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DEVELOPMENT OF NATURAL RESOURCES: PROGRESS REPORT

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## I. INTRODUCTION

1. The by now familiar basic argument about economic growth is that it means increases in the physical output of goods and services (to meet the needs of the mass of the African population). These increases must inevitably come from the application of relevant factor inputs to the conversion of raw materials, extracted from primarily African natural resources, into semi-finished and finished products. The relevance of factor inputs is thus broadly determined by the natural resource base and more narrowly by product choice. There are three levels of natural resources from which complementary raw materials are drawn: national and multinational, regional and world. It is the range of effective complementarities that determines the scope of production possibilities and therefore the range of product choices and hence the speed and scope of diversification of production.

2. At the national level therefore the range of complementarity rests on the scope and reliability of information on exploitable natural resources. This information is also essential for identifying effective complementarities at the multinational, regional and interregional levels except that two additional factors are required: (a) marketing capabilities and (b) transport and communications infrastructure.

3. Thus the range of product choices within Africa as a whole depends firstly on the scope and intensity of work at the national level on the compilation, evaluation and dissemination of information on national natural resources/raw materials. It is this that accounts for the increasing interest in national and regional natural resource maps and atlases in other parts of the world. It depends, secondly, on the extent to which the regional transport network is designed to facilitate the least-cost movement of raw materials in bulk in one direction and the least-cost movement of semi-finished and finished products, especially engineering goods, in the other direction. A much greater understanding is needed of how far transport costs in a region as large as Africa can aid or undermine the effective participation of individual countries in rapid industrial development and structural transformation of the region as a whole.<sup>1/</sup>

4. At the national level therefore the highest priority is the compilation of information on known natural resources <sup>2/</sup> including the training of nationals in

<sup>1/</sup> Increasing prices in the 1980s for the delivery of heavy minerals may favour the location of new mining operations in areas permitting the lowest delivered cost of product to the customer. At the end of 1979, 50-75 per cent of the delivered United States price for Australian ilmenite and 34-45 per cent of the delivered United States price for Australian zircon was related to freight.

<sup>2/</sup> "Known" here covers resources identified as existing right down to resources (e.g. minerals) whose reserves have been fully evaluated in quantity and quality.

natural resources/raw materials inventories and management. If this is to be actively pursued a ministry should be charged with the responsibility for co-ordinating and pushing on with this work. Thus in so far as external assistance, including that of ECA, is concerned anything which can be done to provide Governments with capabilities in this field is of first importance.

5. A very important but little recognized factor is that most Governments and indigenous business communities in Africa are unfamiliar with simple information on complementarity of raw materials and other inputs into the production of specific products, i.e. with the "physiology of production". Unless this weakness is rapidly repaired the matching of demand for and supply of natural resources/raw materials will be severely limited. Actually this is a simple task: to compile and make widely available such information to planners, policy-makers, parastatals and other appropriate indigenous agents of production. At the present time policy-makers, planners and agents of production are confused by limiting attention to only one well-known natural resource/raw material at a time and are frequently inhibited by being told that nothing can be done with "it". There is a minimum density of information on feasibilities (broadly interpreted) required to activate entrepreneurs. It is not merely that the one-at-a-time approach leads nowhere, alternative end-uses of any one resource/material are frequently also unknown. Unfortunately, African universities do not offer courses either in manufacturing technology - an amazing deficiency in the face of 20 years of repeated declarations of the intention to build up a manufacturing sector - or in the science and technology of materials so that policy-makers and planners could have ready at hand specialists to advise them on complementarities, substitution, recycling, etc.

6. As regards marketing mechanisms it is clearly a matter of urgency to decide on and establish mechanisms to facilitate intra-African trade in industrial raw materials. In conventional terms these exchanges have great advantages and disadvantages. The financial aspect of marketing need not be as formidable as it seems because of the potentially substantial role of after (which is far more widely used than is apparent).

7. It will have become clear that the building of inventories at the national level is also a condition of the effective participation of individual countries in intra-African production and trade, where this goes beyond the existing structure of production.<sup>3/</sup>

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<sup>3/</sup> It does not seem to be fully obvious that traditional export products were never intended by Governments for intra-African trade and that non-export crops were not so intended either. In almost every case new or expanded production is involved.

8. Furthermore, the inventory also provides the basis of regional programmes for natural resources exploration, evaluation and management.

9. As is by now well recognized remote sensing is a supplement, not a substitute, for conventional ground level techniques of exploration and evaluation of resources. However, conventional methods are undergoing such rapid improvements that the time may be here for a series of seminars/workshops on modern methods of exploration and evaluation of groundwater resources, hydrocarbons, forest resources, marine biological resources, etc. One of the outstanding trends is the development of portable (back-packed, hand-held, or motorized) equipment. It is not unlikely that the day is not far off when back-packed or hand-held equipment will be carried and read by school drop-outs and the readings entered in simple or even crude, large-scale, local maps. This may include scintillometers and other equipment for first stage testing of geographical and geological indications and sampling of vegetable cover, streams, atmosphere, etc. The essence is to simplify equipment and readings down to the level of a relatively abundant factor - labour - rather than attempting to raise the level of education of large numbers of workers to the level of sophistication of modern equipment. High school and university students during their year of national service, for example, could be given intensive short courses and deployed in selected areas for intensive ground coverage. Very large areas of ground can be quickly covered and promising oil and mineral bearing areas indicated for further, more detailed and more sophisticated work. To facilitate this the geological and cartographic services would have to be very differently organized than at present in African countries (where they tend to cluster in one or two towns) and extensive use would be made of mobile laboratories and of hydrofoils. The essence of the plea made here is for Africans to break away from fixed conventional concepts of natural resources exploration and evaluation and to make use of an imaginative mix of techniques from local information to advanced technologies. Africa will never get far by waiting for UNDP to finance bits and pieces of surveys here and there. Perhaps one ought to find out how China is doing it. In any case African institution and associations of cartography, geology and minerals should be invited to organize a seminar on these possibilities.

10. Nigeria is now making use of laser photography for the inventory of its forest resources. Ground sampling could easily be carried out by trained forest rangers. Even university and high school students could - with some training - be used in vacation time for a concentrated ground sampling programme. The point at issue is that some fresh thinking and experimentation is needed on the subject of rapid methods of inventory and evaluation of the natural resource base which optimizes the use of expensive human and technical resources.

## II. CARTOGRAPHY AND REMOTE SENSING

11. Cartography, which embraces both surveying and mapping, is a sine qua non for other activities relating to the judicious planning, exploration, exploitation and rational utilization of the natural resources for the benefit of the whole community. It is therefore a gateway to meaningful development of natural resources.

12. In spite of the certainty that Africa is endowed with enormous natural resources, very little is known of their exact location, type, size and extent. In such a situation, it is not easy to carry out further exploratory studies which will assure effective and efficient planning and development of those natural resources of reasonable quality and quantity and assess their economic value before going into their exploitation on a massive scale.

13. It should be borne in mind, therefore, that the rapid development of the natural resources of any nation inevitably depends on the type of maps and cartographic services available. Maps are needed for planning highways, air fields and water development and are basic to the recording of geological, soils, energy, population and other data. The primary purpose of making maps for natural resources survey and development is therefore to enable national Governments to gain a fuller and more specific knowledge of their own natural resources with a view to developing and using them in promoting economic development.

14. Remote sensing, one of the off-shoots of space technology, is a relatively new scientific "tool" which, when properly used, may serve as a complement to existing tools for investigation, exploitation and utilization of natural resources. This new technology, which is a science as well as an art for obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area or phenomenon under investigation, utilizes electromagnetic energy sensors that are operated from air-borne and space-borne platforms to assist in inventorying, mapping and monitoring earth resources. The quest for rapid development of Africa's natural resources, believed to be bountiful, must look for modern techniques or technologies that will respond to the need for quick transformation of those natural resources.

15. In its present stage of development, this technological tool has proved very efficient and effective in its application in the spheres of navigation, cartography, communications, agriculture, geology, geography, forestry and the monitoring of changes in the environment.

16. The role of cartography and remote sensing in the economic development of the natural resources of member States is somehow found difficult to appreciate by many, not only because these complementary disciplines are not themselves "natural resources" that can be exploited and developed like minerals, energy, water etc. but also that they are seen as playing only second fiddle in the developmental processes, and hence usually rated very low among the areas that ought to be given priority in the allocation of funds in the national budgets. This should not continue to be so if a solid foundation is to be laid for the judicious and meaningful development of Africa's natural resources.

17. Following the attainment of political independence in some countries in Africa in the early 1960s, the succeeding years witnessed a vacuum in basic services created by the mass exodus of the "colonial masters". In some cases equipment and valuable data were also carried away with the result that planning and development of the resources were adversely affected. Retrieval of such equipment and data was difficult, and when they were released, most times it was too late for the actions for which they were intended. In the field of cartography the situation is still gloomy. At the end of 1981, less than 40 per cent of the cartographic establishments in Africa can meet the basic cartographic needs of member States. The remaining 60 per cent are either ill-equipped (in terms of skilled indigenous manpower and equipment, infrastructure etc.) or are wholly dependent upon external sources even for basic services. Most times only part of those needs are met through bilateral technical assistance; counterpart staff are often not available and skills cannot be transferred.

