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A REPORT ON INSTITUTES OF INDUSTRIAL DEVELOPMENT AND RESEARCH ON SUB-REGIONAL BASIS FOR AFRICA

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I INTRODUCTION

1. The Standing Committee on Industry, Natural Resources and Transport of the ECA at its first session held in Addis Ababa on 12-20 December 1962 made inter alia the following recommendation:

"(a) Both fundamental and applied industrial research should be developed in African countries, but owing to the high cost involved, this should be on a co-operative basis, taking full account of existing facilities. The help of the United Nations should be sought in the setting up on a sub-regional basis of institutes for industrial research.

"(b) At present, evaluation of industrial projects is largely in the hands of foreign companies, and efforts should be made to train Africans in this field. This requires teams specialized in project evaluation such as agricultural economists, industrial engineers, industrial economists and accountants, etc. ECA should be requested to consult other agencies concerned with a view to preparing proposals for the training of African personnel for such teams".

2. The Economic Commission for Africa at its fifth session held in February 1963, adopted this recommendation, and requested the secretariat to undertake studies of the present position, needs and prospects of development of industrial research and technical training in Africa; and the possible need for regional or sub-regional institutions to complement existing institutions.

3. Following on these recommendations the ECA secretariat requested from the Centre for Industrial Development at the UN Headquarters the services of a consultant to make a preliminary survey of the total need of institutions for industrial research and industrial development, by visits to selected African countries and existing institutes and to make recommendations regarding the establishment, organization, structure, and type of services an industrial research and development institute should have to meet the present industrial needs of African countries.

4. The Commissioner for the Centre for Industrial Development made available to ECA for a period of four to six weeks, commencing 7 October, the services of Dr. A. Sundralingam, Special Technical Adviser on Technological Institutes to the Centre, and Director of the Ceylon Institute of Scientific and Industrial Research. Within the time allocated it was not possible to visit all the countries of the African continent; it was therefore decided first to eliminate from this survey those countries which are already well served by institutions of this type such as South Africa, Southern Rhodesia, and the UAR. In order to make a critical evaluation of the existing institutes, both national and sub-regional, and to determine how satisfactorily they have met the industrial needs and services of the area it was decided to visit the East African Industrial Research Organization in Nairobi and the Federal Institute of Industrial Research in Lagos. As the EAIRO is a sub-regional institute of many years standing, serving Kenya, Tanganyika and Uganda it became further necessary to visit one other East African country to ascertain how effectively the needs for technical and industrial research services of that country have been met by the sub-regional institute at Nairobi. Khartoum was visited to finalize the plan of operations for the establishment of an Industrial Research Institute which had earlier been approved by the UN Special Fund. Nyasaland and Ghana were also visited, as the former represented a very small country with no research services of its own and the latter a relatively developed country with a number of research organizations and a National Academy of Science.

5. Limitations imposed on this study by the restricted travel to the named countries have been largely overcome by the data obtained from documents and literature made available by ECA on industrial development and institutions of research in the other countries and the many consultations and discussions with ECA officials, and officials of the Ministry of Industries, Ministry of Economic Planning, UN agencies, development corporations, and AID agencies in each of the countries visited.

Particular acknowledgement should be made to the advice and assistance given by Mr. Arthur Ewing, Director, Economic Development Division of the ECA and his Deputy, Mr. Bax Nomvete.

6. The present report discusses the role of science and technology and concludes with a scheme for the establishment of a network of seven sub-regional technological research institutes. While the focus on a scheme of this nature has been determined largely by the terms of reference under which this study has been prepared, the author does not ignore the feasibility of other approaches, such as a network of technological research institutes specializing in certain industrial branches or a combined scheme incorporating features of more than one approach. The comprehensive discussion of a sub-regional scheme in this report should therefore not be interpreted as a final preference for this approach.

7. If these recommendations have the general approval in principle of the Standing Committee it is further recommended that the Standing Committee authorize the secretariat and the Centre for Industrial Development to convene a meeting early in 1964, of technical representatives of the constituent African countries, the specialized agencies of the United Nations and the Special Fund, and representatives from governments of countries now giving bilateral aid in order to:

- (a) Determine ways and means of obtaining the fund necessary to provide equipment, land, buildings, specialized personnel, and to provide for training of counterparts;
- (b) Determine in relation to technical factors the siting of these institutes in the sub-regions;
- (c) Determine in relation to the resources available in each sub-region the fields of specialized activity of each institute and provide for co-ordination between institutes;
- (d) Take such other practical steps to implement the establishment of these institutes with the shortest possible delay.

8. It is also suggested for consideration of the Standing Committee that to avoid delays the proposed technical action committee should be delegated full powers to execute and implement the project.

II SCIENTIFIC RESEARCH AND DEVELOPMENT

9. Advancement in science has long been considered synonymous with economic growth. Scientific research leads to new knowledge, the application of which to practical ends results in more efficient techniques and methods of production. Scientific research therefore came to be regarded as an indispensable tool for development.

10. The high standard of living which industrialized countries enjoy is to a large extent the result of their early advent into science and scientific research and to the harnessing of science for improving industrial and agricultural production. All the advanced countries of today did not enter the field of science at the same time or advance in science at the same rate. Some had long histories of scientific advance, others are of later and even of more recent origin. The early settlers in America often moved from place to place in search of better and more productive lands. Because of the lack of knowledge of manufacture of nails the settlers burnt their old homes to recover the nails for building homes in the new territory. America at that time was possibly half a century behind Europe in science and technology yet it was later to make many of the discoveries in science which have benefited mankind in communications, medicine, transport and other fields.

11. This was made possible not only by the early recognition of the value of science in development and the impetus given to science and scientific research by the leaders of the newly independent America, but also by the genius of the people in applying the then existing knowledge to practical ends.

12. During the last two centuries the advanced industrial countries have built up a huge reservoir of accumulated knowledge in science and technology and in their own advancement they had drawn on each others' resource for their needs. This accumulated knowledge is available for

immediate utilization with possibly slight modification or adaptation by the less advanced countries.

13. That this can be used most effectively in rapid industrialization was demonstrated by Japan in the early part of this century. Such lessons of industrial and scientific history are of particular and important significance to the new nations. They need not despair that their advent into science and technology has been too late. They can draw confidence and courage in the rapid advance in industrialization which Japan and Russia have made in the short period of twenty years.

14. The new nations have, however, particular limitations. The number of scientific research men in the under-developed countries is very small. It is estimated that the under-developed countries have only twenty research scientists per million of population while the comparative figure for the developed countries is of the order of 1,000 per million. The developed countries spend as much as two per cent of their Gross National Product in research and because of their higher per capita income, this represents a very much larger percentage of GNP for the under-developed countries. Yet with these limitations of manpower and financial resources they are making determined efforts to develop themselves and to provide better standards of living for their peoples.

15. The problem before them is to determine how their scarce resources may be utilized efficiently to effect rapid industrialization and thereby make sufficient economic progress for the 'take off' in science. In order to indicate a solution to this problem it is necessary to discuss the two aspects of scientific research, viz. basic or fundamental research and applied research.

16. Basic research is undertaken with a view to extending the frontiers of existing knowledge and to building a reservoir of fundamental knowledge. It is altruistic in nature and its sole purpose is the pursuit of knowledge

for its own sake. The support is to the man and not to the subject. It is generally long term and is undertaken without immediate expectation of reward or material benefits. It is for these reasons that this type of research is conducted mainly in the universities.

17. Applied research is scientific research directed to the solution of a problem of practical significance. The difference between basic and applied research is one of intention and not of method. Applied research will have specific objectives aimed at solving practical problems connected with agriculture, medicine, engineering or industry. When applied research is aimed at solving problems in industry it is termed industrial research. In applied research it is the problem that is supported, not the man.

18. If other sources of knowledge are not available both types of research will be required for development and the under-developed countries will either have to find the large resources of scientific manpower and finance or accept the position that they will always be poor. Fortunately however there exists a large reservoir of knowledge built through scientific research in the developed countries which is freely available and the results of continuing research, in spite of particular limitations, are also available. This availability of the results of research in other countries permits a selective use of the meagre resources of manpower and money towards objectives more urgently desired by the under-developed countries. These objectives are rapid industrialization and improved productivity in agriculture so as to develop their economies and raise the standard of living of their peoples.

19. Japan and Russia have already shown that it is possible to effect industrialization by successful adaptation of known technologies and utilization of the available reservoir of knowledge. The main problem facing the under-developed countries therefore is not the unavailability of technology but their inability to draw upon, adapt and use available

and known technologies for their needs of industrialization and their inability to harness sufficient men and facilities for carrying out research in those areas of knowledge specific to their immediate and urgent needs and on which outside knowledge is unavailable.

