouar, east of the Tenere desert, which at one time supplied a large part of North Africa but today cannot compete with other imports.

A small production of natron is being obtained from important deposits in the south-east of the country. They require further studies before any estimate can be made as to their industrial value.

A limestone deposit of 10 million tons has been proved near Malbaza, close to the border with Nigeria. The installation of a cement plant is under consideration. The plant would produce 30,000 tons per year and serve the needs of the Niger Republic. On the other hand, such a plant would have to be protected from the lower operating costs of the Sokoto plant across the border in Nigeria.

Small deposits of clay, kaolin, gravel and other building materials are sufficient for local housing needs.

Petroleum exploration in the north has been unsuccessful to-date and the Say iron ore occurrence is of geological rather than economic interest.

Nigeria

Nigeria has a variety of mineral resources most of which lend themselves to local transformation and thus contribute to industrialization projects. Amongst these the following may be worth mentioning :

Tin: the entire production from the Bauchi field in north Nigeria is being smelted in Joss: in 1962, 7,933 tons of metal were shipped out of the country;

Coal: the Enugu coal field is the only producer in West Africa; its present production rate is 600,000 tons per year. The coal is not regarded as of the coking type, but this statement may have to be revised as a result of extensive recent trials. Reserves are considerable and amount to several hundred million tons.

Limestone: important deposits extend right across the country and several of them have given rise to cement plants.

Lead and zinc: the Abakaliki deposits have been known for a long time. The exploitation for the export of concentrates is not an economic proposition. However, it might well be possible to mine the ore and transform it for local use, and this is being given serious consideration.

Petroleum: at present production amounts to 3.5 million tons of crude oil, and about 30 million cubic metres of natural gas per year. The latter is being used industrially in southern Nigeria.

Several other mineral occurrences appear to be deposits of economic value: amongst them are the silica sands near Enugu which could serve a glass manufacturing industry, the diatomite deposits in Bornu province, and possibly the iron ore of Lokoja which is being considered for a steel plant.

Senegal

The country's principal mineral resources are the phosphate deposits on the coast. They find a ready market because they are very high grade.

The shipping product is over 80 per cent BPL and thus very suitable for export.

The country is also an important producer of ilmenite, rutile and zircon, due to the extraction of the black sands along the coast. At present, Senegal is the second biggest producer in the world zircon. The limestone deposit of Bargny supplies a cement plant producing actually 200,000 tons per year. An important brick and tile industry is based on the clay deposits at Pout.

Senegal's iron ore occurrence on the Faleme river represents an estimated 120 million tons averaging 60 per cent Fe. The distance of 800 kilometres from the coast renders its economic value problematical.

The ilmenite and rutile production could be used by West African paint industries. Senegal might also be in a position to manufacture cement and building materials for neighbouring countries which do not have the necessary raw materials.

Sierra Leone

Mineral resources account for over 80 per cent of the total value of the country's exports. A little over half of this is due to diamonds: Sierra Leone is the second most important producer in the world for gem stones and the third for industrial diamonds. In these circumstances, a diamond cutting industry might well be worth considering.

The Marampa iron ore operation ships a 65 per cent concentrate at an annual rate of 2 million tons, which will be increased to about 2.8 million. Another important deposit which also has an estimated tonnage of about 100 million, is that of Tonkolili, whose ore does not lend itself to up-grading by presently known methods.

Sierra Leone became a bauxite producer during the second half of 1963, when the first shipment from the Mokanji Hills deposit was made. This is exceptionally high grade material averaging 57 per cent alumina.

Initial production is scheduled at 100,000 tons per year which is to be increased gradually to 400,000 tons per year. It is likely that further high grade deposits will be found.

About $5 million have been spent so far on the exploration of a rutile concession. A production project for 100,000 tons per year averaging 1 per cent rutile is under consideration. The country appears to be lacking building materials although no exact information is available on this subject.

It would seem that conditions in this country are well suited for beneficiation industries which transform local production into more highly priced products for the export market. Local manufacture or fabrication does not appear to be called for at this stage; just as the iron ore is already being concentrated to a premium grade so bauxite might be reduced locally to alumina. It might also be worth considering whether the rutile could serve a local paint industry.

Chad

Natron constitutes the country's only known mineral resource of economic value. The annual production is around 5,000 tons worth US$ 8-9 million. It is probable that this production could be increased considerably by improving mining and marketing methods.

Togo

Togo has recently joined the ranks of African mineral producers with the inauguration of the lower Togo phosphate production. The reserves are estimated at 100 million tons, yielding some 50 million tons of high grade concentrate. The plant's production capacity is around 500,000 tons of concentrate per year, but existing market outlets limit it to half that figure.

The cheap power available from the Volta dam project could be of great benefit to the Togolese phosphate industry.

Togo's Bangeli iron ore and Ahito chrome deposits are at present of geological rather than economic interest.

ANNEX V

PROSPECTION AND EVALUATION OF NATURAL RESOURCES AND RELATED PROBLEMS OF SCIENTIFIC AND TECHNICAL RESEARCH

For the prospection of resources, large scale studies are required, either for a particular resources (mineral resources, underground water, etc.), or for a region as a whole. Research programmes of this nature are at present undertaken by different kinds of foreign assistance or by the country themselves and represent a considerable expenditure; they commit the future; the choice of their scope, of their geographical coverage and of their methods is therefore of great importance for the further balanced development of the sub-region.

The starting point of such studies can be found in the documents arising out of the exceptionally active scientific collaboration which prevailed for a long time in the region considered. However, the maps and synthesis report already established or in the course of preparation in geology, climatology, etc. are in fact the results of basic research work undertaken in the last decades on a regional level. It is important that governments strengthen all formal and informal links which would enable national fundamental research institutes to work on a sub-regional scale.

The large-scale prospection of natural resources must utilize the considerable documentation available on the countries of which a first general synthesis is presented in an "Enquiry on the natural resources of Africa". It appears that the collection and utilization of such documentation justify an effort at the sub-regional level; furthermore the exchange of information, developing parallel to the progress of the studies, would result in a considerable saving of efforts.