18. It was in order to ameliorate this situation and be able to spread the knowledge of modern and more efficient techniques of exploration and evaluation of natural resources that the Economic Commission for Africa sponsored the proposal to establish multinational cartographic and remote sensing centres in the region. Today, two regional cartographic centres and five training and user assistance centres in remote sensing have been established. Regrettably, these centres which were established at the request of member States suffer from inadequate numbers, effective members and financial support (through payment of their contributions to the annual budgets of the centres). They are therefore unable to fulfil the purpose for which they were established. The result is that the interests of donor countries wane and their assistance is either totally withdrawn or considerably reduced. The viability of the centres and, hence their existence, is greatly threatened.

19. One of the primary objectives for convening the United Nations Regional Cartographic Conferences for Africa, four of which had been held in 1963, 1966,

1972, and 1979, with a fifth coming up in November 1982, and the philosophy behind the considerable emphasis laid upon institution building in the chapter of the Lagos Plan of Action, in the field of cartography and remote sensing were to assist member States in developing their national cartographic and remote sensing services so as to reduce the degree of dependence upon external sources for basic services (thereby paving the way for self-reliance and self-sustenance), and to speed the knowledge of modern and more efficient techniques of exploration and evaluation of their natural resources. To achieve these, member States must demonstrate much more than at the moment their seriousness of purpose through their effective participation in, and prompt payment of their contributions to the budgets of the centres. Thus, the centres will be fully operational and meet the aspirations for adequate indigenous manpower, acquisition of modern and more efficient techniques and various types of accurate and up-to-date maps vitally needed for the development of natural resources.

20. The United Nations has in the past attempted to document the global amount of work that has been done in surveying and mapping but not much was done for the African continent to bring all studies together in such a comprehensive manner as has been undertaken by ECA in its cartographic inventory for Africa project. The inventory has been an exercise which has revealed that the countries themselves often do not know what they actually have in terms of survey records for natural resources or even scientific studies.

21. With the experience gained by ECA in the preparation of the inventory, it is now possible to call on member States individually to carry out an inventory which will bring together records of activities of their different national surveying and mapping organizations. Out of national inventories it will then be simple to up-date the continental inventory that was started in 1976. It is unfortunate to mention that work on the Cartographic Inventory for Africa project has been suspended for lack of funds. Ten out of 12 atlases should be completed by June this year. Therefore assistance or financial support by member States would be appreciated to enable the completion including the printing and dissemination of the remaining two atlases.

### III. MINERAL, LAND AND SOIL RESOURCES

#### A. Introduction

22. The economic development of Africa, in the foreseeable future will for many countries be directly linked with improvement and structural development in the agricultural sector, but mineral resources are also of great importance. For the



agricultural sector itself the three most crucial factors influencing productivity and development can be summarized as follows:

- (a) Resource (inclusive of technology) availability and use;
- (b) Agricultural development policy and farm organization;
- (c) Investment levels.

23. This section briefly examines the resource situation, concentrating on mineral land and, soil, resources for agricultural development in Africa. Planning for increased productivity, and more specifically for increasing food supply in Africa, would have to take into consideration the essential factor inputs and factor productivity as these relate to optimal use situations, without which the future social and political stability as well as the economic independence of Africa would clearly be frustrated.

24. Concerning the mineral resources, the Government of the majority of developing countries in Africa have made sustained efforts, often with some United Nations bodies like UNDP, to set up physical and institutional infrastructures to meet their countries' interests. These efforts are laudable but, with few exceptions, mineral development has had relatively less impact on socio-economic development than it should because of:

- (a) Inadequate infrastructures;
- (b) Mismanagement;
- (c) Policies pursued by the producing countries or by the foreign mining companies;
- (d) External orientation of economies of countries in terms of financing;
- (e) Fluctuation of mineral raw material prices;
- (f) World demand, etc.

25. In spite of their willingness to exercise full sovereignty over their mineral resources, member States still rely on external actions from transnational corporations or bilateral or multilateral organizations to develop their mineral. Accordingly, at the first Regional Conference on the Development and Utilization of Mineral Resources held in Arusha, the United Republic of Tanzania, in February 1981, ECA member States adopted some recommendations to improve the situation regarding the development of mineral resources in Africa, which can be considered as lines of action for the African Governments.

#### B. Mineral resources

26. The African region has great potential in terms of mineral resources (table 1)

and many African countries are among the main producers of minerals in the world (table 2). They produce raw materials needed for the steel industry (cobalt, chromium, iron ore and manganese), various non-ferrous base mineral raw materials (copper, lead and zinc and tin) raw materials for light metals (bauxite, magnesite and spodumene), precious mineral raw materials (gold and silver) nuclear and electronic mineral raw materials (beryllium, selenium, etc.) fossil fuels and mineral raw material needed for chemical and fertilizer industries and for construction and ceramics industries.

27. The development of these resources has not effectively contributed to the socio-economic development of the countries because of a number of domestic and external factors including poor and inadequate infrastructures, mismanagement policies pursued by the producing countries and/or foreign mining corporations, external orientation of economies of countries in terms of financing, fluctuation of mineral raw material prices, world demand, etc.

28. However, the last 20 years have witnessed a big change in the field of mineral development in Africa. Before independence, African countries through the colonial administration allowed the staking of large concessions by individuals and companies at nominal fees. For example the large mines in the central African copperbelt covering Zaire and Zambia were developed by such companies. This was followed by the establishment of huge transnational mining companies as a result of the: decline in the world demand for mineral resources after the War and depletion of many rich ore deposits followed by the increase of financial requirements for exploration of large but low-grade mineral deposits.

29. With independence, the newly emerging nations, desirous of exercising sovereignty over their resources, began to take control over some key decisions affecting mining operations in their countries as well as those connected with mineral marketing. They imposed higher taxes and royalties in order to maximize the revenue derived from their non-renewable resources, took out some share participation in the mining companies and in some cases nationalised the mining companies. This was followed by a drop in mineral exploration activities on African countries undertaken by the transnational companies, which, for considerations of political and financial stability, transferred those activities to some areas of the world like Canada and Australia, considered as "good and stable areas" for mining activities.

30. To try to overcome these difficulties, African countries, particularly those with mineral resources endowments, established governmental departments (geological surveys, mining departments) for the management of their resources and State corporations oriented more specifically towards trade in mineral

Table 1. Value of African mine production in 1978

Substance	Developing Africa		Total Africa		Rank
	Value \$US million	Percentage	Value \$US million	Percentage	
1 Crude oil	30 701.4	31.0	30 701.4	66.73	1
2 Natural gas & condensate	1 542.8	4.1	1 542.8	3.35	3
3 Copper	1 276.8	3.4	1 506.8	3.28	4
4 Diamonds	930.1	2.5	1 466.1	3.19	5
5 Phosphate rock	876.3	2.3	937.4	2.04	7
6 Iron ore	522.8	1.38	779.8	1.70	8
7 Uranium	352.4	0.93	583.4	1.27	9
8 Bauxite	310.7	0.82	310.7	0.68	12
9 Gold	214.1	0.56	4 585.1	9.97	2
10 Cobalt	190.2	0.50	190.2	0.41	14
11 Coal	145.5	0.38	1 206.5	2.62	6
12 Manganese	117.6	0.31	318.6	0.69	11
13 Nickel	112.2	0.30	188.7	0.41	15
14 Tin	105.6	0.28	136.7	0.30	17
15 Asbestos	103.4	0.27	232.4	0.51	13
16 Lead	97.5	0.25	97.5	0.21	19
17 Zinc	55.1	0.15	75.4	0.16	20
18 Chromite	54.5	0.14	181.5	0.390	16
19 Salt	54.1	0.14	63.6	0.140	
20 Silver	51.9	0.13	68.7	0.150	
21 Fluorspar	12.6	0.033	37.9	0.082	
22 Tungsten	10.7	0.027	10.7	0.023	
23 Soda ash	9.9	0.026	9.9	0.021	
24 Baryta	7.2	0.019	7.4	0.016	
25 Colombite- tantalite	6.0	0.016	6.0	0.013	
26 Graphite	5.5	0.014	5.6	0.012	
27 Vanadium	4.8	0.013	139.8	0.300	18
28 Kuolin	4.7	0.012	7.3	0.016	
29 Pyrites	4.4	0.011	18.0	0.040	
30 Mercury	4.2	0.011	4.2	0.010	
31 Antimony	2.7	0.007	19.8	0.043	
32 Platinum	-	-	532.0	1.156	10
33 Kyanite	-	-	10.3	0.022	
Other substances	13.6	0.036	37.1	0.081	
Total	37 895.8	100.00	46 003.5	100.00	
Value of world mine production in 1978: \$US 478 917.9 million					
Developing Africa:			7.9 per cent		
Total Africa			2.6 per cent		

Sources: Annales des mines, novembre-décembre 1980.