20. It can therefore be argued that given the particular limitations in resources referred to earlier, the greater need is for applied research and the means of using effectively the available knowledge.

21. This does not, however, mean that basic research should be abandoned. Basic research is necessary for the development of applied research and particularly in the study of the raw materials which are specific to individual countries. It should therefore be encouraged in the many universities that exist under conditions most conducive for this type of activity. The bulk of available manpower should be used in applied and adaptive research as these are most likely to produce the rapid development required. In the restrictive sphere of industry, the research most needed will be industrial research and this is dealt with in greater detail in the following chapters.

III INDUSTRIAL RESEARCH FOR DEVELOPING COUNTRIES

22. Industrial research can be defined as applied scientific research directed to utilisation of results in industry. It includes both applied scientific research into processes, products and materials, and development research to enable the fruits of research to be transformed into goods and services. It has definite direct and indirect objectives. The direct objective is to provide the technology required for industries both in existence and planned for the future. The indirect objective is to provide the reservoir of systematized knowledge regarding raw materials, by-products, waste products, natural products, and other resources through composition studies and basic research. It has been said that the job of industrial research is to help a country implement its industrial plan in all its phases. To do this effectively and in the shortest possible time it has to supply the technology of the right amount and of the right kind and have it ready when needed. Its objectives are therefore directly connected with the welfare of the peoples it serves and its programme closely linked with their development plans.

23. The functions of an industrial research laboratory may be summarized as follows:

- (a) To improve the quality of products;
- (b) To develop new uses for existing materials, processes or devices;
- (c) To develop new materials, processes or devices;
- (d) To effect savings in cost;
- (e) To prevent or cure troubles of production or use;
- (f) To assist in standardization;
- (g) To make use of by-products otherwise wasted;
- (h) To amass technical information leading to a better understanding of material, process or product and contribute to the common store of knowledge by library and information services.

24. In order to provide the technology required by new industries and to utilize effectively the natural resources and waste products, industrial research conducts process research, product research, raw materials research, waste utilization research and development research.

25. Process research leads either to a new product or improved quality or performance of an old product. It is attained by direct or indirect modifications of a particular product. Direct modifications are brought about by the use of cheaper or more abundant raw material, improved quality or changes in design. Indirect modifications follow research into new or improved uses of a product.

26. Raw materials research endeavours to improve the supply, cost or quality of a material. In many cases substitute materials either at lower price or of local origin are developed. It involves pre-processing and modifications to improve quality or supply.

27. Waste utilization research is undertaken to find uses for waste products of agriculture or industry, or to convert waste to useful products. Waste may sometimes be a social nuisance and consequently research and development may be necessary in finding the cheapest way of disposal. Some of the waste materials in the African region for which thorough research can be converted into useful products are saw dust, coir dust, groundnut shells, cashewnut shells, banana trunks, rubber scrap, cotton seed waste, etc.

28. Development research is that area of adolescence, where a product or process takes shape and reaches the stage of commercial possibility. It is in this development phase that research grows in size and complexity. For mechanical devices this calls for designing, making and evaluating a number of full scale working models. Emphasis is laid on specifications and on design criteria which will be realistic and practical in the final production.

29. In process development, the principal steps are:

- (a) Pilot scale work and design;
- (b) Product evaluation;
- (c) Utilization studies;
- (d) Economic studies;
- (e) Process design;
- (f) Market research;
- (g) Market development.

30. Pilot scale studies: An increase in size of operation which is involved in pilot scale work frequently makes a process harder to handle. Heating and cooling cannot be done as easily or as efficiently as under laboratory scale. Plant equipment is also less liable to good agitation or accurate weighing or measuring. Most of the snags on this scale have to be re-studied and optimum conditions of pressure, temperature, rate of agitation, velocity and other factors worked out, not only for the pilot scale, but by projection for industrial scale as well. Pilot scale studies yield information on materials of construction, plant design, optimum yields, quality expectation, etc. It provides samples for laboratory evaluation and market appraisal.

31. Utilization studies: Utilization studies are most important in new products. When a laboratory produces a new material which appears to offer commercial possibilities, the next logical step is to determine its physical properties. This study might disclose some novel property which may suggest valuable use. While properties such as viscosity, specific gravity, conductance, resilience, tensile strength, abrasion resistance, hardness, tackiness, bonding strength, tear resistance, wetting power, polymerization, calorific value, vapour pressure, can be determined in the laboratory in exact terms, certain other empirical properties can only be determined by comparative practical tests against known accepted standard products.

32. Economic feasibility studies: Having established utility of a product, a preliminary evaluation should be made to determine economic feasibility. In the world market a product is only marketable at a particular price range. If the new product displaces an already existing product on the market, the price should at least be equal, if quality is higher; or price slightly higher if quality far exceeds present product; or price lower if quality is only just comparable. The price factor is controlled by cost of plant, yields and recoveries obtained, utilization of by-products of the process, and cost of operation. Process design is the translation to commercial scale of data obtained by pilot scale investigations and economic studies. It is concerned with operating conditions, process flow, materials of construction, limits of recovery, product specification, raw materials specification etc.

33. Market research: All these aspects of development are carried on simultaneously, and so too is market research on the product. This search seeks to determine demand supply relationship and to anticipate the situation when the new product comes on the market. The type of research will depend on the product, whether industrial, agricultural or household, and whether it is a completely new use or an attempt at displacing an existing product in the market.

34. It will be apparent that industrial research is no test-tube affair but a practical exploration into industrial development through all phases except production itself. It should provide full information on process, machinery, and the entire know-how of a manufacture. It includes all research, pilot-scale operation, process design, product evaluation, utilization studies, economic studies, market research, specification of final product, quality control and testing, standardization etc. It will be no use offering a process or a product for exploitation unless the research organization can provide full data on costs of plant and machinery, capital costs, unit cost of production and market expected. No government

or private entrepreneur will risk capital until such data are available to them.

35. Technology can be thought of as a primary resource and like a primary resource it has no value unless it is used towards making a new, improved or lower cost product. It has to find a sponsor or entrepreneur who will invest money, machinery, materials and men to produce new wealth in the form of goods. This area of promotion, and further servicing in regard to industrial testing, quality control, solution of production problems, efficient maintenance, industrial engineering and management may not come within the generally understood definition of industrial research, but these are essential elements of service if research results in the under-developed countries are to be extended to production and accelerated industrial development generated within the region with local manpower. The picture of research in the minds of most people stops with discovery, but if a scientist does only this he would not have contributed to world well-being. He must in addition be responsible for extending discovery to production itself.

IV AN INSTITUTE TO MEET AFRICAN INDUSTRIAL NEEDS

36. If an institute had the functions described under industrial research, it would only effect break-throughs in technologies particularly in areas where utilization of indigeneous materials would be an advantage and would develop these to the production stage. Such break-throughs are rare and even if an institute did have the good fortune to have more than a normal share of these, it would still have failed in its major purpose of adaptation of technology to meet immediate product on needs. It would have failed industry in that certain essential services, such as industrial testing, in plant standardization quality control, industrial engineering, trouble shooting, feasibility studies, project evaluation, machine maintenance and design, etc. would not have been provided. It would have therefore failed the country in not assisting in the implementation of its industrial plans.

37. In order to justify these assertions, it is necessary to review the factors and problems of industrialization in African countries. The peoples of Africa are predominantly engaged in agriculture, pastoral and fishing activities, and forestry. Consequently they understand agriculture, which has been the traditional occupation for centuries and capital resources which are modest are preferentially directed to this and related activity. Because of the non-existence of industrial tradition, lack of knowledge of the technologies and know-how of production, lack of technical and industrial skills, lack of entrepreneurial talent, and lack of an institute where technical services could be obtained to overcome these handicaps, Africa has failed to attract sufficient internal capital to generate industrial activity at the rate and expectation most of the new countries have planned for industrial investment from the indigenous population has therefore been meagre. In addition to this, limitation of national boundaries and inability to offset this by economic integration of a group of countries, coupled with low consumption of goods, have meant poor markets for industrial products.

38. Against this background let us examine the areas of support that will be required before entrepreneurs will venture into industry. For this purpose four different groups can be envisaged.