A regional co-operation of this kind would avoid the difficulties arising out of the absence of a common strategy of resources; however, it assumes that each country has developed its own set-up for the planning and decision making in matters concerning studies and research, a set-up

which is obviously linked to the operation of a planning machinery. It is necessary therefore to create the organs of the national scientific policy in each country. For the time being this is the case only of a minority of countries in the sub-region.

The sub-region lacks almost completely institutes of industrial research (only one really autonomous and specialized is in existence). But the problems of utilization of resources, especially those linked to raw materials of animal and vegetable nature, require at least transfers and re-adaptation of techniques, even if such techniques are already known, to suit African conditions. Furthermore, new research may open the way to the utilization of new raw materials and to new outlets. The precise objectives of this type of research, which is very definitely oriented, require special structures. The creation of a research institute on natural resources covering several countries of the same ecological zone and neighbouring ecological zones would thus meet the requirements of industrialization.

Among the consequences of the lack of a national policy of research in the field of natural resources in some countries is the fact that they fail to draw all the possible benefits from the infrastructure of institutes and laboratories existing on their territory, within universities and research centres. With the view to improving the knowledge of resources in a sub-region, it would be important that the possibilities of such infrastructure be inventorized.

ANNEX VI

TRAINING OF SCIENTIFIC, TECHNICAL AND MANAGEMENT PERSONNEL[1/]

Technical education is insufficiently developed in West Africa. The missions on planning of education undertaken in some countries of the sub-region by UNESCO and the studies carried out by different institutions stress the need, both for English and French speaking countries, for a better articulation of technical education at all levels within general education, especially in secondary education. Original proposals have been made for the creation of a polyvalent secondary education with a technical content, both in urban and rural areas. Options of this kind, whereby technical education ceases to be an isolated branch, imply reconsidering the whole of the school system; some countries have undertaken or/are planning to undertake such revision. It is important, within the framework of the Addis Ababa plan, to intensify the efforts for planning the education simultaneously in all the countries of the sub-region. Thus the concentration for groups of countries of the badly needed means required, for instance for the training of teachers for technical education - a major problem in the immediate future - could be envisaged more easily.

Among the structures required for national planning, but also for the promotion of technical education in the whole of the sub-region, mentioned can be made of:

- In agency for the projection of man-power needs, especially at intermediate and higher level (a problem of statistics);
- An office having an exact knowledge of highly trained personnel (cadres), trained in the country or abroad, and of their employment;

1/ Some of the points raised in the present note will be considered at the conference on the organization of research and training in Africa in relation to the study conservation and utilization of natural resources, organized by UNESCO in collaboration with ECA for July 1964, where data concerning West Africa shall be considered.

- An advisory body attached to the Ministry of Education and specialized on technical education, comprising representatives of the interested industries and professions.

Real progress can be observed but the national situations are still heterogeneous.

In the countries of the Sahel-Sudan zone, were industries for the processing of animal products, and some agricultural products are immediately possible, efforts for technical training should be directed specifically towards these types of activities. In those countries of the coastal area which are not yet industrialized but will dispose gradually of a growing number of national cadres for primary and secondary education, the most pressingly felt need is in the field of teachers for technical education.

In almost all the countries the proportion of technical staff in urban areas is insufficient. The means necessary for technical training in connexion with industrialization must be strengthened, especially at intermediate level (technologists and technicians). Industrialization require not only personnel specialized in crafts and techniques but also managers and "entrepreneurs, i.e. personnel having a spirit of enterprise. These three categories are equally indispensable. The most suitable field for sub-regional co-operation appears to be the training of technologists and technicians, since the training of managerial personnel at intermediate and higher level belongs to national schools, within schools of administration or schools for intermediate cadres created locally or in universities. Regional institutions exist already in the field of agronomics and zootechnique. In the field of civil engineering, mining and geology, and for the industry processing agricultural products, specially chemicals, educational units of sufficient size are required to meet the cost of education at a reasonable level. Their location must be such as to facilitate to the students the necessary contacts with the realities of industry. Considering the complementary character of technology in some fields of industry and the drawbacks of an extreme specialization of

students, it is probable that the best solution be the creation of polytechnical institutes of different levels.

The language obstacle remains an important consideration for the establishment of technical relations, formal or informal. The major universities in the sub-region facilitate such contracts to some extent; and at various level the problem has been considered and the solution appears to be found through agreements of reciprocity between English speaking and French speaking countries of a more precise character or through the development of cultural agreements, on the condition however that the latter be effectively implemented through standing joint commissions.

ANNEX VII

FEASIBILITY DATA ON SELECTED MEDIUM AND SMALL SCALE INDUSTRIES

In this annex, which should be read in conjunction with part III of the report, feasibility data and profitability profiles are presented for the following medium and small scale industries:

(a) Paper

(b) Composition board

(c) Furniture

(d) Plywood

(e) Cloth bags

(f) Solar salt

(g) Glass containers

(h) Cotton yarn spinning.

(a) Paper

The paper making process selected for this projection of a typical economically sized manufacturing plant is of conventional design, consisting basically of a stock preparation system in which pulp is processed, a paper formation system employing a Fourdrinier type machine equipped with a size press and vertical collendar and correcting facilities for the manufacture of paper bags and corrugated boxes.

The processing capacity of the projected plant is designed for an initial daily production of about ten tons of gross product. For future plant expansion at reasonable cost, a paper forming machine of adequate size should be installed initially. The difference between the cost of a ten ton and a 20 ton machine is only about 20 per cent and installation costs are substantial. Accordingly for this projection a Fourdrinier machine for a 78 inch maximum trim width and a top speed of 300 feet per minute to yield twenty tons of paper products per day has been selected. All auxiliary equipment in operation with the machine has been sized at ten tons per day capacity. To raise the production to twenty tons per day additional units could be purchased.