Table 2. Africa's share of world totals (percentage)

Substance	Africa			Developing Africa			South Africa		
	Reserves	production	consumption	Res.	Prod.	Cons.	Res.	Prod.	Cons.
	Res.	Prod.	Cons.	Res.	Prod.	Cons.	Res.	Prod.	Cons.
Oil and condensate	9.4	9.9	2.0	9.9	10.2	1.6	..	-	0.4
Natural gas	8	1.6	0.5	8	1.6	0.5	-	-	-
Coal <u>a/</u>	6	3.7)	2.9	0.9	0.2	0.2	5.2	3.5)	2.7
Uranium <u>b/</u>	23.5	28.7		10.1	17.0	-	13.4	11.7	
Iron (steel)	11.9	7.2	2.2	7.3	4.1	1.5	4.6	3.1	0.7
Copper	14.0	17.6	0.9	13.2	14.9	0.3	0.8	2.7	0.6
Tin	11.2	5.5	1.6	10.6	4.3	0.6	0.6	1.2	1.0
Lead	7.0	4.9	1.7	3.0	4.9	0.9	4.0	-	0.8
Zinc	11.0	4.0	1.8	3.0	2.9	0.7	8.0	1.1	1.1
Bauxite	43.0	15.6	0.9	43.0	15.6	0.6	-	-	0.3
Manganese	53.3	32.1	NA	11.6	11.5	NA	41.7	20.4	NA
Chrome	97.0	41.5	4.1	26.0	8.5	NA	71.0	33.1	NA
Nickel <u>c/</u>	10.2	8.7	0.8	7.5	5.2	-	2.7	3.5	0.8
Cobalt	45.2	67.5	NA	45.2	67.5	-	NA	NA	NA
Tungsten	0.6	1.4	NA	0.6	1.4	-	-	-	NA
Titanium	32	3	NA	25	-	-	7	3	NA
Lithium	10	10.9	NA	10	10.9	-	NA	NA	NA
Colombium	9.5)	3.5	NA	9.5)	3.5	-	NA	-	NA
Tantalum	67			67					
Phosphates	70	26.3	2.6	69	24.2	1.3	1	2.1	1.3
Diamonds	NA	72.3	NA	NA	54.3	NA	21	18	NA

a/ Lignite and peat are not included in the figures for production and consumption.

b/ The figures are world totals, except that the centrally planned economy countries have been excluded.

c/ Total identified resources.

resources. But while it is one thing to assert that an African country with mineral resources should stand on its own feet and be self-reliant organizing its own development programmes undertaken by its own experts, it is another thing to translate this into practice. For the national surveys and State corporations suffer from lack of qualified personnel and even in countries where local expertise seems to be available the countries still find it necessary to bring in people with special skills for specific tasks. The development of mineral resources also requires heavy capital investment and most of the time the African countries with known mineral resources either have to invite private capital to come in and develop the resources or establish joint ventures with multinational companies. Moreover during the last decade, the countries have found themselves in a very difficult position with regard to securing resources for mineral projects as international finance sources were generally not interested in them for the reasons quoted above and even some multinational companies were not able to finance mining projects.

31. The objective to be achieved in order to develop mineral resources, the type of development, its rate and the means to be used for this development constitute a mineral development policy which is necessary before mineral resources management can be put into effect. Unfortunately some African countries do not have a mineral development policy and most of the time, those which have mineral policies inherited them from a legislation often common to a group of countries developed under colonialism. The mineral policies in African countries are only in exceptional cases reflected in the national development programme and with the exception of a few countries like Algeria which had set up an intergovernmental committee on minerals, in many African countries, planners and decision-makers often operate in isolation and are not aware of their countries' mineral potential and its possible contribution to the development of the economy. A mineral development policy is necessary for government control over the exploitation and marketing of its mineral resources and African countries should have or develop a mineral resources development policy consistent with their national concerns and objectives.

32. The efforts made by African Governments to develop minerals are laudable, but the achievements are not yet enough. In that connexion, the first Regional Conference on the Development and Utilization of Mineral Resources in Africa, held in Arusha, the United Republic of Tanzania, during February 1981, adopted some recommendations which can be considered as lines of action for Governments of member States, to improve the situation regarding the mineral resources development. Those recommendations cover a number of areas, including:

(a) Building of technical knowledge of the mineral resources base (State geological and mining services should be considered as part of the basic infra-

structure for economic growth and should therefore be given high priority and adequate resources to strengthen technical capabilities; member States should review and update national legislations in order to provide a modern framework for the exploration, evaluation and extraction, processing and marketing of minerals);

(b) Development of national capabilities for mineral extraction and processing and for marketing of mineral products (establishment and/or strengthening of State mining corporations, processing and marketing enterprises);

(c) Development of intra-African market for minerals and mineral products (national machinery and capabilities for negotiations of trade agreements on minerals and mineral products of interests should be strengthened);

(d) Development of manpower;

(e) Development of national mineral regulations and mining and processing equipment industries (indigenous companies should be established for intra-African production and marketing of equipment, implements, tools and other supplies for medium and small-scale mining);

(f) Research and development (national corporations should be established for negotiating the transfer and use of imported technology);

(g) Creation of financing, investment and insurance, institutions (member States should contribute to the establishment of their institutions);

(h) Protection of the environment (countries should include appropriate environment protection provisions in national mining legislation).

### C. Land resources

33. Land resource ownership and use constitute one of the most important, if not the most limiting, factor for agricultural productivity in Africa, especially under conditions of stagnant mediaeval agricultural technology used in most African countries. One of the most limiting factors in planning land use in Africa is the extremely meagre data available either at national or subregional level on existing and potential use of land resources. This dearth of information has to be corrected urgently, if the land resource potential of Africa is to be fully exploited.

34. In table 3 below estimates are given for the land use pattern observed for the different ecological areas of Africa. The total land area of Africa can be roughly divided into three major land uses; arable land, pasture and forestry and others occupying 230, 711 and 636 million hectares respectively with arable land constituting only 15 per cent of the total land area.

Table 3. Land use in Africa (1975)

Ecological subregion	Arable land	Crop area	Major food crop area <sup>a/</sup>	Other crop area <sup>b/</sup>	Crop area as percentage of arable	Pasture	Forest etc.
- millions hectares -							
North Africa	39.2	25.6	17.7	7.9	65.3	85.0	100.2
Sahel	43.4	13.6	13.0	0.6	31.3	137.1	56.7
Western Africa	69.4	39.0	28.9	10.1	56.2	55.1	80.1
Central Africa	19.2	7.3	4.9	2.4	38.0	73.1	238.6
Eastern and Southern Africa	59.1	33.1	25.1	8.0	56.0	361.0	160.7
Total	230.3	118.6	89.6	29.0	-	711.3	636.3
Percentage of arable	100	51.5	38.9	12.6	51.5	-	-

<sup>a/</sup> Cereals, rootcrops, pulses and groundnuts.

<sup>b/</sup> Industrial crops and other foodcrops.

Source: FAO, Regional Food Plan for Africa, (ARC/78/5), (July 1978).

35. The global land use in 1975 indicates that some 52 per cent of the arable land was under crops. In all the subregions, except for North Africa, the arable land resources considerably exceed the area under crops. The subregional cropping pattern varies from 31 per cent of arable land in the Sahel to a high of 65 per cent in Northern Africa which enjoys a Mediterranean-type climate. Variations within subregions are also significant.

36. Recently FAO-UNESCO completed a world soil resources map and FAO is now making a detailed analysis of the information (FAO agro-ecological zone study) to assess the production potential of world land resources. This exercise, which is at an advanced stage, will give some detailed information on Africa. For instance the potential arable land in Africa is given at 636 million hectares,

and the potential arable land reserve is 433 million hectares (or 68 per cent of the total potential). This regional picture, however, hides the country-to-country variations. The arable land-to-man ratio is tight in a few countries such as Burundi, Egypt, southern Uganda, the Kikuyu country of Kenya and Rwanda.

37. Thus, for Africa, with a relatively static mediaeval technology, a growing population and large unutilized arable land, increases in agricultural and food output have come about largely as a result of extension of arable land. Clearly, this strategy has not been adequate even for generating enough food supply to meet current food demands. In the immediate future this strategy of land expansion is likely to come under severe pressure.

38. Although the land resource potential seems to be large, the exploitation of these reserves requires large investment of infrastructural development and eradication of human and animal diseases. Given the present level of technology, it is also correct to assume that the reserve lands are of lower quality and the cost of developing them would be relatively higher than land now under use. Furthermore, land degradation in most African countries is high and the share of cultivated land exposed to major degradation hazards (erosion, salinity, desertification) is increasing at a frightening rate with desertification as a major cause of degradation. The need to arrest land degradation and indiscriminate land exposure and to check erosion, leaching and all forms of land misuse cannot be over stressed. Simultaneously it must be emphasized that access to land for increased productive use must form the cornerstone of a progressive agricultural policy in all countries of Africa.