- (a) Local entrepreneurs wishing to enter industry where some limited knowledge and experience exists.
- (b) Local investors wishing to enter into a small-scale industry where no local knowledge or experience is available and it is not proposed to import know-how from abroad.
- (c) Local industrialist entering into medium-scale industry, in technical and or financial collaboration with an overseas manufacturer or trading company.
- (d) The Government intending to set up a large-scale plant for a basic industry such as cement, oilrefining, heavy chemicals, fertilizers, paper and pulp, iron and steel, or a large-scale textile mill.

39. In the first category will be a majority of products now exported in the raw or unprocessed forms and a number of products locally consumed such as processed food, timber products, bricks, tiles or weaving. If the products replaces hitherto lower priced export commodity, it is necessary to know whether this would be preferred in the traditional market and if so in what quantities, price and quality. When raw products are imported into a consuming country for use in various manufactures, there already exist units for processing them into forms acceptable to an end product manufacturer and these interests are likely to thwart attempts of a primary producing country entering into competition with them. Consequently the traders who supply the processing factories abroad will also be unhelpful, not because they are unpatriotic but because they have no contacts with the end use manufacturers and will therefore lose an existing trade. The enthusiasm of the local entrepreneur is likely to vanish at the end of this preliminary enquiry unless he has ready access to an impartial organization which could advise him of the end uses of the processed product and direct him to information regarding manufacturers to whom

he can apply for details of price, quality and specification, and quantities required.

40. Having obtained this information and established a potential market at a price which appears to be advantageous both to country and the sponsor, he will now search for details of size of economic production, type and cost of machinery, industrial skills required, management, supplies of raw material, etc., attainment of quality specifications, cost of processing etc. He will require specialized assistance in all these areas and continual services of testing his product, assistance in overcoming process or machinery breakdown and in improving efficiency of operation.

41. In the case of production for local consumption he would require information on total demand, what proportion of this is already met, and what plans if any the local manufacturers have for expansion and if these do not exist the reasons for not expanding production. If the reason is lower demand caused by poor quality or too high a price further information may be called for on the desired quality optimum price and the techniques and technologies of production required to meet both quality and price. This will lead to further enquiries on size of production, source and type of machinery, specifications of quality of raw material, capital required, and cost of production.

42. Where a local entrepreneur enters a field of industry on which no know-how or experience exists - he will require the assurance of competence and availability of sources which can also provide the adaptation of technology, layout of selected machinery and technical supervision of production besides other services referred to earlier.

43. In the case of medium scale industries which are to be established by local enterprise in collaboration with foreign technical know-how and or financial participation, the problems are many and varied. Foreign know-how is in many cases that supplied by machinery salesmen with access to persons experienced in the industry and their main objective is to sell the most expensive equipment at the best possible price. The machinery offered

may not be the best of its type, or the most desirable for the size of production envisaged. Where industrial skills are unavailable it may be unwise to have ultra modern equipment with push button controls, as these would require accurate adjustments and high maintenance which involves higher skills, even if the higher cost of such type equipment may not be a major factor. The machinery may on the other hand use a technology without modification to local conditions, or have a capacity several times in excess of anticipated production. The know-how is of limited value as it does not have the assurance and reliability of a reputable manufacturer. The manager supplied by the machinery manufacturer is an industrial who might make unreasonable demands on the local company and hold it to ransom. Many cases of this type have been reported in the less advanced countries of Asia and elsewhere and this may well be the experience in Africa. It can only be avoided if the local industrialist has access to competent help in the formulation, supervision and operation of his concern.

44. Where collaboration with a foreign manufacturer is envisaged the above mentioned particular problem may not arise but advice will be required on the minimum and maximum number of local personnel in various categories of management and their training, the disclosure of know-how, the conditions of purchase of raw materials, and generally on the type and contents of a technical agreement between a local sponsor and an overseas manufacture.

45. In the case of basic industries, which are becoming increasingly under public ownership in the underdeveloped countries, largely because of high initial capital and inadequate return on investment, a local institute may not have the competence to prepare full and detailed project reports and to make technical and economic feasibility studies. It could, however, make the initial survey of the quantity and quality of raw materials available, of the availability of technical and skilled manpower for the particular industry, of the market existing with projection for consumption at the time when industry will be established, and make a preliminary feasibility

study for consideration of the government. If in the view of the institute the prospects of economic operation seems satisfactory or even marginal, it could make recommendations for the choice of a specialized consultant in the particular industry, and provide such a consultant with all the local background data he will require. When the consultant arrives, he can be based on the institute where both technical and other data would be available or special information obtained for him through analyses and tests on water, and raw materials of local origin.

46. There is yet another and important field of activity by which an institute would assist industrializations. As indigenous industrial investment in industry is likely to be meagre for some considerable period of time, the entrepreneur looks to industrial banks, development corporations and commercial banks to provide loans on long term credit but unfortunately the banks themselves require evidence of fundability to come to them. The local entrepreneur will be unable to prepare a project report with all the details of capital cost of land, buildings, machinery, cost of installation and services, raw materials and labour required, market potentials, cost of production, etc. and consequently a worthwhile project might never be started. Assistance in the preparation of feasibility studies which would lead either to a bankable project or to the rejection of uneconomic projects which are a drain on the resources of the country will be a service of great value to industrialization in the less advanced countries and should therefore be included in the functions of an institute.

47. Against this background of needs it is necessary to review the scope, objects, and organization of industrial research institutes already existing in some of the African countries, so as:

- (a) To effect the desirable co-ordination and avoid duplication;
- (b) To effect economies in very scarce scientific personnel and costly equipment;
- (c) To make such services available to a wider region;
- (d) To determine complementary needs which have to be met.

V INSTITUTES IN AFRICA ALREADY PLANNED OR EXISTING

48. The region covered by this study is shown in the map (annex I). In this review of existing institutes only those organizations which either principally or partly assist in industrial development will be considered and these will include industrial research institutes, food processing and research centres, building research and materials testing laboratories, industrial consulting services, standards and testing institutes and productivity centres.

Sudan

Industrial Research Institute

49. An institute with functions identical to those proposed in this study for an industrial development and research institute will become operative early in 1964. Assistance in the establishment of this institute was sought by the Government of Sudan from the United Nations Special Fund early in 1962 and the project received approval of the Council in June 1963. The institute will have research and development functions and services rendered will include industrial consulting, feasibility studies, loan surveys, industrial testing and assistance in production. Specialized fields include technology of oil and fats, silicate technology and textile technology. It will be established as an autonomous corporate body with powers and duties vested in a governing board. Co-ordination with other institutes and bodies has been provided for to avoid duplication of both research and other services in Sudan through a Technical Advisory Committee consisting of representatives of the University, Food Research and Processing Centre, Industrial Bank, Public Works Department, Labour Department, government chemist, etc., with the Director of the Institute as Chairman. "The Institute will as far as its competency and finances permit conduct and render research and technical services for the benefit of the Government, or any public authority or any industry or any financing institution in Sudan" and will make charges for its services.

Building materials testing laboratories

50. A testing and research unit for building materials, well equipped with testing equipment, has been established within the Engineering Faculty of the University of Khartoum. It has no senior professional staff of its own. The professor of mechanical engineering is in charge, and he has the assistance of other teaching staff and students in providing a testing service on building materials both for government and private sector. It has an advisory committee composed of representatives from various departments to assist in determination of research programmes.

Food processing and research centre

51. This project approved by the United Nations Special Fund in June 1963 has now been taken to the operative stage. It has as its objectives:

- (a) Processing of food and food products and to provide demonstration units;
- (b) The development of Standards and testing of food;
- (c) Extension services and training in food processing and preservation.

52. The FAO acts as executive agency and will provide seven to eight experts in food processing, food technology, microbiology, canning, packaging, standardization, etc. Counterpart training both in Sudan and abroad has been provided for.

Hides and skins demonstration and training centre

53. The objectives are

- (a) Raw hides and skins improvement;
- (b) Improvement of rural production of semi-tanned hides and skins;
- (c) Development of leather production on an industrial basis;
- (d) Introduction of improved tanning and finishing techniques; and
- (e) Developing methods of utilization of by-products.

The Centre was officially opened on 19 November 1963 and experts on tanning, finishing, utilization and marketing have been supplied by the FAO.

Productivity and feasibility studies

54. The Industrial Bank has obtained the services of a team of consultants through US AID Mission and this team undertakes loan surveys, project evaluation and vetting for the Bank.

Ethiopia

55. The Ethio-Swedish Institute of Building Technology was established with aid from Sweden and is concerned with teaching, research and documentation. It conducts a four-year course for building supervisors and contractors. It is also conducting research into building materials. Its latest studies include the production of hand made bricks, soil stabilization and use of local materials in construction. It undertakes testing of materials besides providing advisory services to the Ethiopian Government on various aspects of construction.