Estimated capital investment for manufacture of selected paper and paper board products at 10 tons per day capacity

Fixed plant investment:	Installed equipment cost in US $
Stock preparation system	
Batch pulper	11,200
Batch beaters, 2,000 lbs capacity, 3 required	16,800
75 HP motors and drives, washing screens	4,200
Consistency Regulator	12,600
Refiner, stainless steel plug, 1 required	10,500
Stock chests, agitators, motors, nozzles	2,100
Centrifugal cleaners	4,200
Rotary pulp screens	
Paper machine, Fourdrinier type, 2 presses	280,000
20 drum dryers, vertical size press	
7 Roll calender stack, upright reel	
2 Roll winder, 100 HP generator and drive	
Finishing equipment	
60 inch sheeter with layboy, guillotine cutter	18,200
Converting equipment	
Corrugating machinery	63,000
Unwinding stands	
Fluting cylinder	
Laminating press	
Motors and drives	
Bag making machinery	35,000
Grocery bags, multi-wall bags	
Pumps	9,800
Total installed equipment cost	467,600

	Installed equipment cost in US $
Process piping at 40 per cent of total equipment cost	187,600
Electricals at 10 per cent of " " "	46,200
Outside lines at 5 per cent of " " "	23,800
Structural steel and painting	14,000
Instrumentation	7,000
Total plant equipment cost	746,200
Building and foundations (US$ per square feet average)	168,000
Stock preparation 8,000 " " "	
Machine room 15,000 " " "	
Converting room 8,000 " " "	
Storage 10,000 " " "	
Land and site preparation, 10 acres	2,240
Auxiliary facilities	42,000
Total physical plant cost	958,440
Engineering and construction (at 20 per cent of total physical plant cost)	196,000
Contingencies (at 15 per cent of total physical plant cost)	140,000
Total plant investment (Excluding working capital)	$1,294,440
Estimated working capital	
Raw material fiber and chemicals (2 months' supply)	42,000
Accounts receivable (1 month's production)	76,200
Operating supplies	7,000
Total working capital	116,200
Total capital investment	$1,410,640

Estimated annual fibre and chemical requirements for production of 1848 tons of specified finished papers

(In US $)

Fiber	Delivered cost per ton	Tons per year	Annual cost
Waste sulphite (bleached)	50.69	130	6,622
Virgin sulfite (bleached)	154.00	42	6,468
Waste news	29.40	775	22,820
Virgin Kraft (unbleached)	139.16	456	63,642
Virgin Kraft (semi bleached)	142.80	6	854
Waste Kraft (unbleached)	32.48	620	20,132
Waste Kraft (bleached)	72.80	80	6,118
Total Fiber		2,113	126,476

Chemicals	Delivered cost per ton	lbs. per year	Annual cost
Starch	0.15	22,000	2,186.80
Rosin size	0.05	27,000	1,360.80
Alum	0.07	48,000	3,360.00
Pigments	0.20	3,300	646.80
Total chemicals		100,300	7,554.40

Summary of paper machine productivity
(Machine trim at 60 inches)[a/]

Product grade	Average basis weight[b/]	Machine Speed (FPM)	Max. Daily Production (Tons/ 24 hrs.)	Production Efficiency[c/] %	Actual daily production (tons/ 24 hrs.)	Average Tons/hour
Writing paper	30	300	10	85	8.5	0.354
Wrapping paper	40	300	13	85	11	0.458
Exercise paper	28	300	9.5	85	8.1	0.337
Paper bags[d/]	60	225	15	85	11	0.458
Liner board	80	200	17	80	13.5	0.562
Corrugating medium	70	200	15	80	12	0.500
Cardboard (chip)	150	120	20	80	16	0.666
Pigmented paper board	90	150	15	80	12	0.500

a/ Product trim average of 60 inches; maximum machine trim width 78 inches.

b/ Lbs. of product per 3,000 square feet.

c/ Includes lost time for clean-up, grade-change and start-up.

d/ Includes grocery bags and multi-wall bags of Kraft paper.

Estimated profitability
For the manufacture of paper and paperboard products
(10 ton plant on 200 day operating schedule)

Basis:

Production

Total machine production - 1908 tons per year
Total finished produce - 1848 tons per year

Estimated capital investment:

Fixed plant investment	$1,288,000
Working capital	116,200
Total capital investment	$1,404,200

Total annual sales $471,100

Writing paper	200 tons at $308.00 per ton =	$61,600
Wrapping paper	100 tons at 252.00 per ton =	25,200
Exercise paper	380 tons at 229.60 per ton =	86,800
Packaging bags	500 tons at 266.00 per ton =	133,000
Corrugated boxes	500 tons at 266.00 per ton =	133,000
Cardboard (chip)	138 tons at 280.00 per ton =	23,100
Pigmented board	30 tons at 280.00 per ton =	8,400

Annual cost of manufacture

Raw materials			433,020
Fiber	$126,420	$133,980	
Chemicals	7,560		
Conversion cost		264,040	
Sales administration cost		280,000	
Research and Development		7,000	
Profit before taxes			$ 38,080
Income tax at 37.5 per cent			14,420
Profit after taxes			$ 23,660
Return on total capital (approximately)			1.7 per cent

Estimated profitability for the manufacture of paper and paperboard products

(10 ton plant on 300 day operating schedule)

Basis

Production

Total machine production - 2,860 tons per year

Total finished products - 2,780 tons per year

Estimated capital investment:

Fixed plant investment	$128,800
Working capital	11,620
Total capital investment	$140,420

Total annual sales from 2,780 tons of finished products		$714,000
Annual cost of manufacture		537,000
Raw materials	$201,600	
Conversion cost	293,860	
Sales and Administration cost	35,000	
Research and development	7,000	
Profit before taxes		$176,540
Income tax at 37.5 per cent		66,500
Profit after taxes		$110,040
Return on total capital (approximately)		8 per cent

Profitability

The cost of equipment and facilities and the cost of raw materials shown in the profitability analysis are estimates of prices in Africa and are likely to be as accurate as any data available without going into a detailed feasibility analysis of a given situation.

