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THE ACQUISITION AND TRANSFER OF TECHNOLOGY FOR PRODUCTION ACTIVITIES
IN AFRICAN COUNTRIES

(Note by the secretariat)

Introduction

This paper sets out the point of view of the ECA on the subject of transfer of technology and the issues in this field which form the main items of concern within the African region. Within this region, the scope of the subject of technology transfer is much wider than the present coverage of the formal concern and discussions which have been going on in the UN system as the result of the UNCTAD II Resolution on technology transfer. Most current discussion in the UN relates to the transfer of patented or privately owned technology which can only be obtained through suitable contractual agreements. This is primarily the type of technology involved in highly sophisticated production processes, or in large-scale production processes, or in the manufacture of specialized products possessing a large technology content. Whilst this area of technology transfer is of considerable importance, it has present significance only for those countries the region that have already attained a significant level of production technologies and that are ready to move into medium- or large-scale production of modern products with wide markets.

Within the African region, our concern covers the whole question of the acquisition and transfer of technology for production in the African economies. This includes the transfer of technology to improve the production of age-old traditional products, the transfer of technology to small and medium-scale industries, as well as the acquisition of large-scale production technologies for mass market goods. However, the production technology required in the African region does not relate to industry alone. A great deal of improvement is necessary in the transfer of technology for agriculture, particularly for food production in the region. This is a crucial

area about which a lot has been said but relatively little achieved in the African region, probably due to too much discussion giving the impression of ongoing action.

One general question that requires attention before one starts to discuss the special features of the subject, is the question of the level of technology. This is a sorely debated question with many protagonists of different viewpoints. A viewpoint which is strongly promoted is that the African countries do not require the advanced, sophisticated technology which is employed in production in the developed countries, but simple technology and simple equipment which is easier to use and easier to maintain. The most vocal protagonists of this viewpoint who form the "Intermediate Technology School" go further on to add that the simple technology and equipment required in the African countries are to a large extent already available in the form of old machinery and simple processes which were in use at an earlier period in the developed countries, but have now been superceded or replaced by more complicated and increasingly more highly automated technologies. In fact, one organization exists, run by believers in this view point, which has prepared reference lists and catalogues of "intermediate technology" equipment and their existing suppliers. This approach of selecting deliberately simple, older technologies, is often buttressed by the argument that they are more labour-intensive than newer technologies and so will promote employment.

The arguments of the opposite school of thought are equally persuasive. Essentially, this group argues that the most up-to-date equipment and technology should be selected, having regard to the type and scale of production. This would provide lower costs of production because of greater efficiency in the utilization of factors and hence would make the local products more quickly competitive with similar products from other advanced countries. This school of thought argues generally that deliberately selecting obsolete or obsolescent technology is a faulty investment policy for industrialization and that the economics of each project only should determine the choice of technology. This debate is still going on and it is our hope that the contributions which will arise in the discussion of the Advisory Committee will throw some more light on the subject.

In addition to the debate on the level of technology, there is the question of the background to the transfer of technology which already exists within a country. It is important to consider the question of background because transferring technology is, in some ways, like building a house. No house of any significance can be built except on a foundation, and the importance of the house that can be built depends on the extent and the importance of the foundations already laid. So it is with the transfer of production technology. Any plan or programme for technology transfer in any production area must be based either on existing traditional production methods, or where there is no such base, this must be created through a minimum of formal technical education within the educational system. Technology transfer is a cumulative process; the wider the existing technology base, the greater the amount of technology that can be transferred and the faster the rate of absorption of new and more sophisticated technologies.