Kenya

East African industrial research organization

56. This was originally established in 1942 to serve the British East African region and has recently been brought under the control of the East African Common Services Organization. The main laboratories are in Nairobi, and it has modest facilities in regard to buildings and specialized pilot plant equipment. The library is inadequate and the Organization has been handicapped by the limited land area available, by inadequacy of funds for expansion and by an unattractive scale of salaries which prevents recruitment of persons of the calibre required. At the present time five out of nine professional posts are vacant and the recruitment situation is likely to get worse on the scales applicable.

57. In spite of these handicaps it has carried out useful work in the examination, analysis and listing of raw materials, in providing a fuel advisory service, and in investigations on ceramics, coffee processing, dehydration of vegetables and drying of papain, sisal and pyrethrum flowers, as well as in the utilization studies.

58. The internal organization consists of three sectors, i.e. Chemical Research, Ceramics Section and Advisory Services. A metallurgical section laboratory which was established in Entebbe, Uganda has since been closed down and the metallurgist transferred to the service of the Government of Uganda. The advisory services are in the narrow field of fuel efficiency in factories and this too may have been already reduced by the retirement of the fuel technologist in 1962. Industrial consulting services, feasibility studies and loan surveys are not part of their functions. The liaison with industries and industrialists could have been better.

59. The present budget is £50,000 and their income from fees from the private sector approximately £4,000. It was established to undertake applied research for industries in East Africa which are in the course of development and also to give technical assistance and advice to established industry on their day to day problems. It has functioned only as an industrial research organization in a limited way, largely due to difficulties in staffing and the limitation enforced by the budget which is grossly inadequate.

Materials testing and research

60. This was established in 1949 under the Ministry of Works and still functions under that Ministry of the Kenya Government. Although in buildings not specifically designed as laboratories, it has 42,000 sq. feet of floor space. The senior staff consists of the chief materials engineer, eight materials engineers, a physicist and a chemist. The other staff consists of 20 materials assistants including 3 other chemical assistants, 30 laboratory assistants, 4 executive staff and 55 subordinate staff. The laboratories are well equipped and adequately staffed to undertake research

and testing of building materials and of buildings. The main divisions consist of soil testing, chemical analysis, building materials, bitumen, physics, paint, timber. They have two small laboratories at Nakuru and Mombasa.

61. The investigations carried out by this unit have included:

- (a) The removal of excess fluoride in water, a process developed and patented;
- (b) Manufacture and use of pumice concrete in building construction which has resulted in reducing cost of building;
- (c) Development of the use of pre-stressed concrete;
- (d) Tests to develop use of local vermiculite deposits;
- (e) Studies in soil stabilization resulting in the successful use of anilene/furfural and the laying of a test road.

62. The services of this unit are available to governmental departments and members of the public in Kenya, Uganda, Tanganyika, Somalia and countries outside Africa. The existing equipment is valued at £60,000 and the present cost of operation is around £6,000 per annum. However, it recovers fees for tests and services rendered to private sector and government and public bodies outside Kenya and its income from this source is approximately £12,000.

Nigeria

Industrial research

62. Industrial research for Nigeria is conducted in the Federal Institute of Industrial Research situated at Oshodi, 10 miles from Lagos. It was established in 1955 on the recommendations of the International Bank for Reconstruction and Development. It has 25 acres of land and ample space exists for further expansion. It possesses a library of 3,000 volumes devoted to chemistry, chemical engineering and industrial technology. Specialized equipment other than normal chemical laboratory equipment includes a pulp and paper laboratory, a ceramics laboratory and a pilot plant equipment. The Institute is administered as a division of the Federal Ministry of Commerce and Industry and the entire budget is provided for annually by the Government estimates.

63. "The aim of the Institute", as stated in their booklet, "is to help anyone to set up as quickly as possible, new industries based on Nigerian raw material. Another subsidiary aim of the Institute is the development of industries which already exist, especially those industries based on Nigerian raw materials. The services of the Institute are at the disposal of any Government, private company or individual, on terms to be agreed upon. Advice is given free of charge".

64. The cadre of the institute consists of 27 senior technical officer posts. Less than half of these were filled and the situation was further aggravated by absence on leave, consequently only a third of the cadre was available. The posts of director, deputy director, chief engineer, 2 senior research officers, 1 senior engineer, cost accountant, 8 research officers, engineer and designer engineer were vacant at this time. One of the two principal research officers will be leaving at the end of December 1963. The Institute's major problem is finding the staff. Five new graduates from Ibadan University were taken temporarily last year but four resigned after a few months to accept scholarships for higher degree.

65. The Institute disposes of good facilities and can be expanded with proper staffing and reorganization, under an autonomous Board, to function more efficiently than it does at present. Research work carried out include:

- (a) Gari processing from cassava;
- (b) Pulp and paper making characteristics of four varieties of Nigerian timber;
- (c) Protein fortification of starchy foodstuffs;
- (d) The occurrence and utilization of plant gums.

The present budget is £70,000.

Hides and skins demonstration and training centre

66. A project similar to that described under Sudan was approved by the Special Fund in June 1963. Its purpose is to provide demonstration, training and research in order to improve the quality of hides and skins and to develop industrial methods of leather processing and manufacture,

Ghana

Building Research Institute

67. The Ghana Building Research Institute, formerly known as the West African Building Research Institute, was one of the seven organizations controlled and financed by the Governments of Ghana, Nigeria, Sierra Leone and Gambia. It was established in 1952 and sited in Accra. With the dissolution of the West African Inter-territorial Research Organization in October 1962 it was incorporated into the Ghana Academy of Sciences. The Institute has moved from the original site in Accra and has been re-established at the University of Kumasi.

68. The activities of the Institute include:

- (a) Investigations into the nature and behaviour of materials;
- (b) Development of indigenous materials and techniques;
- (c) Application of existing knowledge to all aspects of the building industry;
- (d) The exchange and dissemination of knowledge;
- (e) Technical apprenticeship and training in industrial research.

It has a well stocked library and its internal organization has four divisions.

Food Processing and Research Centre

69. A project under FAO and approved by the United Nations Special Fund will become operative in 1964. Its main objects are the processing of food products and the operation of pilot plants as demonstration and training units. It also includes food standards and testing and research into local food products.

Productivity

70. There are two consultants of the Ford Foundation attached to the Planning Commission working on manpower survey and productivity. Two ILO members are believed to be attached to the Ministry of Industry.

Libya

Libyan Date Laboratory (Trust Fund)

71. This laboratory undertakes research on date processing, and manufacture of date syrup is carried on in the government packing house where a pilot plant is also available for process work. It receives assistance from FAO. There has recently been established, also with FAO assistance, a pilot plant for the processing of citrus juice, jams, jellies and other citrus products.

Egypt

72. Egypt has a large number of research institutes under its Department of Scientific and Industrial Research. For the purpose of this survey only the Productivity Centre, Standards Institute and Building Research Institute will be described.

Productivity Centre

73. In July 1954, with the assistance of the ILO, a Productivity and Vocation Training Centre was established in Cairo. The functions of the Centre are:

- (a) To undertake productivity studies in selected plants;
- (b) To organize practical courses in industrial engineering and management;
- (c) To apply modern industrial engineering and management in selected plants.

The Centre is also required to promote the adoption of cost accounting and statistical techniques, train supervisory staff, advise on designs and layout of plants. The Centre is under Egyptian direction and is fully manned. It has carried out useful work for industries in Egypt.

Standards Institute

74. The Standards Institute was established some years ago. It formulates and develops standards and has its own laboratories. The Institute could serve the whole of North Africa, including Sudan, Ethiopia and Somaliland.

Building Research Institute

75. This Institute is a large organization and forms part of the Department of Scientific and Industrial Research and has plans for expansion. Their work has so far been on research on building materials and their testing. They expect to extend their activities to functional requirements, building economies and building techniques. The Institute is adequately staffed and can serve the sub-region of North Africa.

General observations

76. In the review of existing institutes no claim is made as to completeness and it is quite possible that other institutes exist particularly in the French speaking countries. Of the countries in the region under study, only Egypt has institutions which meet most of the industrial needs. Sudan will have met the requirements when the Special Fund projects on Industrial Research, and Food Processing become operative and when they make suitable arrangements for standards with Egypt and for building research either with Egypt or Ethiopia.