The ten ton plant (capable of expansion to 20 tons) and operated on a (short) 200 day per year schedule would return only 2 per cent on the investment based on local competitive market prices. This estimates that a 300 day per year operating schedule might return 8 per cent and a 20 ton plant might be expected to return 25 per cent on the investment.

The marketing of consumer and industrial paper products has always been considered peculiar by normal product market development standards. Availability seems to create demand and combined with lower prices the market seems to grow at a phenomenal rate.

(b) Composition board

Flakeboard is discussed here. It is an engineered product and is of the highest quality of the various composition boards. It is manufactured by a completely controlled process using a specific type of raw material without variation. The flakes are formed from green raw material and immediately flash dried to a moisture content of approximately 6 per cent. The flakes have parallel grain structure and are of uniform size. In processing, the flakes are thoroughly impregnated with quality building chemicals, such as white ant (termite) repellent and flame-proofing and coated with a bonding adhesive in an atomized chamber. This material is carefully screened in a balanced density and then hot-pressed to cure the adhesive and form the panel. In the process projected, the product can be varied to suit end use requirements and economic requirements.

Some of the product types are described below:

Five-layer board has special advantages for furniture manufacture and for industrial applications where critical edge face screw holding strength is required. It is also widely used in door and framing applications in the construction industry.

In graduated type flakeboards there is continuous graduation from coarse flakes at the centre to finer flakes at each surface. It has the highest strength properties and its high density face provides an excellent surface for finishing. This product is free from "telegraphy" - a defect of other types of board wherein large particles are often isolated in an area of small particles, so that they "show through" and thus cannot be used in such demanding applications as case stock for plastic or veneer overlays.

Homogeneous type flakeboard has the same distribution of various flake sizes throughout its thickness. Although it is not as high in strength value as layered flakeboard, it is extensively used in the building trade. Applications include roof decking, wall enclosures and floor underlayment where asphalt tile or hardwood is used.

Three-layer board with a coarse centre layer and finer surface layer is primarily used as a building material. It has excellent surface properties for finishing or overlayment. The product is also used in cabinet work, display signs and for such sports equipment as ping-pong tables. In much of the world, flakeboard has become an increasingly important material in the building industry, the furniture and case goods industry and in industrial markets. As the material becomes more widely available and knowledge of its use and handling improves, its consumption will increase partly as a substitute for lumber, plywood, hardboard and other composition boards, and partly as a result of the penetration of new markets.

In Africa, the principal markets for flakeboard are in the following four areas:

Building materials especially external siding; roofing; interior wall panels; flooring; and cases, cabinets and enclosures.

Prefabricated housing: Flakeboard can be used for the manufacture of modular sections for prefabricated housing. A typical group of such prefabricated panels would include exterior and interior walls, exterior and interior door openings, window openings and roof panels.

Furniture and case goods manufacture: chests and case parts such as drawers, sides, backs and tops; tables; chairs; beds and cribs; wardrobes and cabinets.

Industrial markets: transportation equipment such as trailers; factory uses such as storage bins and trays; signs and display; sporting equipment.

Flakeboard is highly acceptable material for the manufacture of many types of furniture. It is widely used as core material for wood veneers and other types of overlays. Part of the reason for this development has been the diminishing supply of wide and clear lumber. A secondary reason has been the reduction of cost and the opportunity to manufacture wider and longer pieces. High quality table tops, cabinet

tops, sides and backs, bed pannels, chair seats and many other furniture items are produced by "picture framing" flakeboard core parts. Two inch strips of exotic woods are edge glued to the case around the perimeter, an exotic veneer is face glued to the assembly and a backing material is glued to the underside. The resulting product is more dimensionally stable and economical than solid wood construction. The precision with which flakeboard is made avoids many of the critical defects that usually occur in overlaid products. "Telegraphing", where marks, stains, rippling and bulging occur on the surface because of improper or alien material in the core, does not occur when flakeboard is used.

At present, there is no sizeable furniture industry in Africa to use appreciable quantities of flakeboard. Later in this report an export based manufacturing possibility in furniture is described. The availability of flakeboard would greatly enhance the prospects for starting up that industry.

An industrial market for composition board products as such does not now exist in Africa. However, it is a market capable of development once the product is available. The superior qualities of phenolic resin and the strength of high density flakeboard meet many of the stringent requirements of industrial parts. Dimensional stability, product consistency and the economy of cut stock parts open up a wide variety of industrial markets for flakeboard. Composition board having the characteristics described will have substantial natural appeal in many uses; and, at competitively attractive prices, it will secure an important place in the market. However, the rate and level of growth required to quickly achieve a profitable volume, will undoubtedly require an effective programme of market development. Aggressive selling to distributors and large direct buyers should be supplemented by technical service to help customers make most effective use of the special qualities of the board and to stimulate the development of new uses and new enterprises to be based upon the product.

Composition boards are manufactured under a variety of process systems. Some are patented and sold as a complete package on a royalty basis. Other patent holders will sell equipment or license part of a system, usually the mat forming area of the processing.

Extensive laboratory research, many years of broad manufacturing experience and end use studies have clearly demonstrated that "green" wood is the best raw material for composition board manufacture. Green wood as round logs (as opposed to green saw mill waste) is preferred since it provides a sustained balance of sapwood and heartwood and continuity of type and condition of raw material. Round logs are usually stored in the open air. In dry climates, the older areas of the storage pile are sprinkled with a fine water mist to prevent excess drying. An inventory not exceeding two months' production is normal. When debarking is carried out, logs are delivered to a debarking conveyor chain in 4 foot lengths. Debarking should be as complete as possible for as little as 5 per cent bark can affect strength properties and resin consumption.