Purpose of transferred technology

The kind of technology, the sources and the arrangements for its transfer will vary according to the type of production for which it is intended. The present range of production activities which are of concern within the region can be covered by the following categories :

1. Operative technology for small-scale traditional industries.

In each country there exist a number of traditional industries producing consumer products such as shoes and articles made out of leather, different kinds of woven and knitted textiles, special types of fabrics with traditional embroidery, carpets, domestic utensils for use in the kitchen and in other household tasks, brassware for utilitarian and decorative purposes, ornaments in precious metals such as gold and silver; many more examples can be enumerated. Many of such articles are widely available in local markets and form part of the familiar range of consumer articles available in the markets and in the shops. However, because of the small scale and the low productivity of the traditional methods of production, we are beginning to

experience the phenomenon of imported articles which imitate these local traditional products coming into the market to replace the local production at lower prices. In other cases, imported products for similar purposes but of a different design origin are coming in to compete and, sometimes, to displace the locally produced traditional goods, owing primarily to their lower cost and to new utilitarian features in the competing products. Some action is necessary in order to preserve and also expand the production of these traditional industries. This is not just for sentimental reasons, but because some of the traditional products are better adapted to the local pattern of life and their production provides employment for a considerable number of craftsmen working in small groups in each African country.

In this field of manufacture, improvements are necessary in production methods and in product design. Better production methods are necessary to improve the quality and increase output and so bring down the cost of these traditional products. This will often involve the introduction of better tools and perhaps some measure of mechanization of arduous manipulative operations. In addition to improving the technology and the employment employed in these traditional industries, it is also necessary in some cases for improvements to be made in the product design. Some of the current designs are very old and appear to have been frozen in the product forms. They have evolved very little even though the societies have changed considerably over the past decades. This category of production is an important one to provide for in any planning for transfer of technology.

2. Operative technology for technical services

(e.g., building, plumbing, electrical installations, vehicle repair, black-smithing, etc.). In all these fields, there are existing craftsmen, and depending on the country, they are at different levels of skill and knowledge of modern techniques, modern materials and modern processes in their various fields. However, in the plans which all the African countries are

preparing for the building of infrastructure, for housing and urban development, for the creation of public service facilities and all kinds of industrial installations, many of the new structures and plants have to be constructed to modern designs which require the most up-to-date techniques in such areas as civil engineering construction, building, and equipment installation. It is necessary that the present local craftsmen and the future ones be properly introduced to the latest techniques in these different fields, so that we will not have a perpetuation of the situation in many countries where blacksmiths, motor mechanics, electricians etc. have to be imported from European countries to build up the local environment.

Some of the technology transfer which is necessary can be carried out in the trade schools. However, in most modern types of installations and large building programmes, special techniques are employed which are often the property of particular contracting firms, or of equipment suppliers. Hence, all the technology that is required in these service occupations cannot be properly covered in the trade schools. Other special arrangements will be necessary in order to ensure that local labour with the required skills is available for the work of building up the new cities and the new industries and that less money will be spent in the future in hiring skilled manual workers from developed countries for this category of operations.

3. Operative technology in the area of rural agriculture, food processing, preservation and storage

In the area of agriculture, the age-old practices and habits of life among peasant farmers have resulted in the present pattern of production and the present level of productivity. Since agriculture and agricultural practices are very much tied in with the nature of the environment in terms of soil, weather, water supply and other local physical characteristics, in general the necessary technology for the improvement of agricultural production is not available as a matter of course by simple transfer from the

developed countries, which are largely in temperate climates. This means that a great deal of the operative technology in the area of rural agriculture has to result from local R. & D. which will provide successful techniques for direct application. The situation is similar with the processing of foods and the preservation and storage of food products. Many of the staple foods and food products which are widespread in the African countries are peculiar to those countries and the improvement of the methods and the technologies for producing these food products again will require local R. & D. or, in any case, research and development on local products.

The first step in this process will involve the study of existing traditional food production processes so as to establish the physical, chemical and biological parameters of traditional production techniques. These can then be extended and improved by the introduction of modern scientific concepts in order to evolve better methods in terms of product quality and productivity. After the research and development has been successfully completed, extension arrangements will be necessary, including the use of pilot projects, so as to transfer these improved technologies and in some cases, new equipment, to the local producers.

One point which has been neglected in many countries where steps have been taken to study existing traditional food processing procedures and to develop modern versions has been the failure of governmental research institutions to promote the adoption of their newly developed methods by local businessmen. It is important that the policies and procedures be formulated for associating local businessmen with the operation stages of pilot plant projects.