77. Kenya with the East African Industrial Research Organization and the Materials Section of the Ministry of Works comes close to meeting its requirements. No facilities exist, however, for feasibility studies, loan surveys, project evaluation and liaison with industry and entrepreneurs is lacking. The two institutions should be combined and additional services and functions incorporated. With additional staffing and reorganization this combined organization would be in a position to serve a wider region.

78. Nigeria has good facilities and its Federal Institute of Industrial Research should, with additional functions and services, be capable of serving a sub-region.

79. Ghana already has a Building Research Institute and a project on food research and processing has been approved; the industrial research functions can be incorporated into either the building research or food research organizations with added functions of industrial consulting.

80. It will therefore be seen that except for Sudan and Egypt, which have or will have adequate facilities to meet industrial needs, and Kenya, Nigeria and Ghana which have facilities but inadequate to meet the total needs, particularly in the area of industrial extension, direct technical services, and industrial consultation, the other 31 countries have no facilities at all. In order to meet the need the institutes of industrial development and research are being proposed on a sub-regional basis. These institutes will take into account existing establishments and the whole programme would be co-ordinated in order to avoid duplication of services and to effect maximum efficiency.

VI AN INSTITUTE OF INDUSTRIAL DEVELOPMENT AND RESEARCH

81. From the discussion which preceded it will be apparent that to meet the needs of industrialization of the 36 countries covered in this survey, it is necessary to establish several institutes having competence in a variety of fields. The functions should include those of industrial research, technical information, industrial consulting, testing and standards, feasibility studies and loan surveys. The institute has been named institute of industrial development research in order to indicate its wide scope and functions.

82. The functions which stem from the discussion of needs can be specifically stated as follows:

- (a) Surveys and studies of the natural resources, by-products of industry and agriculture and their utilization;
- (b) Investigations and research into and development of new products and processes for industry, and the development of new technologies for the utilization of local raw materials;
- (c) Laboratory services of analysis and testing of industrial products and export products;
- (d) Assistance to governments in the formulation and development of standards for industrial products;
- (e) Techno-economic feasibility studies, loan surveys and project evaluation for financing institutions, public and private sector of industry, and other bodies;
- (f) Consultation service to industry on production management, industrial engineering, marketing, cost accounting, quality control, inventory control, in-plant standards, and general engineering and production problems;

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- (g) Technical information services based on a specialized library for the purpose of disseminating information on known processes, operations, and technologies; and publication of suitable pamphlets or brochures on the characteristics, utilization and industrial possibilities of the natural resources;
- (h) Foster training in collaboration with the universities, and other educational institutions, of research workers, engineers, technologists, managers;
- (i) Produce liaison with other institutes both in Africa and elsewhere and thereby foster the spirit of co-operation and the universality of knowledge.

Staffing

83. The efficiency of a multi-service institute depends almost exclusively on the quality and calibre of its staff. The professional research staff should be qualified in industrial economics, chemistry, chemical engineering, mechanical engineering or physics, have a post graduate degree in a field of industry or full professional qualifications, a diploma in industrial management and at least one year's work in a factory. Ceylon experience shows that it takes five to seven years after the first degree to make an officer of the calibre required. It is common experience in the under-developed countries for persons to believe that educational attainments or university degrees is all that counts. In the field of research, this is only the beginning, a graduate should do at least three years of post-graduate work and acquire techniques of research before he could claim to status of research officer. He would then be expected to specialize in a selected field, but having specialized in one field he must also acquire additional specialized knowledge in others by practical experience and study. A research officer cannot delegate, he should carry out each and every operation himself, however menial this may be, as this is the only way for every experience conducted

to result in accurate observation. In most of the under-developed countries, the educational and social systems have given a prominent place to white collar jobs and consequently young men have come to believe that working with their hands is degrading. This attitude is out of harmony with industrial development and is disastrous for research activity. If an institute of the type suggested is to be efficient and to provide the services expected of it, its staff must believe in and practice dignity of labour.

84. With persons of the training and attitude mentioned it is possible to operate an institute of the type envisaged with a professional staff of as low as 16 to 20 persons. The requirement of professional staff will be determined by the areas of specialization to be included in each institute. Assuming, however, that in the first instance the general services of information, industrial products analysis and testing, industrial consulting and feasibility studies are to be rendered, and research activity will be limited to general areas of food and general processing, the following professional staff will be required:

- 1 director and 1 co-director (nationals of outstanding ability with scientific or economic background)
- 1 deputy director for research (preferably an experienced industrial economist)
- 1 deputy director for industrial consultation services
- 1 administrative officer and secretary
- 2 librarian (professionally qualified)
- 1 accountant (professionally qualified)
- 1 analytical chemist (fellow of the Royal Institute of Chemistry or similar qualification)
- 1 food technologist
- 1 chemical technologist
- 1 chemical engineer
- 1 silicate technologist (cement, glass, brick, tiles and pottery)

- 1 microbiologist
- 1 mechanical engineer
- 1 industrial engineer
- 1 cost accountant
- 1 economist and market research officer
- 1 statistician

85. In addition the supporting staff would consist of 18 technical assistants, workshop superintendent, stores superintendent, 5 secretary-stenographers, 3 clerks, telephone operator, 10-15 skilled machinists, 5 computers, carpenters, electrician, blacksmith, tinker, mason, 2 drivers, 3 watchers, 3 cleaners or attendants, and 3 maintenance men. If special areas of study on particular groups of industries such as oil and fats, tanning, mineral processing, rubber goods manufacture, etc. are required suitably qualified and experienced professional staff and equivalent number of technical assistants should be added.

86. While the administrative officer, librarian and accountant among professional staff and all supporting staff will certainly be found in the region, it is hoped that at least one outstanding technical man can be found to be co-director right from the inception. It is also hoped that specialists such as analytical chemist, chemical technologist and cost accountant will also be available, leaving 10 posts to be manned by United Nations experts in the first five years. This will entail increasing the cadre by 10 counterparts, who will understudy the UN experts.

87. Assuming that level of salaries for African nationals are as follows:

Director	\$8,000 - 10,000
Deputy director	\$6,000 - 8,500
Research and administrative officers	\$3,500 - 7,000

the cost of staff salaries alone per annum will be \$200,000 to \$250,000.

Operational expenses such as journals, chemicals, glassware, apparatus, materials and other supplies and administration and office expenses and travelling would cost another \$100,000. Even assuming assistance from the United Nations and its specialized agencies towards provision of initial staff and of the training of African counterpart staff both in Africa and overseas the recurrent annual expenditure will be a minimum of \$300,000 rising in five years to around 500,000.

Land and buildings

88. It is desirable to have about five acres of land and buildings with a floor area of approximately 50,000 sq. feet. It is important in designing the building to bear in mind that laboratories of this type are places to work in and not to sit in. Laboratories should be large halls without innumerable partitions for rooms. Services of gas, compressed air, vacuum, power points and water at pressure of around 30 lbs. per square inch will have to be provided to chemical laboratories, testing laboratories, workshop and pilot plant bays. Certain areas which include specialized laboratories and balance rooms will require air conditioning

89. The allocation of floor area for various services will be as follows:

Chemical and testing laboratories	12,000 sq. ft.
Pilot plant	10,000 " "
Workshop	5,000 " "
General services and wash rooms, etc.	2,000 " "
Auditorium and library	4,000 " "
Specialized laboratories	3,000 " "
Administration and offices; halls, etc.	10,000 " "
Stores (issue and bulk)	3,000 " "
	<u>50,000 sq. ft.</u>

90. It is assumed that land will be provided on lease of 99 years free of charge by the Government. The cost of buildings and provision of

services is expected on the present average price of construction of \$10 per sq. ft. to be \$550,000. In addition to this will be cost of erection of plant, equipment, and cost of laboratory benches with fittings and services which is assumed at \$100,000.

91. The total cost of \$650,000 is to be a charge on the country or group of countries which form the sub-region.

Equipment

92. The equipment should include unit process and unit operations equipment, workshop equipment, a standby generator, automatic boiler, a library of 10,000 volumes and racks for books, auditorium public address systems and folding chairs, laboratory testing equipment for normal routine work and investigations, testing equipment for industrial products, chemicals, glassware, and other specialized physical, chemical, engineering equipment, photocopying, duplication, microfilm reading and instruments. The average cost depending on fields of specialization will be around \$1,200,000.