#### D. Soil resources

39 The soils of tropical Africa<sup>4/</sup> are not as fertile as is often thought. In general, tropical soils have low natural fertility of fragile consistency and difficult to operate and maintain when compared to temperate soils. An ECA/FAO publication puts the situation as follows:

"Broadly speaking, the great majority of African soils are chemically poor, and even very poor. Their organic matter content and their exchange capacity are very low, .... The nitrogen and phosphate contents are normally not high, and, in the savannahs, the phosphate content is particularly low. The savannahs, the phosphate content is particularly low. The savannah also lack sulphur, and the forests lack potassium and magnesium"<sup>5/</sup>.

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<sup>4/</sup> FAO-UNESCO, Soil map of the World, vol. VI, Africa, UNESCO-Paris, 1977.

<sup>5/</sup> United Nations, African agricultural development, E/CN.14/342, New York 1966, p. 18.



40. Large areas covered with dense rain forests have a favourable climate but their soils, usually of the ferralsols, aerisols and ferrah arenosols types, have a low natural fertility. After deforestation they are extremely susceptible to degradation through leading erosion, disappearance of organic matter and accelerated diminishing fertility.
41. Soils (such as yermosols, yerosols, regosols, vertisols and fluvisols) found in the dry regions of Africa are said to be chemically rich but nitrogen is a limiting factor. Extensive areas with poor drainage occur in the Niger and the Congo basins and in the southern region of the Sudan, and often in many valleys in the humid and tropical zones. They can be used for rice cultivation and pasture but are difficult to manage for other crops.
42. Savannahs or dry forest found in regions between high forest and semidesert zones seem to be more suitable for arable farms because of their soils, such as chromic and ferric luvisols, vertisols (black cotton soils), planosols and arenosols, which have a richer chemical composition and receive sufficient rainfall. However, the morphology of luvisols and the heavy precipitation in these zones facilitate rapid erosion which must be kept under control. Vertisols are poorly drained, and the arenosols of Senegal, the Niger and Chad often lack nutrient elements and water absorbing capacity and occur with iron pans.
43. Highlands such as those in Ethiopia and Lesotho often have a basement of volcanic rock, and if not eroded have fairly favourable humus soils as found with andosols, ferralsols and nitosols.
44. The mediterranean climatic types of northern and southern Africa have rich soils (luvisols, chromic cambisols, calcareic and eutric cambisols and kastanozems) and are generally more suitable for cultivation. But erosion can be severe and often produced lithosols.
45. Reflecting on the soil situation in Africa, three major areas of activities call for urgent development action, namely: (a) the need at the national level for a comprehensive soil map survey and crop pattern; (b) research into soil fertility levels and supplementary fertilizer needs (artificial and natural fertilizers); (c) policy incentives for appropriate and optimum crop-livestock combinations in the different parts of the African region.

#### IV. WATER AND IRRIGATION

##### A. INTRODUCTION

46. The importance of water resources development is essential for the over-all economic and social development of all nations, in sustaining life itself, in contributing to the increase of food and fibre supplies, in improving health and the environment and in turning out other resources needed by man.

47. The uneven distribution of water resources in the various parts of the continent presents a major difficulty and therefore requires concerted action leading to a plan for the optimum utilization of water resources under a well considered policy and programme.

48. The Lagos Plan of Action provides guide-lines for water resources development in specific areas of high priority such as: establishment of national water committees; formulation of national water plans in the area of drinking water supply and agricultural water use; in the identification, preparation and implementation of water supply and irrigation projects as well as the establishment of subregional river/lake basin organizations for the integrated and rational development of common resources.

##### B. Availability of water resources, their development in high priority sectors and action recommendation

49. The limited surface water resources of Africa are far from evenly distributed in the different parts of the continent. Nearly 50 per cent of the total surface water resources of the continent is in one river basin, namely, the Congo basin; while 75 per cent of the total water resources is concentrated in eight major river basins, namely the Congo, the Niger, the Ogoone (Gabon), the Zambesi, the Nile, the Sanga (the United Republic of Cameroon), the Chari-longene (Lake Chad basin) and the Volta. Comprehensive development of these basins is therefore of paramount importance if Africa is to exploit its water resource potential fully.

50. The relative scarcity of water and its highly uneven distribution over the various parts of the continent and at different periods of the year constitute the three major constraints of the water resources in Africa. The relative abundance of water in the equatorial zone of Africa in the Congo and the other major basins contrasts with a total lack of water in the Sahara and the Kalahari to the south, with varying degrees of sufficiency or insufficiency in the intervening

areas. The savannah belt lying between the humid equatorial belt and the deserts of the north and the south is also most vulnerable to periodic severe drought.

51 It is necessary at any stage in a country's development to take an inventory of available and potential water resources, water uses, excess of water and any deficiencies through time and space. Acquisition of such basic data in the first instance would facilitate sound planning for the integrated and rational development of water resources in various sectors. Secondly, available water resources need to be closely related to soil potential for efficient land use, and thirdly a comprehensive arable land potential (both rainfed and irrigated) map for optimum agricultural productivity is necessary.

### C. Institutional arrangements

52. At the national level. The creation or strengthening of national institutions to co-ordinate all water-related activities is a prerequisite and efforts are being made in this regard by about one third of the African countries according to recent information. The information reveals that some countries have established committees, commissions and councils with responsibilities defined by a decree or constitution.

53. Similar action should be undertaken by countries which have not as yet done so. Such steps at the national level would facilitate and promote joint action in the integrated development of shared water resources.

54. At the subregional level. Only about five of the 54 international river and lake basins in Africa have some form of an organization responsible for multi-purpose development such as agricultural water use, hydropower, flood control, navigation, recreation, combating desertification and environmental control, fisheries and municipal and industrial water supplies. In order to have sound and integrated development leading towards rational utilization of common resources, including inter-basin transfer of excess water, it is necessary that member States should immediately start negotiating among themselves to establish the requisite legal institutions.

55 Master plans in the sector of water supply and agricultural water use. An important strategy to provide a perspective on future development approaches is based on the formulation of national master plans and river basin plans to which a number of countries in the region have been attaching considerable importance and keen interest. Efforts being made by the countries need to be continued to ensure that they pass from the stage of general planning to the stage of detailed project planning and implementation.

Table 4. Average annual water balance of Africa and the world's regions

Authors:	Baumgartner			USSR Monograph			Lvovich, <sup>a</sup>		
Year	1975			1974			1974		
Region	P	E	R	P	E	R	P	E	R <sup>b</sup>
Africa	20.7	17.3	3.4	22.3	17.7	4.6	20.8	16.6	4.2
Europe	6.6	3.3	2.8	8.3	5.3	3.0	7.2	4.1	3.1
Asia	30.7	18.5	12.2	31.2	18.1	14.1	32.7	19.5	13.2
Australia	7.1	4.7	3.4	7.1	4.6	2.6	6.4	4.4	2.0
North America	15.6	9.7	5.9	18.3	10.1	8.2	13.9	7.9	6.0
South America	28.0	16.9	11.1	28.4	16.2	12.2	29.4	19.0	10.4
Antarctica	2.4	0.4	2.0	2.3	0.0	2.3	111	....	....
Land area <sup>a</sup>	111.0	71	40	119	72	47	113	72	41
Oceans	385	425	-40	458	505	-47	412	453	-41
World	496	496	0	577	577	0	525	525	0

a/ Values are adjusted upwards to include Antarctica for comparison with corresponding volumes derived by the other two authors.

b/ P -- Precipitation  
E -- Evaporation  
R -- Run-off

Source: ECA, Problems of Water Resources Development in Africa, Regional report United Nations Water Conference, Africa Regional Meeting, Addis Ababa 20-24 September 1976 (E/CN.14/NRD/WR/1/Rev.2), annex 1.

56. At the stage of planning in the preparation of master plans it is important that the sectoral plans should be integrated to form part of national planning for economic and social development. For example the targets for expansion of irrigated areas need to be integrated into an over-all agricultural strategy for increased production along with other inputs. Similarly the targets for drinking water supply and sanitation should be closely linked and integrated with the plans for agricultural development and human settlement projects.

57. In the sector of water supply and sanitation, surveys have revealed that many countries have not prepared their plans for the International Water Supply and Sanitation Decade which were to be ready between 1977 and 1980 for

implementation during 1981 and 1990, the Drinking Water Decade. It has also been noted that the sector has not received high priority by the majority of the countries and therefore a substantial increase is required in national commitments as well as technical and capital co-operation to register the needed improvement. This is particularly important as the pace of development in the sector does not in many countries cover the rate of population growth. It is therefore necessary to make a radical reorientation in policies, plans and projects. In view of this the Lagos Plan of Action calls for member States to identify and prepare bankable water supply projects without waiting for the formulation of national master plans.

#### D. Irrigation potential

58. The uneven geographic and seasonal distribution and the unreliability of precipitation makes the development of the water resources of Africa a prerequisite for the development of agriculture. One of the main reasons for the instability and chronic food problems of Africa is the major dependence on rainfed agriculture which is subject to the vagaries of nature. Although the water resources of Africa as indicated above are relatively small and unevenly distributed within the region, even the little that is available is yet to be used on a significant scale to increase agricultural productivity.