Flaking is critical in the manufacture of flakeboard. It is extremely important to use equipment and methods that will produce a flake parallel to the wood grain of uniform thickness, length and width. Flakes can be manufactured by shaving the debarked wooden logs directly, or by a more recent method of reducing the logs to a long fibre pulp chip and then flaking the chips in a squirrel cage type flaker. The green flakes should be passed through a series of vibrating screens to remove excessive fines and oversize flakes and slivers. Green flakes should be stored for as short a period as possible and then flash-dried to a moisture content of approximately 6 per cent. A gas fired rotary type flash drier appears to be the most efficient type of equipment used. Particular care must be taken in the choice of handling equipment to ensure that the dry brittle flakes are not appreciably reduced in size. Flakes are air blown from the conveyor into a horizontal drum type mixer. The resin and other additives are atomized and the entire mixture rotated through the drum, so that each flake receives maximum coverage.

The impregnated flakes should be transferred as quickly as possible into a lay-up storage bin. A number of methods and types of equipment are used to lay up the mat on a steel caul or travelling belt. A recent development using a vibrating screen with a series of proper sized punched holes seems to produce a well-balanced controllable mix. In the manufacture of homogeneous flakeboard, the mat is produced by laying up flakes without screening. For the manufacture of three layer type board, finer impregnated particles are screened out and transferred to a separate mat forming storage area. The three-layer board has each of its surface layers composed of fines to a thickness of 1/16th of an inch and the centre of the board is a homogeneous mixture. Five-layer type flakeboard is produced by separating the impregnated fines from the flakeboard mix as is done in the three-layer board process. The board has a 1/16th inch surface layer of fines on each side and a 1/16th inch layer of fines in the middle of the board. The other two layers are of homogeneous flakes. Graduated type flakeboard is produced by arranging the mat forming section of the system to screen the finer particles of the impregnated flake mix on the steel caul or travelling belt first, and then to progressively screen the larger particles on the mat up to approximately half the thickness of the finished product. The remainder of the mat is made by progressively reducing the size of the particle to fines at the surface.

A flake mat of approximately 15 inches high is laid up to produce 3/4 inch finished product. The mat on the travelling caul or belt is passed under a continuous roller that will reduce the mass to approximately 4½ inches thickness. A recent development indicates that high frequency curing can be incorporated with the pre-pressing operation to remove some of the moisture. This reduces the closing cycle of a hot press considerably.

Hot pressing is a critical part of flakeboard processing. Care must be taken to avoid too much time lapse between the application of the glue to the flakes and the closing of the press. This critical time for some resins is approximately 20 minutes. Hot pressing can

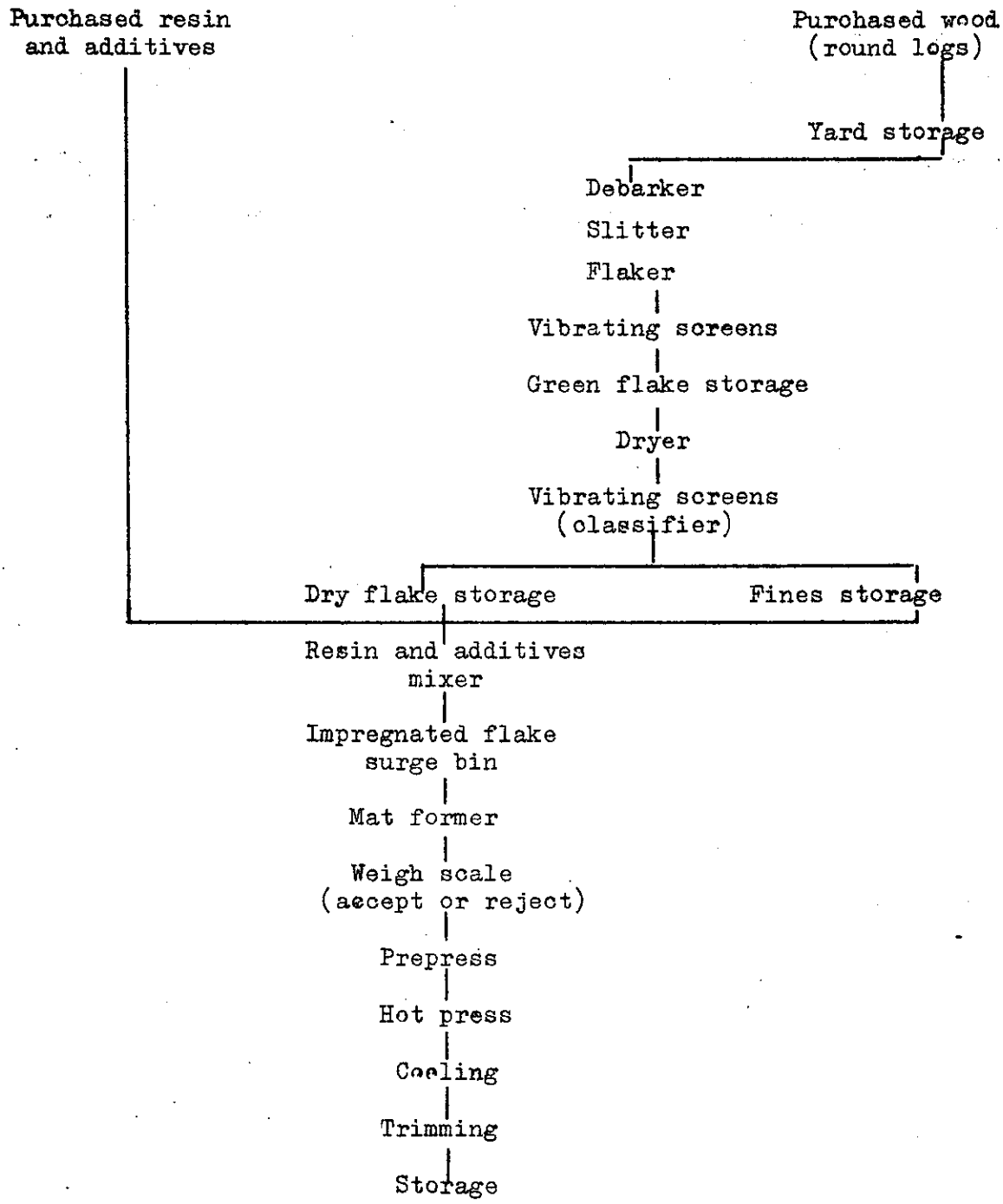
be done in either a single opening or a multi-deck press. A four feet by eight feet size for many years was the standard length and width dimension of composition boards. However, in recent years, most of the hot presses manufacture and produce boards are from 4 feet to 6 feet wide and from 12 feet to 16 feet long. The panel boards coming out of the hot press have a surface heat of approximately 150°F. Cooling is usually accomplished by blasting refrigerated air on both surfaces of the panels as they pass out on a conveyor. The panels are passed through edge saws and are trimmed to the length and width desired.