The breakdown will be as follows:

Library - technical books	\$100,000
Unit operations and unit process equipment	300,000
Service equipment - generator, boiler, gas, vacuum, air pressure, air conditioners	200,000
Chemical laboratory equipment	200,000
Physical testing equipment and instruments	200,000
Workshop	100,000
Miscellaneous	100,000
	<u>\$1,200,000</u>

Organization

93. The internal organization will consist of three divisions, Research and Development, Industrial Consulting and Administration, with specialized

sectors under each Division. The director will be in over-all charge and head of the Administration Division, while a deputy director will be in charge of each of Research and Development and Industrial Consulting Divisions.

94. Institutes of this type function more efficiently under an atmosphere of freedom from red tape and control normally associated with government departments. Part of the difficulties experienced by existing institutes in Africa have been due to their being tied to rigid regulations of governments with regard to salary scales, promotions, purchase, procedures, budgeting, publicity, etc. This has been overcome in other countries by placing the institute under an autonomous board of competent men representing both science and industry who would determine policy, leaving the role of management to the director.

95. Costs of establishment and operation - Summary

Capital cost

Buildings, land, services and installation	\$ 650,000	Country or sub-region
Equipment and books	1,200,000	Aid countries
Specialized staff (10 experts for an average of 4 years and consultants on special fields on short term)	1,000,000	United Nations
Training of 10 consultants for average 3 years abroad	200,000	United Nations
	<hr/>	
	\$3,050,000	

Annual recurrent expenditure to be met by the country or countries on the sub-region

Staff (16 professional and subsidiary staff)	250,000
Running expenses of laboratories travelling and costs of journals, etc.	100,000
	<hr/>
	\$ 350,000

VII NATIONAL VERSUS SUB-REGIONAL INSTITUTES

96. The terms of reference of this study is provided by the recommendations made by the Standing Committee on Industry, Natural Resources and Transport at its first session, which stated that, owing to the high cost involved, the institutes should be developed on a co-operative and on a sub-regional basis, taking full account of the existing facilities. In addition to the high initial capital cost and annual recurrent expenditure there are other factors such as the great scarcity of trained scientific research personnel, the greater interests of developing the smaller and less privileged nations of Africa and the necessity to utilize scarce resources for the maximum benefit of the whole community which favour sub-regional institutes.

97. The proposed institutes have a broad spectrum of functions and services in order to meet the needs of industrialization in Africa. The range of services and fields of specialization are large, requiring not only a great number of specialists but also a range of equipment in a number of fields of scientific activity. The capital cost of establishment, which includes the buildings, equipment, experts and training of counterparts is approximately \$3 million. In spite of the provision for the institute to make charges for its services to the private sector of industry, the recurrent annual expenditure is likely to be \$350,000. This figure is unlikely to be lowered even when personnel is supplied by international organizations during the first five years.

98. Of the 36 countries in this study listed in annex II there are possibly two countries which can afford this order of expenditure, and only one which can find the highly trained research scientists among its nationals in the quality and number required to staff such an institute. There are also three or four other countries which, because of their own pressing needs and advanced plans, might be tempted to establish institutes with limited scope and functions in order to satisfy their own individual national interests and aspirations. This step would serve to develop only the nations which have already attained by comparison a higher growth and surrender some thirty countries to a bleak future which offers no hope of development.

99. The African countries which through the OAU have recently found new political unity and strength are also looking for means of integration in economic and other fields in order to obtain co-ordinated development and general upliftment of the whole region. The unequal sharing of the fruits of development with the relatively more advanced countries making greater progress will strain any attempts at economic or political unity and it is believed that the countries will endeavour to avoid such a calamity. The more developed countries have in addition a role to play in leadership of their sub-regions and in providing the scarce personnel required for development. Of all the various fields of economic and social activity, science provides, by its very nature of universality, the easiest area of co-operation and African nations are unlikely to throw out this opportunity of building goodwill and co-operation among themselves which might later lead to still greater and more fruitful collaboration in the economic and political fields.

100. The international agencies such as the United Nations and its specialized agencies and the governments of the developed countries which are anxious to assist the new nations of Africa are also unlikely to subscribe to a philosophy of aid to those who are already comparatively advanced and abandon the relatively poorer countries to greater poverty. Their intentions are forcefully described by Prof. W.W. Rostow of America who stated: "We must face the fact that a lenders club is not enough. The borrowers must have a role in the whole process, they have the possibility and the duty of working together on a self-help basis. Here regional arrangements might prove useful". In the establishment of these institutes a large quantum of aid is envisaged and required from these agencies in the initial staffing, training of counterparts, and the supply of equipment.

101. These considerations favour sub-regional institutes. The 36 countries have been divided into seven sub-regions and the groupings are shown in the map (annex I) and the table (annex II). In determining the sub-regions a number of factors were taken into account. These included institutes and facilities already available, land area and geographical limitations,

population, communications and transport facilities within a sub-region, and the necessity to have at least one country which can provide leadership.

102. One of the arguments adduced against sub-regional institutes is that they might not give priority to individual and urgent needs of individual countries in their programmes of research and services. This has been overcome by the provision in the Act that a third of each country's contribution will be considered a deposit from that country with the institute, to be used on request on any specific project which that country may consider to be of immediate importance. This permits identification of every country with the work of the institute while it contributes to the well-being of the whole group through a programme of research and technical services based on the raw materials and industrial plans of the sub-region. The funds which constitute two-thirds of the contribution of each of the countries will be used on the support of overheads and cost of such a general programme of research with the approval of the governing board.

VIII ESTABLISHMENT - LEGAL IMPLICATIONS

103. The establishment of an institute on a sub-regional basis poses particular problems. The countries of the sub-region are required to subjugate their individual national interests for the general upliftment and greater prosperity of a group and to jointly and severally assure the autonomy of the institute. The legislation establishing the institute will therefore have to be passed by all the Governments in the sub-region in identical form. The countries in which the institutes and branches may be sited would have in addition to agree:

- (a) To import of chemicals, equipment, instruments, vehicles etc. free of customs duty and excise duty;
- (b) To exempting the institute or its branches from stamp duty, income tax, etc;
- (c) To permit the institute to maintain and use equipment for laboratory and experimental services without any licence, permit or approval;
- (d) To permit the institute to negotiate and receive aid in personnel or equipment from other governments, international agencies, foundations, etc.;
- (e) To afford such privileges and exemptions to personnel of United Nations and other international organizations as are already in force;
- (f) To permit the unrestricted use of exchange for the import of its specialized equipment, books, etc.;
- (g) To permit free entry and exit for the members of the governing board and the staff of the institute.

104. The draft of an Act (annex III) has been based on similar Acts elsewhere. It provides for the establishment of a sub-regional institute as a corporate body with powers and duties of the institute vested in a Governing Board consisting of the representatives of each of the participating countries. Financing of the operation of the institute is provided

for by contribution from each country of .02 per cent of its Gross Domestic Product each year. The Act also provide for Institute to work for Governments, public bodies, and the private sectors of industry, finance and trade and to make charges for services rendered to non-government agencies.

IX . ROLE OF INTERNATIONAL AGENCIES AND DEVELOPED COUNTRIES

105. A number of developed countries and particularly the United States of America, the Union of Soviet Socialist Republics, the United Kingdom, France, the Federal Republic of Germany, Japan and Sweden are already providing both financial and technical assistance to many countries in Africa. The extent of this aid is large but it is channelled into areas of limited usefulness and often to countries which because of their greater affluence and well-being are better able to determine their requirements and ask for such aid. Consequently, the greater needs of the smaller or poorer countries are overlooked and a number of projects with inherent duplication often result in others. This is unfortunately true in many cases of even the United Nations and its specialized agencies, which because of the limitations of their individual terms of reference restrict a project to the area of its own mandate or competence. Avoidance of such defects calls for greater co-ordination of aid not only by the donor countries but also within the family of the United Nations. It also requires the determination of the total needs and priorities of each country or group of countries of a sub-region. The aid to be effective and fruitful requires not only a donors' club but also a receivers' club.

Governments of aid giving countries

106. Bilateral aid has preferentially gone into the provision of (a) equipment, and (b) technical personnel. Both have certain implications and reasoning and for these reasons they are also suspect by receiving countries. Technical assistance is suspect because as advisors they may influence ideology or attract custom for capital goods and services to the country giving aid. This is not felt so strongly in the case of aid in the form of equipment, and donor countries would prefer for sake of identification to give this form of assistance if requirements have been closely determined in relation to the important needs of the country.

107. The donor countries have therefore been assigned assistance in the provision of the equipment required for these seven institutes. The overall cost of such equipment will be \$8 million.