59. At present irrigated agriculture is insignificant. It is estimated that in 1980 only 6.7 million hectares (5.8 per cent of cultivated land)<sup>6/</sup> were under irrigation compared to the estimated potential irrigable land of 115 million hectares. Irrigation plays a significant role however in Egypt, the Sudan, Morocco, Madagascar and Algeria. Irrigation is also relatively important in the economies of Mali, Senegal, Nigeria, Somalia, the Libyan Arab Jamahiriya, Tunisia and Sierra Leone. The increase in irrigated area during the last decade is of the order of one million hectares and the target for 1990 is an additional 3 million hectares.<sup>7/</sup>

60. The aggregate demand for food in developing Africa is projected to grow at an average rate of 3.5 per cent, while the supply on the basis of moderate assumptions is projected to grow at an average rate of a mere 2.5 per cent yearly which indicates an increasing food deficit to be covered by rising food imports.

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<sup>6/</sup> According to the World Bank report Accelerated Development in Sub-Saharan Africa (1981), formal schemes with full water control irrigated area amounts to only some 2.5 million hectares of which 65 per cent is in the Sudan and a further 15 per cent in Madagascar in Sub-Saharan Africa.

<sup>7/</sup> ECA study on land and water resources survey for irrigation in Africa, 1980.

61. The ECA study on land and water resources survey in Africa showed that adequate attention is given to irrigation development by some Governments with the help of bilateral and multilateral organizations. It was also noted that 15 countries in Africa needed as a matter of priority assistance for the identification of irrigation projects.

62. Table 5 shows the extent of irrigation and the potential for expansion in some African countries for which information is available. Although the reliability of the statistics on irrigable area could not be ascertained, the table nevertheless demonstrates the existence of large areas suitable for irrigation in all the countries listed.

63. For the Third Development Decade, in "Agriculture: Toward 2000", FAO had proposed a growth rate of 1.9 per cent per annum, a slightly lower figure than the estimated 2.0 per cent trend. The reason given for the deceleration of irrigation development was to give more attention to repair, (in many African countries because of a relapse in maintenance of irrigation facilities a major rehabilitation programme has become essential), modernization and completion of existing schemes; to allow for expected resistance of farmers to many of the changes involved in reorganizing tertiary distribution systems and the need to consolidate fragmented holdings; and lack of trained manpower for the planning, execution and management of irrigation schemes.

64. Because of the high cost of irrigation development the crops to be planted have to be high yielding and of high market value. Food crops generally do not normally pay under irrigation farming and for a successful irrigation project adequate and timely provision of all complementary inputs and incentives to participants is a must. Thus the institutions for this purpose need strengthening. Where food crops such as wheat, rice, legumes and vegetables are being irrigated vertical integration (production, processing, packaging and marketing) processes have proved more effective and profitable.

65. It is suggested that countries at an early stage of irrigation development should start with pilot schemes which could provide the required experience and skills in the construction and management of irrigation. Part of the success of the Gezira irrigation scheme in the Sudan is attributed to the careful prior research and pilot schemes carried out.

66. With the development of irrigation facilities adopted agricultural production and improved production techniques can be intensified. This however is greatly influenced by the land ownership and tenure structures. Land ownership and tenure structures that permit a more equitable distribution of income are needed.

Table 5. Cultivated and irrigated areas in some countries of Africa  
(in thousand hectares)

Country	Total area <sup>1/</sup>	Cultivable area <sup>1/</sup>	Irrigable area <sup>2/</sup>	Irrigated <sup>1/</sup> area (1980)	Percentage irrigated of irrigable area
Benin	11 262	575	42.9	19	44.3
Botswana	58 537	1 360	35	2	5.7
Egypt	100 145	2 838	5 000	2 850	57.0
Ethiopia	110 100	13 730	1 818	55	3.0
Ghana	23 002	2 720	1 200	22	1.8
Ivory Coast	31 800	3 800	47.6	26	54.6
Kenya	56 925	2 270	200	46	23.0
Libyan Arab Jamahiriya	175 954	2 564	260	140	53.8
Malawi	9 408	2 290	112.6	10	8.9
Mali	122 000	2 050	1 101	100	9.1
Nigeria	98 300	23 990	15 000	25	0.2
Sierra Leone	7 174	566	28.4	6	21.1
Sudan	237 600	7 515	4 090	1 700	41.6
Swaziland	1 720	154	57	30	52.6
Uganda	19 365	5 610	92.8	5	5.4
United Republic of Tanzania	94 509	5 140	536	62	11.6
Upper Volta	27 380	5 633	152	5	3.3
Zimbabwe	89 058	1 631	148.4	60	40.4

Source: 1/ FAO Production Year Book, 1980.

2/ ECA, Problems of water resources development in Africa, Regional report, United Nations Water Conference, Africa Regional Meeting, Addis Ababa 20-24 September 1976 (E/CN.14/NRD/WR/1/Rev.2).

67. One of the great dangers in irrigated farming is the concentration of salts that results from poor drainage systems. Large areas of land have been ruined in India and Pakistan by salinity problems. This could be avoided only by proper planning and management of irrigation projects. Ad hoc irrigation efforts could endanger future irrigation development.

In order to attain the objectives for food self-sufficiency and self-reliance, member States which have irrigation potentials should make concerted efforts in the identification, preparation and implementation of irrigation projects as called for in the Lagos Plan of Action.

68. It is seen from the foregoing that, while some efforts have been undertaken to harvest the development of the bountiful land and water resources in Africa, the pace of development so far made is not adequate. This is attributed to various constraints, the majority of which could be resolved by the Governments themselves.

69. The attainment of the objectives of the Lagos Plan of Action requires a series of measures especially with respect to legislation and administrative regulations, the planning and management of resources, the choice of development priorities, mobilization of public and private funds as well as co-operation and co-ordination with other Governments and international organizations.

## V. LIVESTOCK, FISHERY AND FORESTRY

### A. Livestock resources

70. In Africa, livestock are kept for multiple purposes: as a source of high quality protein food, clothing, the provision of draught power, on-and-off-farm transport, manure for soil fertility maintenance and for fuel, store of value (security), capital investment and enhanced social status. In the drier and savannah regions where pastoralism prevails, livestock raising is the basis of the social and economic life of the people.

71. The livestock population in Africa (excluding South Africa) in 1980 numbers about 154 million cattle, 12 million camels, 123 million sheep and 147 million goats. There are also a large number of horses, mules and donkeys. There is about one animal per individual (see table 5).

72. Livestock densities (in cattle units)<sup>8/</sup> per inhabitant range from 0.03 in Burundi to 5.3 in Somalia. The highest livestock densities are found in Somalia (5.3), Namibia (4.2) Botswana (3.9) and Mauritania (2.4) and the lowest in Burundi (0.03), Sao Tome and Principe (0.05), Gabon (0.06), Liberia (0.06), Zaire (0.06), Mauritius (0.07), Egypt (0.07) and Cape Verde (0.07). The average for the continent is 0.52.

73. Livestock productivity in Africa is extremely low. Beef and veal production per animal per annum ranges from 7 to 183 kg. Chad, Ethiopia, Guinea and

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<sup>8/</sup> Cattle units = 1.0 cattle, 6 sheep and goat and 0.5 camel.



Mali produce less than 10 kg per animal. The highest producers are the Ivory Coast and Egypt (61 kg), Liberia (100 kg), the Libyan Arab Jamahiriya (183 kg), Reunion (45 kg), the Congo (28 kg), Mozambique (26 kg), Tunisia (28 kg) and Zimbabwe (25 kg). Africa (excluding South Africa) averages 14.8 kg/animal. Per capita productivity of beef and veal range from 1 kg/person in Mauritius to 58.5 in Botswana. The average for Africa is 6.2 kg per inhabitant, which compares unfavourably with 37.3 kg per inhabitant for the World (see table 6).

74. It has been estimated that 50 to 200 head of African cattle are required to produce 1 ton of meat whereas semi-intensive grassland production systems in Australia and Argentina produce 1 ton of meat from only 20 head <sup>9/</sup>. While Africa has one eighth of the world cattle population it produces only one twentieth of the world's meat production. Annual offtakes average less than 10 per cent, and mortalities in young animals claim up to 50 per cent. African herds produce less than 20 per cent of the milk they could produce if management and technical innovations which are already practiced elsewhere in the world were applied <sup>10/</sup>.

Table 6. Livestock population in Africa by subregion, (1980)  
(in millions)

Subregion	Cattle	Camels	Goats	Sheep
North Africa	26.6	3.3	25.6	59.1
West Africa	32.0	1.7	49.5	35.2
Central Africa	8.3	0.4	5.6	4.7
Eastern Africa	84.8	7.1	37.7	46.4
Great Lakes Community	2.7	-	4.3	1.3
Total	154.4	12.5	122.7	146.7

Source: FAO, Production Year Book, 1980.

<sup>9/</sup> ILCA, The First Years, Addis Ababa, Ethiopia, 1980, p. 7.

<sup>10/</sup> Ibid.