A flow chart of the production process is shown in Figure I.

FIGURE I

Composition Board Manufacture

Flow chart of a flakeboard manufacturing plant



Composition board manufacture

estimated profitability of a flakeboard plant

(24 tons per day capacity)

based on the production of 3/4 inch flakeboard

in US $

	1,500 MSF/yr. 1 shift operation		3,000 MSF/yr. 2 shift operation		4,500 MSF/yr. 3 shift operation	
	Mill price at $147,00 1/	Mill price at $196,00	Mill price at $147,000	Mills price at $196,00	Mill price at $140,00	Mill price at $196,00
Sales income	$220,500	294,000	441,000	588,000	661,500	882,000
Cost of manufacturing (from Table)	204,400	204,400	298,900	298,900	391,860	391,860
Profit before tax	16,000	89,600	142,100	289,100	269,640	490,140
Return on investment (including working capital)	2.3%	12.8%	19.6%	39.9%	36.4%	66.1%
Less taxes at 37.5%	6,038	33,600	53,288	108,413		
Net profit	$ 10,063	56,000	88,813	180,688	168,525	306,338
Return on investment (including working capital)	1.4%	8.0%	12.3%	25.1%	22.7%	41.3%
Total investment	$ $697,900		$723,800		$741,020	

1/ Per thousand surface feet.

Composition board manufacture

estimate of installed cost for a flakeboard plant

(24 tons per day capacity)

in US $

Item	Approximate cost
Major process equipment:	
Breakdown section flakers	29,400
Storage section	8,820
Dryer Section	58,800
Resin and wax section	4,900
Resin mixing and felting section	29,400
Prepress section	19,600
Hot press section	147,000
Caul conveying section	24,500
Board finishing	78,400
Mobile equipment	14,700
Total installed equipment cost	$415,520
Facilities	
Substation	11,760
Boiler section	24,500
Laboratory	3,920
Machine shop	19,600
Air conveying system	29,400
Air compressors	8,820
Electrical	58,800
Hydraulic	4,900
General piping	14,700
Instruments	980
Total physical plant cost	$177,380
Buildings and foundations	
Land and site preparation, aux.facilities at 5 per cent of total physical plant cost	

Plant investment	Total plant investment		
	One shift	Two shift	Three shift
	$675,220	$675,220	$675,220
Working capital			
Raw material wood	2,058	4,116	6,174
Raw material chemicals	3,543	7,087	10,630
Accounts receivable (1 month)	17,038	24,906	32,655
Goods in process	8,400	12,460	16,380
Sub total	31,039	48,569	65,839
Total investment	$706,259	$723,789	$741,059

Composition board manufacture

Estimated operating costs of a flakeboard plant
(24 tons per day capacity)

Manufacturing cost	Operating cost per 1,000 surface feet of 3/4 inch product		
	1,500 MSF/yr. one shift operation	3,000 MSF/yr. two shift operation	4,500 MSF/yr. three shift operation
	US $	US $	US $
Wood	8.23	8.23	8.23
Urea resin[a/]	17.91	17.91	17.91
Additives	10.44	10.44	10.44
Power and light	8.09	8.09	8.09
Factory labour supervision and fringe benefits	17.83	12.10	10.02
Operating supplies	3.43	3.43	3.43
Maintenance supplies	3.43	3.43	3.43
Depreciation	47.36	23.67	16.15
Administrative and sales expense	19.60	12.32	9.38
	$136.31	$99.62	$87.07

a/ The factory cost for exterior grade board using phenolic resin for maximum water resistance and durability would be increased by approximately $17.55 per 1,000 square feet.

Composition board manufacture

Manpower requirements

	Manpower 1st shift	Estimated cost per shift in US $	Manpower 2nd shift	Estimated cost per shift in US $	Manpower 3rd shift	Estimated cost per shift in US $
Gateman	1	0.70	1	0.70		
Yard loader	1	0.70	1	0.70	1	0.70
Barker and saw tender	1	1.12	1	1.12	1	1.12
Flaker operator	1	1.12	1	1.12	1	1.12
Dryer tender	1	1.12	1	1.12	1	1.12
Felter operator	1	1.40	1	1.40	1	1.40
Relief labour	2	1.40	1	0.70	1	0.70
Sander operator	1	1.12				
Grader	1	1.40				
Warehousman	1	1.12	1	1.12		
Carloader	1	0.70	1	0.70		
Knife maintenance	1	1.40	1	1.40		
General maintenance	1	5.60	1	5.60	1	5.60
Electrical maintenance	1	8.40				
Quality control	1	8.40				
Development engineer	1	9.80				
Clerk typist	1	3.50	1	2.80		
Foreman	1	8.40	1	8.40	1	8.40
Manager	1	11.20				
Fringe benefits to labour		17.50		6.70		4.69
	20	$86.10	13	$33.60	8	$24.85

(c) Furniture

A typical manufacturing plant to produce wood tables and chairs is projected as follows:

Production (annual)

One shift operation

21,250	chairs
4,250	tables
4,250	arm chairs
29,750	total pieces

Capital requirements	in US$
Land and buildings	$11,000
Facilities and equipment	$15,590
Working capital (including training costs)	$6,800/$31,400
Total	$57,990

Materials and supplies (annual)

Lumber (256,700 board feet)	$33,350
Nails	1,700
Woodscrews	950
Glue	850
Paint and varnish	2,150
Supplies	1,390
Total	$40,390

Power fuel and water (annual)

Electric power (app. 80 kilowatt hours per day)	500
Fuel (wood waste used)	0
Water	200
	700

Labour requirements and cost (annual, one shift)

Skilled workers	8	27,400
Semi-skilled	8	25,600
Manager and supervisor	2	14,000
Clerical	1	5,000
Miscellaneous	3	9,400
Totals	22	$81,400

Approximate annual cost of sales	In US$
Materials	39,000
Direct labour	53,000
Manufacturing overheads, AOM and sales	30,990
Discounts, bad debts and other	17,950
Depreciation	2,810
Total cost of sales	143,750
Annual sales revenue	182,750

The plant is projected to be labour intensive. The sanding will be done by hand and moulding by several passes through simple machines.