The United Nations and its specialized agencies

108. The United Nations because of its international character, means of support and ideology has served principally in the field of technical assistance and training. These are unaltruistic fields, but they are precisely the fields of strength of an international organization. Consequently, they have been assigned these areas of assistance.

109. The United Nations Special Fund has already a number of projects in Africa executed through its agencies such as the Centre for Industrial Development, FAO, ILO, UNESCO, LAEI, etc., and it will have to determine what co-ordination is necessary within its own family in order to obtain the maximum competence in the staff to be provided for the many fields in which the institute will work.

110. In order to assist the institute in its study advice and execution of projects in the very specific and specialized industrial fields of basic industries such as petroleum refinery, heavy chemicals, steel, fertilizers, cement, machine tools, etc., the United Nations Special Fund, ECA, and the Centre for Industrial Development should also explore the possibility of having a pool of high grade consultants to be made available to the institutes for short terms up to three months.

111. The total cost of experts on the field and short term consultants, and the training of local counterparts is estimated at \$8 to \$10 million.

Economic Commission for Africa

112. The ECA has a dominant role to play in establishing liaison between the institute and the Governments of the countries of the sub-region and in providing the liaison between the institutes and the United Nations family. It could further provide the means of co-ordination of the research programmes of the institutes in Africa and act as central agency for the dissemination of inter-territory information. In the hope and expectation that ECA will fulfil this important role, a representative of ECA has been recommended to be on the board of each of the sub-regional institutes.

X. SUMMARY AND CONCLUSIONS

113. Considerations of the more pertinent and urgent needs of African countries to develop suggest that applied research should be given preferential support rather than fundamental or basic research. Developing countries cannot afford to expand their very scarce scientific talent on obtaining new scientific knowledge, except in so far as it has application in a current problem. It is suggested that industrial research which is applied research for industry and the organization for drawing effectively on the large reservoir of scientific knowledge and technologies offers the greatest scope and chances for rapid industrial development desired by the African countries.

114. The study of the needs of African countries for development of industries and implementation of their industrial programmes, and consideration of the scope and functions of industrial research indicate that industrial research as defined would not meet all the needs, and that an institute which combines the functions of industrial research, testing, consulting, and direct technical assistance to industry would be required.

115. A review has been made of the existing and planned institutes of industrial research, building, food research and processing, standards, and productivity for the 36 countries covered by this study. The review reveals that, except for Egypt which has the institutions and trained staff to service the needs of industries in their country, the Sudan which will have adequate institutional devices when the projects now approved become operational, and Kenya, Nigeria and Ghana which have facilities but inadequate to meet total needs, the other 31 countries have either meagre facilities or none at all.

116. The functions of an institute of industrial development and research are defined and the requirements of staff, equipment, buildings, and services and organization are detailed.

117. The main requirement in organizing for research or other scientific activity is to provide an atmosphere in which this activity can flourish. It has been conclusively shown in other countries that the administrative structure of government is not suited for this kind of activity. In research all major decisions must be made by the research worker while in government a chain of command is provided for decision making. A research organization requires flexibility as an essential prerequisite for service. The institutes proposed are therefore to be set up as autonomous bodies under a board and the powers and duties of the institute are vested in the board by an act.

118. The arguments for and against sub-regional institutes have been considered and it is concluded that the greater interests of the African countries will be served best by sub-regional institutes. The following sub-regions have been suggested (see map and table, annexes I and II).

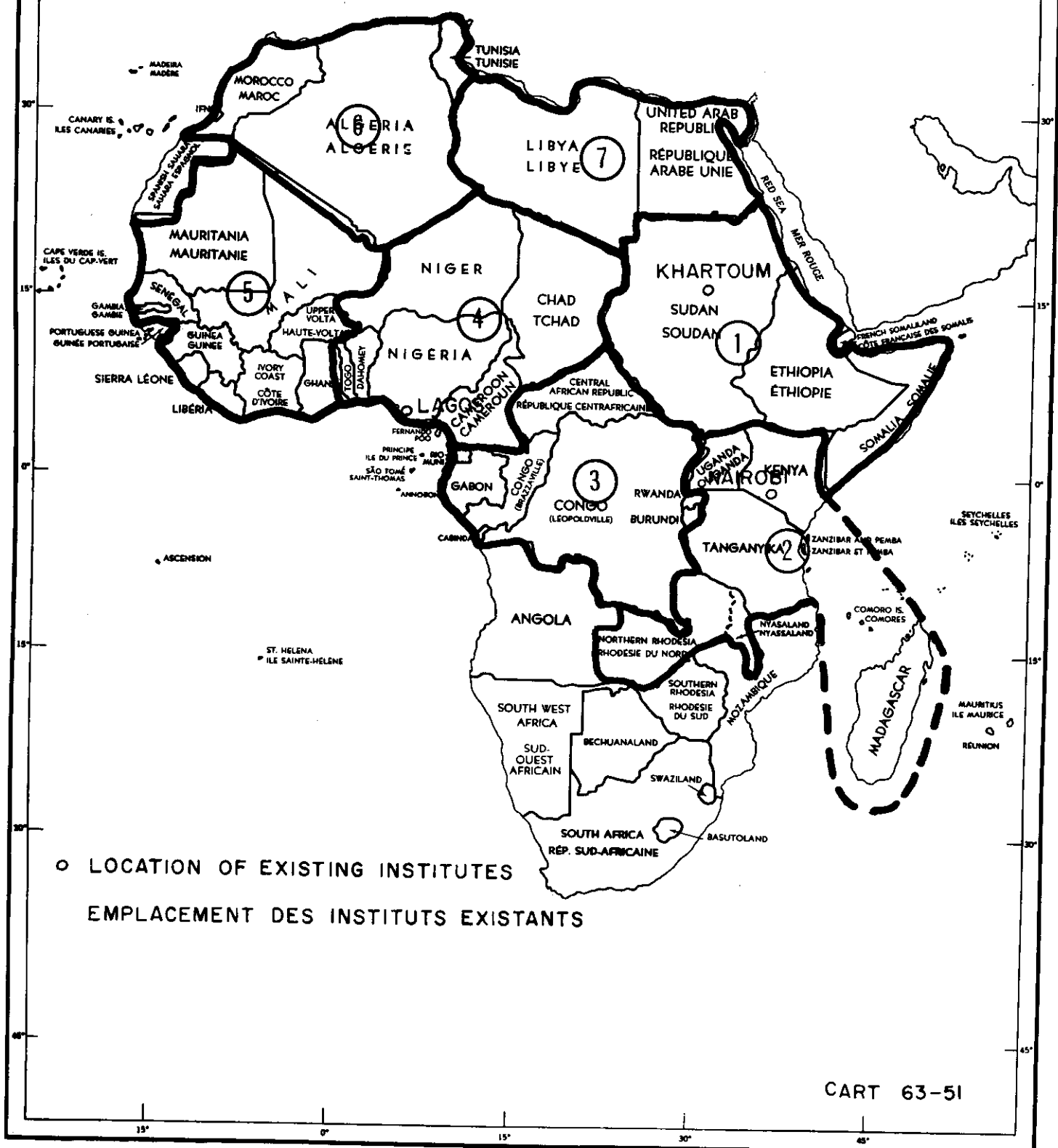
- (a) Sudan, Ethiopia, and Somalia
- (b) Kenya, Uganda, Tanganyika, Madagascar, Nyasaland, Northern Rhodesia, Zanzibar and Pemba
- (c) Congo (Léopoldville), Congo (Brazzaville), Rwanda, Burundi, Gabon and Central African Republic
- (d) Nigeria, Cameroun, Chad, Niger, Dahomey and Togo
- (e) Ghana, Ivory Coast, Upper Volta, Liberia, Mali, Sierra Leone, Guinea, Senegal, Mauritania
- (f) Morocco, Algeria and Tunisia
- (g) Libya and UAR (Egypt)

The legal implications of the establishment of a sub-regional institute are discussed and a draft act (annex III) is presented which overcomes these problems.