Table 7. Comparative livestock productivity for Africa and selected other Countries, 1980

Country	Beef and veal production kg per head of cattle	Milk production kg/country
Africa	14.8	491
United States	90.0	5 386
Argentina	52.2	1 982
Netherlands	81.5	5 019
EEC	70.2	3 480
Japan	68.4	4 366
World	37.3	1 927

Source: FAO Production Year Book, 1980.

75. Average milk production for Africa is 491 kg/cow/annum. The lowest milk yields expressed in kg/cow/annum are obtained in the Ivory Coast (84), Liberia and Togo (100), the Central African Republic (110), Benin (120), Mozambique and Sao Tome (170), the Upper Volta (182) and Mali (199). The highest producers also expressed in kg/cow/annum are Egypt (704), Zaire (838), Algeria (978), Zimbabwe (2 053) and Mauritius (2 300). Most African countries range between 200 and 400.

76. These are several factors explaining the deplorable level of livestock productivity in Africa. A few of the major ones needing urgent attention include the following:

- (a) Poor inherent genetic factors;
- (b) Lack of an adequate research and systematic breeding programme;
- (c) Unscientific management and feeding practices;
- (d) Overgrazing, overstocking, and poor pastures;
- (e) Lack of control of trypanosomiasis and other endemic, epizootic and epidemic livestock diseases; control of trypanosomiasis alone according to FAO would release some 10 million km<sup>2</sup> of land for livestock raising. This zone has

an additional carrying capacity of 120 million head of cattle producing \$US 5 billion worth of meat annually;

(f) Inconsistent agricultural policy and a pathetic agricultural industry;

(g) Lack of co-operation at the subregional and regional levels for the control of population, livestock movement, health and sanitation.

77. The livestock situation in Africa is a very disturbing one, but still more disturbing and rather perplexing is that the situation is likely to get worse as a result of the apparent indifference of many African Governments to their livestock and their livestock husbandry men. This unwholesome attitude cannot be dissociated from the general malaise of the agricultural industry as a whole on the continent. A sustained thriving livestock industry in any country, sub-region, or region is only feasible, along with other things, under conditions of surplus supply of grains. In Africa, grain happens to be the largest food import item and, in spite of efforts to generate the awareness of African Governments to the problem of food supply, very little is being achieved. This paradoxical situation is unfortunately being perpetuated: poor domestic food supply, increasing food imports, deplorable livestock industry and a frustrating agricultural industry.

#### B. Fisheries potential

78. Although accurate statistical information on the fisheries stock of African waters is not readily available it is felt that present levels of exploitation are far below the potential. A study for ECOMAS indicated that in 1974 fish production from both marine and inland sources of ECOMAS countries was only a third of the potential harvestable fisheries resources of the subregion. As high as 2 million tons are additionally caught within the EEZ<sup>11/</sup> by foreign-based vessels operating in the subregion. These catches are never landed at the coastal ports of ECOMAS member States prior to shipment.

79. Aquatic organisms production and consumption for Africa is given in table 8 which also indicates that rates of increase in the production is estimated to decline and total demand is expected to exceed production by 2000.

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<sup>11/</sup> EEZ - Exclusive Economic Zone.

Table 8. Aquatic organisms - Actual and estimated production and consumption in Africa

Year	Production (million tons)	Rate of increase (percent of year)	Total <sup>a/</sup> consumption and projected demand (million tons)	Food kg/per capita actual and projected
1961/65	2.1			
1972/74	-	6.1 <sup>b/</sup>	2.7	8.2
1974/76	3.8	1.5	-	-
1980	4.1	2.2	3.4	8.7
1990	5.1	1.8	5.0	9.8
2000	6.0		7.3	10.8
2000/1974/76	-	1.8		

a/ Excluding demand for meal.

b/ 6.1 is percentage change from 1961/65 - 1974/76.

Source: FAO, Agriculture: Toward 2000, July 1979, pp. 117 and 119.

### C. Forestry resources

80. As indicated in table 9 closed forests in tropical Africa were estimated at 173.95 million hectares<sup>12/</sup> (27.4 per cent of total forest area). Of this 77 per cent is found in Central Africa (about 50 per cent in Zaire alone). The forests of Central Africa are less threatened by deforestation (only 0.2 per cent per annum) compared to forests of West Africa which are deforested at an annual rate of about 4 per cent<sup>13/</sup>. An FAO-UNEP forest resource assessment estimated annual deforestation at 1.3 million hectares (0.6 per cent). Plantation success fully established every year are estimated at only 2.5 per cent of the area of tree formations cleared annually.

81. The unabated forest resource depletion affects not only the production of forest products but seriously endangers the lives of people living particularly in the ecologically marginal areas. Desertification is caused to a large extent no doubt by deforestation activities, and by national policies that reflect an attitude of indifference to Africa's forest heritage.

<sup>12/</sup> A recent assessment by FAO and UNEP puts this figure at 216 million hectares.

<sup>13/</sup> FAO-UNEP, Forest resources of tropical Africa, part 1: Regional synthesis, Rome 1981.

Table 9. Forest resources of Africa, 1970-75 (million hectares)

Subregion	Total forest area 1/	Forests as a percentage of total land area 2/	Closed forests as a percentage of forest area			Other forest types	Area of forest reserves	Forest area per capita (ha) 3/	Roundwood production (1974-76)		
			Closed forests	as a percentage of forest area	of forest area	Forest area	Forest area	Man-made forests	Fuel wood	Industrial	million m <sup>3</sup>
									Roundwood	Roundwood	Total
North Africa	101.31	12.49	20.82	20.55	79.76	1.89	16.2	0.76	28.809	2.292	30.601
West Africa	87.70	14.46	8.15	9.29	37.88	19.48	22.29	0.18	112.694	13.716	126.410
Central Africa	286.16	43.72	133.4	46.62	115.86	3.42	5.22	0.265	44.595	8.301	52.896
Eastern & Southern Africa	150.20	22.71	11.57	7.70	79.40	24.41	23.32	0.31	122.938	10.045	132.983
Africa 2/	635.37	22.35	173.95	27.38	312.9	49.2	1.67	1.52	308.538	34.354	342.892

a/ Excluding South Africa.

Source: 1/ Total forest area for 1973 from FAO Forest Production Yearbook 1979.

2/ Land area from FAO Production Yearbooks.

3/ Population figures for 1975 from FAO Production Yearbook 1979, and Persson, Reidar, Forest resources of Africa.

Part I: Country descriptions, Stockholm, 1975.

82. The situation therefore calls for effective forestry development, conservation and management policies by each State and the provision for continuous monitoring of forest depletion at the national, subregional and regional levels.

## VI. ENERGY RESOURCES

83. Energy resources play an increasingly important role in the economic and social development of African countries and often the improvement of living conditions of their population is reflected in a steady increase in energy consumption. Frequently, a slowdown in the production and supply system or a simple lack of adequate energy resources may considerably impede or even paralyse the operations of the productive system of a country. Energy resources and energy as a product are indispensable elements in the economic growth of a country because, by taking advantage of available energy resources, that country can effectively strive towards the creation of an economic environment favourable to industrial development. Consequently, there is a close interrelation between development and utilization of energy resources and development of such sectors as agriculture, transport, industry, etc.

84. Africa has registered over the years a steady residential energy consumption growth, directly related to population growth, particularly in rural areas which contain the bulk of the population. During the most recent years, the residential energy consumption has registered a higher increase in African urban areas to which a significant percentage of rural population migrates. In the industrial sector energy use has not been as high as that of the developed countries, but its trend is sharply upwards particularly in such sectors as food and agriculturally related processing, manufacturing, petroleum refining, raw materials processing, etc.

85. Currently, Africa's share of energy resources in international trade is about 8.5 per cent of crude petroleum resources, 7.9 per cent of natural gas resources, over 30 per cent of uranium resources (reasonably assured reserves), 5.3 per cent of thorium resources, 35.4 per cent of the technically exploitable hydroelectric potential of the world, 7.99 per cent of coal resources and about 0.03 per cent of lignite resources.

86. The above percentages represent considerable energy resources which could provide a significant support for African development during the next decades. In real figures these resources are estimated as follows: 55.1 billion barrels of crude oil, 208,470 billion cubic feet of natural gas, 214.2 billion tons of coal, 1.8 billion tons of lignite, 0.59 million tons of uranium at \$US 80/kg U, 0.75 million tons of uranium at 130 \$US/kg U (both reasonably assured resources), some 0.3 million tons of estimated additional uranium reserves, 26,000 tons of thorium and 200,000 MW of hydroelectric potential.

87. In addition, Africa possesses an appreciable potential in solar, wind, biomass, geothermal and ocean energy. The continent straddles the equator and so has the sunshine all the year round. Wind power, although not capable of exploitation in every region of Africa, could be very useful at least as a standby if not as standing energy source. Africa's plant cover can provide the equivalent of 100 million tons of coal annually. Economically exploitable geothermal resources can be found along the whole length of the Great Rift in East Africa and in the West and Northern regions of recent volcanic activity. For coastal countries, the energy of the thermal gradient of tropical seas or that of waves, currents and tides might provide a valuable standby source of energy.