Potential users of the products considered for manufacture in this projection would be households, schools, assembly halls, restaurants, hotels, clubs, hospitals and nurseries.

Profitability

Based on the gross sales revenue of $182,750 and the annual cost of sales of $143,750, the annual profit before taxes would be approximately $39,000 or about 22 per cent. The annual return on investment before taxes would be about 69 per cent.

(d) Plywood manufacture

Production:

Annually 5 million square feet based on 3/8 inch thickness measurement

The projected manufacturing plant is designed to be labour intensive and to make the maximum use of practical inexpensive equipment. The veneer dryer is one-third the capacity of the rest of the equipment and should operate on a three shift basis. Production can be increased by lengthening the existing dryer or by adding a second drying unit.

Capital requirements	In US$
Land and buildings	124,000
Equipment and facilities	254,000
Working capital (including training costs)	84,800
Total capital	$462,800

Materials and supplies (annual)	
Logs for 5 million sq.ft. plywood estd.	150,000
Glue	40,000
Supplies	8,000
	$198,000

Power, fuel, water (annual)	
Electric power connected load app. 150 hp	3,000
Fuel (wood waste used)	0
Water	500
	$3,500

Labour requirements and cost (annual)		
Skilled workers	4	17,000
Semi-skilled workers	24	78,000
Unskilled workers	16	48,000
Manager and supervisor	2	18,000
Clerical	3	14,000
Miscellaneous labour	3	10,000
		$185,000

The Manager and Supervisor should have reasonable experience in the manufacture of plywood and together with 4 skilled workers especially trained in an existing plywood plant, they should be able to handle all the necessary training of the rest of the labour force. Normally the new plant should work up to full production within three months.

(e) Manufacture of cloth bags for agricultural products

The development of an industry to produce cloth bags for the handling, shipment and storage of agricultural produce offers an agricultural production opportunity in addition to a manufacturing opportunity. The use and demand for cloth bags has steadily increased in recent years despite the competition of multi-wall craft paper bags.

Cloth bag industries can be viable, placed in strategic locations and produce sufficient quantities of variable products on demand at equal or lower cost than imported products.

The following projection outlines in general terms a typical plant of economic size manufacturing soft fiber cloth bags. The data and information have been officially accepted in the planning of industrial projects in many parts of the world.

While there have been varying degrees of success in the economics of the growing and processing of soft fibers such as kenaf, ramie jute and others it is generally accepted that the production of fibers is not a serious handicap. There is much successful experience to draw from and many problems have been overcome by the blending of different types of fibers and the careful selection of proper strains.

The weight of the yarn and the density can be varied to suit end-use requirements and double wall sacks can be produced for critical requirements.

Markets for the production of this type of plant are usually based on agricultural production and processing in specific areas and the bags are sold in bulk to substantive producers of agricultural products.

Profitability

Based on the gross sales revenue of US$285,600 and the annual cost of sales at $223,000 the annual profit before taxes would be $60,000 or about 21 per cent. The annual returns on investment before taxes would amount to about 35 per cent.

It must be borne in mind that the above estimates are based on fixed assumptions of location, power cost and labour rates and an annual production of approximately 700,000 cloth bags, and that profitable plants can be built for less investment and lower production.

The cloth bag manufacturing plant is projected as follows:

Production - 700,000 bags per year (one shift)

Capital requirements

Land and building		US$ 35,500
Equipment and facilities		82,750
Working capital		38,300
	Total capital	US$ 156,550

Materials and supplies (annual)

Fiber (jute)	' 826,735 Lbs.'	US$ 115,740
Plant supplies		7,600
		US$ 123,340

Power, fuel and water (annual)

Power connected load 134 hp.	4,000
Fuel	775
Water	300
	5,075

Labour requirements and cost (1 shift)

Skilled workers	1		5,000 (annual)
Semi-skilled	3		9,000
Unskilled	18		36,000
Manager	1		7,000
Clerical	2		4,000
	25	Total	61,000

Approximate annual cost

Materials	115,740
Labour	50,000
Manufacturing overhead	23,680
Administration and other	10,560
Sales cost	13,000
Depreciation	10,020
	223,000

Annual sales revenue (estimated) US$ 285,600

(f) Salt production (solar process)

Introduction

Salt is produced in the solar process by pumping sea water into especially prepared earth beds or vats that are graded for efficient drainage and are situated to attract maximum sun and wind for evaporation purposes.

The first crop of salt is usually left as a base for subsequent crops which are harvested after a layer of approximately 3 to 6 inches has accumulated. The salt is then washed dried and ground for bulk shipment.

The above product is known as crude salt and requires refining for some industrial uses and human consumption.

The annual capacity of the projected plant is approximately 23,000 tons. The labour force will be occupied on a one shift basis.