4. Operative technology for import substitution industries

In this category we are dealing with the production of goods which are currently being imported and hence only obtainable from abroad. Two important characteristics of these imported products are that they have been designed as well as manufactured abroad. Hence the subject of the transfer of technology in this category of industries has two aspects: there is the aspect which relates to the technology incorporated in the product design and a second aspect which concerns the technology for the manufacture of the product itself. Where the product design is patented or otherwise privately owned, the transfer of the design technology can only be practical for medium and large scale industries. However the technology for the manufacture does not necessarily fall into the same category as the technology for the design. This is to say that many patented products can be manufactured by generally known and well established production methods. Hence we can have a product based on a patented design, but which can be manufactured by generally available methods of manufacture. On the other hand, both the design as well as the manufacturing process may be privately owned and only obtainable under licence, or by similar contractual arrangements. The main issues for this category of production are as follows :

- a) where the technology necessary for the product design is not patented and is available from general technological sources, what arrangements are necessary for the acquisition and transfer of such technology?
- b) where the technology for production is also generally available and not patented, what would be suitable mechanisms for the acquisition and transfer of such technology?
- c) in the other two cases where the product design is patented and where the special methods of production are also privately owned, it is unlikely that many

African countries will be able to acquire the technologies involved other than through the method of inviting the foreign company that owns the patent to set up a subsidiary for the production of the particular goods.

There may be other approaches to this question which will be raised in the discussion by the Advisory Committee.

5. Operative technology for export oriented industries

Products intended for export markets have to compete in quality, in the excellence of design as well as in price against similar goods produced in other countries. Hence significant success in the transfer of technology for export-oriented industries is only likely to be possible when there exists already a background of a fairly high level of technological capability within a country. However, there is one area in which the African countries can, through specialization, make an impact and compete successfully; this is in the area of production of basic minerals and in extraction of metals and other raw materials from mineral ores.

Within this field, the technology required is essentially large scale technology except perhaps where very rich deposits of precious metals are concerned. Processing techniques will require to be developed to suit the geological and chemical characteristics of the mineral deposits occurring in the area concerned. Even where the technology is borrowed, it will require some modification to adapt it to local conditions in terms of the raw materials and the kinds of skilled labour available. Hence a prerequisite for successful technology transfer in this field of production is the creation of adequate supporting institutions, locally, for research and development in the technologies concerned.

18 November 1969

MODERN TRENDS IN TRANSPORT TECHNOLOGY AND THE DILEMMA OF AFRICAN
TRANSPORT DEVELOPMENT

(Note by the secretariat)

1. The background to the work of the Economic Commission for Africa in transport may be summarized as follows:

- (i) relative thinness of population and wide dispersal of population concentrations;
- (ii) a high ratio of land-locked countries. The Region accounts for fourteen out of the total of nineteen land-locked countries in the developing world;
- (iii) a high ratio of least developed countries among developing regions;
- (iv) an economic system characterized by a small number of modern-oriented urban enclaves in a vast sea of rural backwardness;
- (v) continuing dependence on agricultural exports (with, however, several marked exceptions) for development resources, in conditions in which such exports (subject to both geographical and commodity constraints) show an apparently irreversible long-term downward trend simultaneously with a rapid growth in population and in the dependency ratio;
- (vi) practically no links among African countries except for purposes of transit traffic;
- (vii) poor use of inland waterways and coastal shipping.

2. The determinants of African transport development may be described as follows. One of the fundamental issues of today is the limited capacity of advanced countries to absorb the export products of the developing world. Tariff reductions or removals, non-discrimination policies, commodity management arrangements, etc., are unlikely to make more than a marginal contribution towards solving this problem. What is required is an enlargement of total world trade possibilities which remove or considerably modify the geographical and commodity constraints which characterize the present direction of flow, volume and composition of world trade. It seems clear that with a population of more than 300 million and with its enormous natural resources the Region itself constitutes such potential enlargement of the world market whose possibilities require study and exploitation. From this point of view the secretariat's major concern today is the integration of national economies as well as the linking of national markets with each other. To pull a national economy upwards as a whole would require the deliberate establishment of new urban and semi-urban relay centres (rural townships) through which modernizing influences reach the rural areas, and the deliberate, planned forging of links between such relay centres and the surrounding rural communities. The development of the physical 'plant' required would involve, for example, an integrated programme of rural housing, rural water supplies, rural electrification and rural transport links.