88. In general, the pattern of distribution of energy resources in the African continent is that there is a major concentration of hydrocarbon deposits in the north and west; water resources in the centre; geothermal potential along the Rift Valley in the east; coal deposits in the south and south-east; and biomass resources and ocean energy in the equatorial and tropical zones. On the other hand, except for hydrocarbons, a less substantial distribution of all these resources can be noticed in the West. Furthermore, there is a very intense solar radiation with long insolation periods above latitude 8° north and below latitude 8° south. Only radioactive areas seem to be better distributed, with two concentration areas: one in the countries of Central Africa and the second, with the greatest potential, in Southern Africa.

89. A large part of African countries, in general, has a disturbing energy situation including unfavourable petroleum supplies, steadily increasing demand for energy, continuously rising petroleum prices, difficulties existing in the distribution of energy, lack of standardization in the electricity sector and the shortage of qualified manpower in the energy field. All these have a serious impact on the social and economic development of African countries.

90. In all, Africa exported 73.2 per cent of its total primary energy production of some 589 million tce in 1979. It consumed only 26.8 per cent of its production. At the same time, imports are running at 65 million tce, more than half from outside Africa.

91. As far as hydrocarbons are concerned, it is noteworthy that in 1980 the import bill of non-oil-producing countries reached \$US 7.4 billion. Together with the food imports of the region as a whole, estimated at \$US 5.6 billion and external debt payments of \$US 2 billion, the region will have paid a total of \$US 15 billion, i.e. 61 per cent of the estimated export earnings for 1980, leaving 39 per cent of such earnings for all other imports including capital goods and services.

92. Africa's apparent crude oil consumption since 1970 has remained around 2 per cent of world consumption (the maximum was 63.5 million tons or 2.03 per cent in 1979) and was around 19.8 per cent of its own production in 1979, a figure which is very low. The continent's remaining 89.2 per cent of non-consumed production is being exported as a raw material, mainly outside Africa. A paradoxical fact is that some African oil-exporting countries are also importers of crude oil. This is to ensure production of oil products in their existing refineries which are not designed to process locally produced crude oil.

93. While Africa's known reserves of crude oil are huge, there are still many large sedimentary onshore areas that have as yet not been prospected and where significant discoveries are still possible. As examples in this respect are the sedimentary basins in the Sudan and in the Central and Southern parts of the continent. Moreover, the offshore areas, with some exceptions are still to be explored. With efforts combined, with exploration expanded and introducing new techniques by utilizing remote sensing data, African countries may benefit from a much greater share of the world's crude oil reserves.

94. Not all the natural gas reserves are located in a convenient position for the market place and the difficulties in natural gas transportation and storage partially explain why interest in this resource has been smaller than that in oil resources. However, during the last years, natural gas has made rapid headway, mainly on account of its cleanness and convenience in use, its availability and its relative cheapness. The value of natural gas is beyond doubt and, although its price is now up, it should be considered as a raw material with great prospects particularly for the petrochemical industry. In this respect conservation, particularly of associated gas, is one of the issues which should concern African oil-producing countries and steps should be taken to minimize the flaring of gas which currently results in a loss of some 50 billion cubic meters per year.

95. Taken as a whole, the hydrocarbon resources are still going to play an important role in the economies of African countries. With this in mind, there should be a major regional effort to find and develop additional deposits of oil and gas. It is especially important that the oil-importing developing countries of Africa build the needed infrastructure to support hydrocarbon exploration and development.

96. Except for South Africa, African countries do not properly exploit coal and lignite resources. Out of some 70 billion tons of recoverable reserves they produce only 81.6 million tons per year (1979), mostly coal and an insignificant quantity of lignite. The output is fully consumed on the continent. Given the present world energy situation, coal is likely to make a significant come-back.



as a valuable source of energy and it is reasonable to expect that African countries will pay greater consideration to the exploration and development of their coal resources as a complementary source of energy particularly during the current energy transition period.

97. Another source of energy which deserves special attention is uranium which, although mined in Africa, has not yet been used as a source of energy by African countries except for a few isolated research purposes. Indeed, a world chart showing the countries using nuclear power for electricity generation has a white spot where the African continent is located. All African uranium production is exported as there is no infrastructure to use it at the national level. This should not prevent the introduction of programmes for local use of this source of energy in the future, based on the training of adequate manpower and systematic transfer and adaptation of technology.

98. The development of African hydropower resources has been impeded by the comparatively large size of some of the sites and the heavy initial capital investment required in relation to the size of the local markets. However, using hydropower, no fuel is consumed and very small running costs are required. Thus, ultimately, the energy produced by a thermal plant is much more costly than that produced by a hydropower plant. Major African hydroelectric schemes could be justified only when supplying large industrial complexes; their development on a multinational or subregional scale should be also taken into consideration, along with the link with rural electricity supply projects so as to speed up the development of rural areas. In addition to major hydroelectric schemes serious attention is being given to the development of small hydropower schemes. Recently, work has been carried out on the development of special types of hydro-systems that could be used for such purposes, and encouraging advances in the field have already been reported in West and Central African countries.

99. Regarding geothermal energy, exploratory activities are in progress along the East African Rift Valley and, in addition to an old station located in Zaire, a geothermal station in Kenya recently came on stream. The trend is encouraging as geothermal energy can contribute significantly to the energy supply in particular of the rural areas.

100. In the field of solar, wind and biomass energy, all African Governments are rapidly becoming aware of the enormous possibilities of these sources of energy. Whereas solar and wind energy are in their initial stages of development or use, biomass, and in particular fuelwood and charcoal, meets over 85 per cent of the energy requirements of rural areas in many African developing countries.

101. Recent studies show that in Africa, fuelwood will for a long time to come occupy an important place within the over-all energy balance of most of the countries. Unfortunately, this energy source is inadequately managed and its consumption in relation to the resource base is increasing at an excessive rate with consequent widespread environmental degradation.

102. In the case of rural Africa, the resulting deforestation and desertification has been so severe that, according to the estimates made by CILSS in 1978, much of the Sahel region will be reduced to desert by the year 2000 unless drastic measures are taken to ensure the rational exploitation of the resource base.

103. The above review of energy resources development in Africa shows that, whereas Africa's energy potential is immense, it is hardly used or needs more rational exploitation.

104. If African countries are to put their development on a sound basis and accelerate its pace, they can do so only through the rapid development of their existing energy resources and through co-operation between energy producers and importers. They must depend first and foremost on their own energy potential, intensively explore and develop their fossil fuel resources (hydrocarbons, coal, lignite and peat), increase the use made of the continent's hydropower resources, develop renewable sources of energy such as solar, wind, biomass, geothermal and ocean energy and start using nuclear energy.

105. African countries should endeavour to achieve an accurate knowledge of their indigenous energy resources, increased capability to explore, develop and use their indigenous energy resources, and the capability to protect such resources from wasteful exploitation. They should aim at substantially expanding the training of manpower and strengthening capabilities with regard to the collection and dissemination of information needed for planning energy resources at the national level with a view to their efficient management and use, including conservation.

106. Recognizing the pressing energy problems and related issues in Africa, attempts were made to find out adequate short-, medium- and long-term solutions. These solutions are defined by the Lagos Plan of Action, the energy component of which suggests the following objectives:

(a) The availability of energy resources in Africa should be rapidly increased and in increasing the quantities so as to ensure endogenous and self-sustained development;

(b) Energy resources should be diversified;

(c) A solution should be found quickly to the problem of the supply of hydrocarbons so that the existence of the most disadvantaged African countries as sovereign States was not threatened;

(d) Better living conditions should be provided for the rural areas by making better use of energy resources.

107. The Plan itself establishes the following priorities:

(a) securing the supply of hydrocarbons as a short-term action;

(b) development of fossil fuels, hydropower resources and other new and renewable sources of energy as medium- and long-term policies.

108. The implementation of these objectives faces a series of issues such as lack of national energy policies in most African countries, the need to integrate energy activities in over-all national development planning efforts, the urgency of undertaking an inventory of all energy resources, periodical assessment of energy supply and demand patterns, training of needed manpower, transfer and adaptation of technology, technical information and dissemination, lack of co-operation and the lack of funds for the implementation of energy development projects.

109. The efficient implementation of the above plan is mostly expected at the national level. On the other side, subregional and regional actions are being undertaken with a view to solving those issues which are impeding its timely implementation. Within this context, the Energy Unit of ECA has the following specific tasks in its work programme such as:

(a) Elaboration of projects for the interconnexion of electrical grids;

(b) Organizing training in the field of new and renewable sources of energy, including hydropower;

(c) Initiation of an inventory of energy resources including the preparation of an atlas of African energy resources;

(d) Preparation of a regional Plan of Action for the development of new and renewable sources of energy and its implementation at all levels as a follow-up to the United Nations Conference on New and Renewable Sources of Energy held in Nairobi in August 1981;

(e) Survey of African indigenous capabilities to develop and use hydrocarbon and coal resources;

(f) Establishment of an African Solar Energy Centre and of a demonstration centre for equipment using solar, wind and biomass energy;

(g) Creation of subregional standing committees on energy including technical committees of experts on new and renewable sources of energy.