Capital requirements	In US$
Land and buildings	43,000
Equipment and facilities	105,000
Working capital	53,700
Total capital	$201,700

Materials and supplies (annual)	
Water is the only material required normally at no cost	0
Supplies	3,000
Total	$3,000

Power, fuel and water (annual)	
Power 20 hp connected load	400
Fuel 480,000 of oil (for dryers)	24,000
Water (for sanitary and fire uses)	100
Total	$24,500

Labour requirements and cost (annual)			
Skilled workers	8		32,000
Semi-skilled workers	6		19,200
Unskilled workers	20		60,000
Manager and Supervisor	2		14,000
Clerical	1		4,000
Miscellaneous	3		16,000
	40	Total	$145,200

Approximate annual cost of sales	
Materials	0
Labour	111,200
Manufacturing overheads	72,300
Administrative and other	18,600
Sales expenses	34,000
Freight-out, Travel, discounts, etc.	19,000
Depreciation	11,700
Total	$269,800

	In US$
Annual sales revenue	$345,000

Profitability

Based on the gross sales revenue of $345,000 and the annual cost of sales of $269,800, the annual profit before taxes would be about $75,200.

(g) Manufacture of glass containers

Glass containers are articles of very common use and in many instances in the countries the Mission visited the flow of available low-cost nutritious foods, fruit and vegetables and beverages are entirely prevented or severely hampered by the lack of supply of containers.

While normally a metal container plant will require a lower investment and produce more units at a lower cost, a glass container industry should be investigated in detail as the most practical for the products and markets discussed.

The use of glass containers for fruits and vegetables, fruit and vegetable juices - coffee, soft drink, beer and other alcoholic beverages, medical and toilet preparations is growing throughout the world and in developing countries the establishment of suitable sized industries would encourage and indeed in many instances would be the factor that would originate or expand many of the industries and markets mentioned above.

The glass container plant mentioned in this report can economically produce the required quantity and variety of sizes and shapes of containers to suit a maximum of the requirements of small and large industries and home canning of most of the countries considered. Glass containers are at present shipped all over the world by large scale producers. However shipping costs are rather high and the variety of shapes and sizes is limited.

A typical of economic size glass container plant is projected as follows:

The plant projected below could produce 6000 tons of glass products annually. The quantity of course depends on sizes and shapes of the many varieties expected to be produced.

To a certain extent the design and selection of equipment for a glass container plant depends on the analysis of the raw material available. However, the following plant with small alteration will suit most situations.

Capital requirements

To produce 6000 tons of products on a three shift basis costs are based on US prices

Land and buildings		US$ 251,000
Equipment and Facilities		812,550
Working capital		139,600
	Total	$1,203,150

Materials and supplies (annual)

The principal raw materials for container glass manufacture are sand, soda ash, limestone and feldspar. Sand and limestone are produced in most countries. Soda ash, feldspar and chemicals may have to be imported but are readily available in world markets.

In addition broken glass (cullet) is required in the manufacturing process to facilitate melting of the mix; rejected glass is used as cullet. Occasionally special chemicals are added as oxidizing agents, colouring agents and de-colouring agents.

Sand 3,500 tons	28,000
Soda ash 1,190 tons	47,600
Limestone 980 "	31,350
Feldspar 294 "	11,770
Cullet 1,050 "	10,500
Supplies 1,050 "	7,400
	$ 136,620

Power, fuel, water (annual)

Power -	connected load 800 hp.	
	Stand-by diesel power 350 kw. incl.	US$ 15,000
Fuel -	App. 450,000 gals. bunker B oil	
	App. 105,000 gals. diesel oil	32,000
Water -	16 million gal. per year	18,000
	550 gals. per min. required	
	Most of this re-used	
		US$ 65,000

Manpower needs and cost (annual 3 shift)

In regard to training requirements the melting operations need at least 5 skilled men and while glass forming is semi-automatic it will require at least 3 skilled men. It is suggested that one man for each of the above operations should be sent to a similar existing plant to be trained for a six month period so that they in turn can train the others.

The Manager and Chemist should be recruited from the glass industry and have sufficient and proper background to train the supervisors and semi-skilled help.

Skilled	8		52,920
Semi-skilled	14		73,920
Unskilled	21		86,240
Miscellaneous labour	7		38,600
Office	5		19,000
Manager, Supervisors	6		54,000
	61	Total	$ 324,680

Approximate annual cost

Materials	US$ 129,220
Labour	213,080
Manufacturing overhead	170,600
Administration, sales and other	196,250
Depreciation	90,850
	US$ 800,000
Annual sales revenue	US$1,140,000

Profitability

Based on the annual gross sales revenue of $1,140,000 and the annual cost of sales of $800,000 the annual profit before taxes would be $340,000 or 29.8 per cent. The annual returns on investment before taxes would amount to about 28.3 per cent.

A typical economic lot size

(h) Cotton yarn spinning

The cotton yarn produced in the following projected plant is designed to produce yarn with a higher twist usually used for weaving rather than knitting and using a larger staple cotton than the knitting yarn. The plant is designed to produce 1,560,000 pounds of yarn annually on a three shift operation.

Estimated capital investment requirements	In US$
Land and buildings	80,500
Equipment and facilities	797,000
Working capital	145,900
Total capital requirements	$1,023,400

Materials and supplies (annual)

Cotton (estd.) 1,800,000 lbs.	620,000
Packaging	5,000
Supplies	5,000
Total	$630,000

Power, fuel and water (annually)			In US$
Electric power connected load app. 70 hp.			6,000
Fuel, 9,000 gallons (US or IMP.?)			600
Water, approx. 800,000 gallons			200
	Total		$6,800

Manpower needs and cost			
Skilled workers	7		25,200
Semi-skilled	17		54,400
Unskilled	8		24,400
Manager and Supervisors	3		22,000
Clerical	2		8,000
Miscellaneous labour	2		7,000
	39	Total	$141,000

In regard to training, the manager and supervisors must be fully experienced and they, together with two skilled workers, should be able to train all other workers and reach full production within two months.

Approximate annual cost of sales	In US$
Materials	625,000
Labour	103,600
Manufacturing overheads	48,800
Administration costs	40,000
Sales cost	24,000
Depreciation	83,700
Total	$925,100
Annual sales revenue	$1,170,000

Profitability

Based on the annual gross sales revenue of $1,170,000 and the annual cost of sales of $925,100, the annual profit before taxes would be approximately $24,900.