119. The role of international agencies, aid giving Governments and the ECA are discussed and particular areas of assistance in each case suggested. The order of financial assistance for the seven sub-regional institutes is of the order of \$18 million made up as follows:

UN Special Fund (personnel and training)	US\$8 - 10 million
Aid Governments (equipment)	US\$8 "

PROPOSED SUB-REGIONS FOR INSTITUTES OF INDUSTRIAL DEVELOPMENT AND RESEARCH
 SOUS-REGIONS PROPOSEES POUR L'ESTABLISSEMENT D'INSTITUTS DE DEVELOPPEMENT
 ET DE RECHERCHE INDUSTRIELS



ANNEX II (Cont'd)

Group	Country	Per capita GDP at factor cost (US dollars) ^{1/}	Mid-year population est. 1958 (millions) ^{2/}	Area in 1000 sq. miles	GDP at factor cost (million US dollars) ^{1/}	Annual Contribution at 0.02% of GDP
5.	Ghana	158	6.2	91.8	986	197,200
	Ivory Coast	199	3.0	127.5	615	123,000
	Upper Volta	38	4.0	106.0	159	31,800
	Liberia	122	1.2(1960 est)	43.0	153	30,600
	Mali	116	3.9	460.0	428	85,600
	Sierra Leone	64	2.3	27.9	154	30,800
	Guinea	117	2.7	94.9	311	62,200
	Senegal	179	2.7	76.0	411	82,200
	Mauritania	102	0.7(1960 est.)	419.0	65	13,000
			26.7	1,446.1		656,400
6.	Morocco	159	10.9	171.0	1,753	350,600
	Algeria	220	10.2	113.8	2,285	457,000
	Tunisia	145	4.0	48.3	586	117,200
7.			25.1	333.1		924,800
	Libya	127	1.1	679.4	146	29,200
	UAR (Egypt)	116	24.6	386.0	2,861	572,200
			25.7	1,065.4		601,400

Sources and Notes:

- 1/ United Nations, Yearbook of National Accounts Statistics, 1962, p. 314.
- 2/ ECA Population Branch, Study on Recent Demographic Levels and Trends in Africa, table 3 -- 1960 mid-year estimates adjusted by rates of growth of population in African countries (table 6) to arrive at mid-1958 estimates.
- 3/ Project approved by the Special Fund.
- 4/ East African Industrial Research Organization at Nairobi.
- 5/ Sub-regional office to be located in either country.
- 6/ Research Institute already established.
- 7/ National Accounts of the Federation of Rhodesia and Nyasaland, 1954-1962.

ANNEX II

Showing groupings of sub-regions and contribution expected from countries

Group	Country	Per capita GDP at factor cost 1/ (US dollars)	Mid-year population est. 1958 2/ (millions)	Area in 1000 sq.miles	GDP at factor cost (million US dollars) 1/	Annual Contribution at 0.02% of GDP
1.	Sudan 3/ Ethiopia Somalia	82 40 51	11.1 19.3 2.0	967.5 400.0 246.3	915 799 101	183,000 159,800 20,200
			32.4	1,613.8		363,000
2.	Kenya 4/ Uganda Tanganyika Zanzibar and Pemba Nyasaland 5/ Northern Rhodesia 2/ Madagascar	85 65 52 101 116	7.6 6.3 8.9 0.3 2.7 2.3 5.1	225.0 94.0 361.8 1.0 49.2 288.1 227.8	582 411 468 30 121 1/ 398 1/ 596	116,400 82,200 93,600 6,000 24,200 79,600 119,200
			33.0	1,246.9		521,200
3.	Congo (Léopoldville) Congo (Brazzaville) Rwanda Burundi Gabon Central African Republic	87 185 53 209 114	13.5 0.8 4.7 0.4 1.1	905.4 139.0 10.2 10.8 102.3 238.0	1,168 144 133 115 87 135	333,600 28,800 26,600 23,000 17,400 27,000
			20.5	1,405.7		456,400
4.	Nigeria 6/ Cameroon Chad Niger Dahomey Togo	81 114 70 68 70 78	33.8 4.0 2.5 2.6 1.8 1.3	356.7 160.0 495.0 490.0 44.3 21.2	2,740 456 182 169 121 111	548,000 91,200 36,400 33,800 24,200 22,200
			42.4	1,567.2		755,700

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ANNEX III

AN ACT TO PROVIDE FOR THE ESTABLISHMENT OF A SUB-REGIONAL
INSTITUTE OF INDUSTRIAL DEVELOPMENT AND RESEARCH

(For the text East African region has been chosen)

1. This Act may be cited as the East African Institute of Industrial Development and Research Act.
2. (1) There shall be established in accordance with the provisions of this Act, an Institute which shall be called the East African Institute of Industrial Development and Research hereinafter referred to as "the Institute".
(2) The East African Institute of Industrial Development and Research shall in that name be a body corporate consisting of the persons for the time being holding office as members of the Governing Board thereof as hereinafter provided, and shall have a common seal and may sue and be sued in its corporate name.
(3) The headquarters of the Institute shall be in or in such other place within the sub-region as may be chosen for the principal operations of the Institute. The Governing Board in consultation with the representative Governments may also establish branch institutes if the need so arises.
(4) The sub-region shall consist of Madagascar, Kenya, Uganda, Tanganyika, Nyasaland and Northern Rhodesia.
3. The objects of the Institute shall be:
 - (a) To undertake testing, investigation and researches in such manner as the Institute may deem advisable with the object of improving the technical processes and methods used in industry, of discovering processes and methods which may promote the expansion of existing or the development of new industries in the sub-region or the better utilization of the raw materials or waste products of the region.

- (b) To advise the Governments of the countries of the sub-region on questions of scientific, technological and industrial matters affecting the utilization of the national resources of the sub-region, the development of their industries, and the proper co-ordination and employment of scientific research to those ends.
 - (c) To assist the Governments of the sub-region in the formulation and development of standards and to provide services of testing of industrial products.
 - (d) To render to industry, Government enterprises and entrepreneurs technical assistance in the formulation, planning, execution of industrial concerns, and in the organization and operation of industries existing or to be established in the sub-region.
 - (e) To undertake or to collaborate in the preparation, publication and dissemination of useful technical information.
 - (f) To provide through a technical and specialized library a technical information service to the general public of the sub-region.
 - (g) To co-operate with departments of Governments, universities, technical colleges and other bodies in order to promote scientific and industrial research and the training of investigators in pure and applied sciences and of technicians, craftsmen and artisans; and
 - (h) To assist otherwise in the advancement of industrial research and technical training.
4. (1) The Institute shall have power:
- (a) To acquire in any manner whatsoever and hold any movable or immovable property and to dispose of any such property acquired or held by the Institute;
 - (b) To negotiate and receive aid in personnel or equipment from the United Nations Agencies, Governments, Foundations and other organizations of aid;

- (c) To impose and recover chartes for its services;
 - (d) To apply for, purchase, receive by assignment or otherwise acquire any patents, brevets d'invention, concessions, licenses and the like conferring exclusive or non-exclusive or limited rights to use, or any information as to, any invention or discovery; and to develop, use, exercise, assign, transfer, sell, grant licences in respect of, or otherwise turn to account the property, rights and information so acquired; and
 - (e) To perform all such acts as may be necessary for, or incidental to, the carrying out and performance of its objects and duties.
- (2) Subject to the provisions of sub-section (3) of this section, it shall be the duty of the Institute as far as its competency and finances permit:
- (a) To conduct and render research and technical services for the benefit of:
 - (i) The Governments of the sub-region or any department or agency thereof; or
 - (ii) Any public authority or regional organisation;
 - (iii) Any industry which is or is to be carried on in the sub-region;
 - (b) To take all such measures as may be necessary for the fulfilment of its objects;
- (3) The Institute shall not undertake or perform any work which, in the opinion of the Governing Body, is contrary to public interest.
5. (1) Subject to the provisions of this Act, the powers and duties of the Institute shall be vested in a Governing Board, hereinafter called "the Board".

(2) The Board shall consist of:

- (a) Six members each of whom has distinguished himself in science or industry or is otherwise specially qualified in relation to some aspect of the Institute to be appointed by the Prime Minister of each of the six countries of the sub-region;
- (b) The representative of the Executive Secretary for the Economic Commission for Africa;
- (c) The two following ex-officio members:
 - (i) The person for the time being holding office as the Secretary General of the East African Common Services Organization;
 - (ii) The person for the time being holding office as Director of the Institute.

6. A person shall be disqualified for being a member of the Board if, having been adjudged an insolvent or bankrupt, he has not been granted by a competent court a certificate to the effect that his insolvency or bankruptcy has arisen wholly or partly by unavoidable losses or misfortune.

7. Any member of the Board who is not an ex-officio member shall, unless he vacates his office earlier or is removed from office by the Prime Minister who appointed him, hold office for a term of two years and shall be eligible for re-appointment.

8. (1) A member of the Board shall vacate office:

(a) If, not being an ex-officio member,

- (i) He resigns office
- (ii) He is removed from office by the Prime Minister of the country he represents;