110. The energy problems currently facing African countries can not be solved overnight. On the other hand it is well known that no single source of energy can meet the continent's future energy requirements. Consequently, exploration for, and development of conventional sources of energy should continue at an intensified rate along with efforts to develop new and renewable sources of energy. In following this policy, a series of recommendations have been drafted by African experts attending various meetings and forwarded as guide-lines for the optimum development and utilization of the continent's energy resources. The most important of these could be summarized as follows:

(a) African policy-makers should implement a comprehensive and co-ordinated energy policy taking into account the special situation of individual countries and the continent's available or potential energy resources;

(b) Such a policy must be based on as complete an inventory as possible of all energy resources, their potential and possibilities for their development and use. To formulate the policy, it will be necessary to chart current or planned energy needs and catalogue energy sources able to meet these needs under the best socio-economic conditions. Energy development plans for the short, medium and long terms should be drawn up at the national and subregional levels and integrated into national development plans;

(c) There should be permanent technological and political structures responsible for energy problems as a whole at both the national level and the regional and subregional levels;

(d) National services should be set up in each country to plan, design and manage energy projects, co-ordination machineries and bodies should be established at the subregional and regional levels and these institutions should be given adequate funds and manpower to carry out their activities efficiently;

(e) Generally, African consultancy firms should be set up, upgraded and promoted to draw up and use the inventories of the continent's energy resources;

(f) The training of skilled staff at all levels and in all spheres to develop, exploit and utilize energy resources (exploration, evaluation planning,

exploitation, R & D, design and manufacture of equipment to exploit and utilize energy resources, etc.) should be considered a prerequisite and therefore be given absolute priority;

(g) Special attention should be given to the development of science and technology and steps should be taken to collect, classify and disseminate this scientific and technological information more efficiently than is now the case. Researchers and inventors should be given encouragement by being offered honorary titles and monetary or material awards;

(h) Additional seminars, study tours and advanced training courses should be organized and possibilities should be increased for African decision-makers from national and intra-African institutions concerned with the energy sector to exchange information and share experience;

(i) The energy future of African countries will depend to a large extent on the ability to organize, implement and develop their own scientific and technological capacity. Specialized institutions, open to all member States, should be set up or strengthened at the national, subregional and regional levels. Support should be given to existing technological and economic documentation centres and a data bank should be set up to classify all information with a view to its preservation and widespread dissemination;

(j) Although it might still be difficult to evaluate the specific contribution made by new and renewable sources of energy in various African countries in the context of a global economic approach, it is nevertheless clear that these sources of energy can and should play an important role in improving the living conditions of the population and the rate of development of rural areas.

111. Unless immediate action is undertaken at the national, subregional and regional levels, the future of energy development on the African continent will look as follows:

(a) Most of the oil-importing developing African countries will continue to depend on petroleum as the main source of energy for their industrial, transport and electrical energy generating sectors. Consequently, any economic growth will be associated with a growth in energy demand, i.e. increased demand in petroleum products and finally with a continuously negative impact on the balance of payments. As a result, a number of African countries will have to reduce their consumption in petroleum products, thus impeding the development of their industrial, transport and particularly agricultural sectors;

(b) Development of hydropower resources will take place at a slow rate because of the heavy capital investment needed for major hydroelectric schemes . . . and the lack of an inventory and know-how for the development of small hydro-power schemes. On the other side, the electricity produced by thermal power stations will be less available owing to the high prices of petroleum products;

(c) The contribution of geothermal energy will remain very low and limited to a few areas. Solar and wind energy will continue to represent a complementary input of reduced volume confined to limited rural areas;

(d) In the development of ocean energy, no experimental stage will be attained by the end of this century. The export of uranium as a raw material will continue, accompanied by its negative effects on the conservation of this source of energy for future generations;

(e) Fuelwood and charcoal will continue to be the main source of energy for rural areas and for low to medium-income population groups in urban areas. Neither petroleum products nor electricity will substitute fuelwood and/or charcoal. Consequently, consumption of fuelwood and charcoal will follow the population growth rate and lead to accelerated deforestation in those areas of the continent which are already affected by it.

112. A series of concrete actions to be undertaken with a view to improving the future energy situation on the continent can be summarized as follows:

(a) Initiation or acceleration of hydrocarbon exploration within prospective areas;

(b) Development and/or utilization on a larger scale of coal and lignite resources; increase in utilization of peat and natural gas; expanded exploration for and development of oil shales and tar sands;

(c) Accelerated development of hydropower resources through multinational ventures, interconnexion of grids, construction of long-distance transmission lines, initiation of projects for development of small-scale hydropower schemes;

(d) Development of new and renewable source of energy (solar, wind, geothermal, ocean);

(e) Establishment of a research and development base within the energy sector. Training of manpower in the field of energy (including nuclear energy through a combined programme of training abroad and the acquisition at home of small nuclear reactors for research and training purposes);

- (f) Setting up of an afforestation policy programme;
- (g) Establishment of national, subregional and regional institutions and the elaboration of energy development programmes integrated within the over all economic development plans and policies.

## VII. HUMAN RESOURCES

113. The human factor is, without doubt, the most vital in any development process and particularly for agricultural development and rural transformation. The supply of labour to work the farm is to some people a mundane and simple process and invariably taken for granted; but labour supply is decisive as to whether a farm enterprise and investment becomes profitable or otherwise; it can become the determinant of progress or failure of farm operations.

114. The role of man and society in the creation and sustenance of the legal and socio-political milieu within which development is nurtured is too often ignored. It is imperative to be also mindful of man's sense of enterprise and entrepreneurial skill, his initiative, his ability to organise other inputs, take risks, to be adventurous, dynamic, innovative, adaptive and self-sacrificing. These are attributes that singly and/or collectively and over time, define the magnitude, level, and rate of the development of all human endeavours especially in agriculture and rural transformation. Unfortunately, the development of human potential, through training, education, research and diffusion of information is an area not well understood, least of all appreciated by most African Governments some of whom still apparently believe that technology and development is to come from somewhere else.

115. Africa, the second largest continent in the world, with 27 per cent of the world's land area, accounts for only ten per cent of the world's population. It is relatively underpopulated but Africa's population is estimated to be increasing at a rate of about 3 per cent with several countries showing rates of growth approaching 3.5 per cent. This relatively high population growth rate, taken at face value, may however be misleading. Africa's major constraint to economic development is low level of technology and shortage of skilled manpower. The shortage of skilled manpower and entrepreneurs in Africa is critical, to the extent that throughout the region, wholesale trade and major industries are almost entirely owned and managed by foreigners. In many African countries, top management and technical posts are occupied by foreigners (see table 10); and some of these countries have been independent for over 20 years. High-level (i.e. university trained) manpower is extremely limiting. At independence, for instance, Zaire was without a single African doctor, lawyer, or engineer, Nigeria had only 25 per cent of its senior staff as Africans; and in Senegal in 1961, over 90 per cent of senior technician posts were held by foreigners.

116. This pattern of underdevelopment of human resources, according to the World Bank, was partially a consequence of the lack of facilities for advanced education: local facilities did not exist, or, where they did, African enrolment was often restricted. By 1958, less than 10,000 African students (one student per 20,000 population) were attending universities (at home or abroad; and 65 per cent of these were from only two countries - Nigeria and Ghana). In fact, very few countries had more than 200 (less than 1 per cent of the relevant school age population) students in university training.

117. The number of people educated at the secondary level was also severely limited. In the late 1950s, the entire region produced only 8,000 secondary school graduates per year, 40 per cent of whom were in only two countries: Ghana and Nigeria. In fact, only 3 per cent of high-school age students were being educated at the secondary level in Africa in 1960, compared with over 25 per cent in the Philippines, 20 per cent in India, and 10 per cent in Burma <sup>14/</sup> in the same period. The situation is fast improving and expenditures on schooling already claim a large portion (4 per cent of GDP) of budget in nearly two thirds of the countries of the region.

Table 10. Expatriate employment as a percentage of total employment or trained manpower

Country	Population ( '000)	Percentage expatriate employment
Botswana	773	42 (1967) <sup>a/</sup>
Ivory Coast	8 227	45 (1962)
Kenya	15 274	48 (1964)
Malawi	5 817	18 (1966)
Nigeria	82 603	13 (1964)
Swaziland	541	35 (1970)
Uganda	12 797	21 (1967)
United Republic of Tanzania	18 030	31 (1965)
Zambia	5 580	62 (1967)

<sup>a/</sup> Year of estimate given in brackets.

118. To achieve accelerated agricultural development and economic growth, African countries need to develop their human resources. The expansion of education at the primary and secondary levels and post secondary vocational training in the technical fields require more emphasis. Along with formal and informal education, there is need to invest in agricultural research which is the fundamental core for sustained technological advancement and without which basic skills cannot be radically improved.

<sup>14/</sup> World Bank, Accelerated Development in Sub-Sahara Africa: An Agenda for Action, 1981.