3. These objectives can be achieved most rapidly through utilizing the revolution in transport technology which is now in progress. But the contribution of the rapid growth of transport technology can only be taken full advantage of, if certain preconditions exist. Perhaps the most crucial of these is the capability to determine precisely when, where and how specific forms or aspects of this rapidly developing technology can be applied to produce optimum results. This capability implies a substantial supply of manpower of high quality over a wide range of specialisms including: the analysis and evaluation of existing transport systems; the design of new systems and projects; management;

research and innovation; and manufacturing. The transport planning function, it will be apparent from paragraph 3, is now developing into a complex, inter-disciplinary operation closely associated with policies and methodologies for regional (i.e. physical) planning.

4. In a report recently prepared for the United Nations it is stated that:

"The old economics of government planning to view transport costs as a separate entity are waning. The new methodologies demand that the costs of transport be related to other costs in the 'distribution' amalgam, such as costs of capital tied up in stocks or inventory (both for inputs and finished products), costs for packaging, for insurance, for handling, storage, warehousing, and inventory control, for documentation, for communications and so on. In other words, what appears to be lower costs in transportation may be the cause of higher costs in other components of the total distribution amalgam and therefore it is no longer sufficient to view only the 'ratio of transport costs to commodity value'. The ratio of the 'total costs of distribution to commodity value' is more relevant."

It will be noted from the passage quoted that the full benefits to intra-African transport which may come from modern transport technology will depend as much on managerial and organizational competence as on technological capability. Yet, on evidence currently available, these are two of the factors in which Africa is most strikingly deficient.

5. In another recent bilateral study of transport in a part of the region it is stated, correctly, that:

"The survey of national development plans, potentials for economic development, and the existing transportation system again highlighted the widespread and serious shortage of skilled employees and of management and executive personnel.....This shortage of personnel

is more serious than are constraints of facilities or equipment. It also has an effect on the general availability of data for planning and decision-making purposes, but if appropriate personnel and inter-governmental organizations were available, planning for regional cooperation and integration could be materially advanced, despite the data shortage."

When attention is turned to inter-continental transport it is easy to notice that the transport revolution which holds such great promise for intra-African development, presents a menacing picture. Bulk ocean carriers, containerization and large supersonic jets demand vast capital and recurrent expenditures on on-shore installations and, at least the case of the latter two, far-reaching changes in the organization and operation of inland transport, in customs administration and in international economic relations. There is, at the same time, not the least certainty that any net benefits will accrue to the developing regions. Indeed, there are reasons to believe that these innovations will not only impose irrecoverable direct costs on African countries but that they will, by destroying the natural protection which distance offers to their emergent industries and by diverting capital investments from the restructuring of the African economies through accelerated industrialization, inland transport development and trade promotion, broaden and strengthen the socio-economic systems from which Africa is trying to escape.

6. The dimensions of the major issues in African transport development are scarcely yet perceived by those most likely to benefit or to suffer from failure in policies or action. At first glance the observer is tempted to consider the main bottleneck as men and institutions. On closer scrutiny it appears to be more fundamental: knowledge, perception and will. The weightiest of the functions of the ECA in the field of transportation in the next year or two may turn out to be to illuminate and to persuade.

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THE APPLICATION OF SCIENCE AND TECHNOLOGY
IN THE FIELD OF AGRICULTURE

In broad terms, the major issues confronting African agriculture today may be logically discussed and approached under the following heads:

1. The mounting evidence that a reducing proportion of the economically active population are engaging in the field of agriculture, in a situation now calling for an increase in overall agricultural production of some five per cent per annum. Productivity per man employed and per acre have therefore to be increased substantially each year.
2. Evidence of a gradual shift from subsistence to commercial production, which brings in its train an increasing need to rationalize the marketing of agricultural produce including livestock products; need to improve the various systems concerned with transport and delivery of agricultural produce; need to provide all-weather storage and the prevention of waste; and lastly, to increase the facilities now available for food processing and food preservation.
3. Rationalization of the organizational problems concerned in the gradual but inevitable shift from labour-intensive systems of management to capital-intensive systems bearing in mind the need to consider the social and other factors implied in such changes.
4. In circumstances where per capita earnings are increasing, to organize agricultural productive efforts so that improved nutritional levels are satisfied by a shift in emphasis from the current preponderance of starchy

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foods common to human diet in Africa, to provision of balanced protective foods, biologically and nutritionally more suitable for physical and mental growth and development. The latter would consist largely of foods of animal and/or poultry origin, and would also include fish, vegetables and legumes.

5. Recognition of the problems posed in competitive world markets by receding prices for certain categories of tropical and sub-tropical products and the necessity, assisted through the agencies of science and technology, to convert some of these basic agricultural products into forms more acceptable in terms of market demand and price.

Fundamental to all other aspects, are those factors which determine overall levels of production.

I. Productivity and manpower

It is evident that to achieve increased productivity with a shrinking labour force and level of cultivable land, that substantial change is now required in the current pattern and organization of agriculture, in the subsistence as well as in the commercial sectors. In the subsistence sector, representing possibly sixty per cent of total agricultural production in Africa as a whole, traditional systems have emerged which previously had meaning and were effective in their special settings. Maintenance and recovery of natural fertility are fundamental to the system of shifting cultivation developed and practised in this sector, producing yields, however, sufficient only for subsistence purposes. This system of husbandry applies reasonably well in Africa so long as there is cultivable land left sufficient to satisfy the needs of current demand. The future, however, holds out no such promise that plenty of suitable cultivable land will be available, and that with the cumulative effects of erosion, caused largely by inefficient cultivation and livestock management techniques; as presently exploited, land in Africa is a wasting asset.

Pressures on good cultivable land, under shifting cultivation, even now are in need of modification of the time span required by natural recuperative processes to ensure continuation of current productive levels.

In many regions, and particularly those situated in high rainfall areas, the ten-year recuperative resting period is now becoming seven or even six years, with evident effect on yield. In this day and age, maize yields averaging 700 lbs per acre, which for instance is the approximate mean yield of maize in West Africa, are no longer sufficient to supply the needs of current human populations. Recourse has now to be made to outside markets, and therefore to other individual's efforts, to supply a fair proportion of the region's basic requirements of cereals, particularly in those years when growth for one reason or another is unfavourable.

Subsistence agriculture must now be appraised more critically against the background of the general economy of a country as a whole; as viewed against human carrying capacity and as dictated by the continuing need to expand production. Agricultural development planning in its fullest sense, has barely started in Africa. Data must now be assembled based on land classification, soils evaluation, water resources, accessibility and other factors of like importance, so that plans can be formulated which more nearly meet the demands of the times. It may be when this has been done, that even with modest inputs and reallocation of land based on technological and scientific appraisal, and more nearly in line with the African farmer's physical and other potentials, that effective change in productive levels could be achieved in a relatively short period of time, and a move away from traditional practices encouraged in the direction of production centred on economics and not on maintenance of an existence and of a way of life.

The spread of education is having a significant impact on attitudes toward agriculture. To some of the rising generation education means escape to the bright lights of the larger village or city, to others it opens up horizons which mean escape from agricultural drudgery and poverty providing at the same time a sense of purpose in the environment of their choice.

What are the principal technological processes and applications of science most likely to hasten agricultural progress in African in a situation where level of production must be the yardstick by which we measure such progress?

1. We must start with the land and its allocation, based realistically on its land-use classification and intrinsic value to produce crops and livestock, and on its potential examined in terms of basic fertility and suitability for growing certain crops and/or pasture, an approach, for instance, which even now is being successfully employed in the resettlement areas of Kenya.
2. We must learn more about the cultivators and their practices; the livestock producers; the rural craftsmen, the people involved in the process of transportation and marketing; the food processors; the skills attained by each class of rural participant, and the level of training and education required to raise levels of efficiency and productivity still further.
3. To improve all farm crops through selection of the best seed and planting material, and to institute a programme of yet further improvement through intensive plant breeding and seed and plant distribution.
4. To improve livestock production by improving general health standards, by careful selective breeding using the best genetic stocks available, and by raising the standards of nutrition for all classes of farm livestock.
5. To raise the value of pastureland, and therefore of carrying capacity, through better management practices and by the introduction and enclosure of newly-sown or planted pastures which would include more productive species.
6. To encourage much greater use of balanced mineral fertilizer which will lead to the improvement of crop yield and of pastureland. In this respect, Africa lags far behind the countries of Europe and of North America in its appreciation of the betterment which accrues to this practice.
7. To prevent waste, by protecting crops and stock by spraying and/or dusting or dosing with appropriate chemicals and pharmaceuticals against the ravages of insects, fungi, bacteria, viruses and conditions of disease in general.

8. To develop processes concerned with the preservation of crops, food-stuffs and animal products, and to develop improved food technologies which offer modified commodities, thus widening the scope of current markets available to the farmers of Africa.
9. To carry out market research and to provide market intelligence which would enable rationalization and more efficient organization of the marketing process.
10. To gradually increase the scope and application of power-assisted farming (including bullock farming) where such aids are likely to prove economic. At the subsistence level of farming, graduation to a market economy will be further assisted by the wider introduction of small hand-operated or low-powered tools, so successfully applied in Japan and in certain countries of Europe. Small hand tools, as aids to the traditional hoe or cutlass, could be expected to increase the area of cultivable land which an individual farmer could handle economically.

In the package indicated above, which includes the most important steps necessary to ensure that manpower is given both the climate and the capacity to go on producing in ever more demanding circumstances, it should be observed that applications of agricultural technological processes and of multi-disciplinary science will be vital in the future if progress is to be maintained. The key to the whole situation, the farmer himself, must be enabled and assisted to break out of his current economic confinement.

Change from subsistence to a market economy would in itself create new yet substantial demands for the products of industry in Africa.

II. Technological aids in the shift from subsistence to commercial production

Resolution 112 (VI), adopted by the Economic Commission for Africa in its sixth session in February 1964, "urged all Governments of member States of the Commission and those Governments and Agencies providing aid to the Region, to give favourable consideration to projects and

measures leading to accelerating transition from subsistence to market agriculture through raising productivity levels in the agricultural sector and through improving the necessary institutional requisites particularly in the fields of marketing, credit and agricultural extension.

It would be interesting to know what progress has been made towards the realization of this resolution in the last six years, what encouragement and initiative African Governments have offered to their large subsistence farming groups to enable them to achieve economic emancipation.

It is generally agreed that the vast majority of agricultural producers fall into a category usually described as "emergent producers who have made a little headway in the market economy but whose sales are still less than their own consumption"^{1/}.

To effect a smooth transition from subsistence to market agriculture, different kinds of Government assistance may be necessary, one of broad coverage involving as a priority, the intensive application of relatively simple extension techniques but particularly those oriented towards crop improvement through development of improved seed supplies and greater use of fertilizer and on the other hand application of those measures more concerned with institutional problems including the organization of co-operatives, development of credit facilities and of market infrastructure, and finally the organization of a system of rural service which would include a contract farm machinery pool, and contract production enterprises aimed at the export market or for local processing.

Transport and marketing facilities are also clearly basic factors in the transition from subsistence to market agriculture. It is obvious that construction costs of modern communication are only justified when schemes are carefully costed against benefit, where, as an example, operating costs can be reduced enabling perishable produce to reach a market from inaccessible areas. All weather feeder road construction may often be justified where

^{1/} FAO/ECA Expert meeting on Government measures to promote the transition from subsistence to market agriculture in Africa, 1964.

central depots are set up, serviced by more primitive forms of rural transport, where the bulking and grading of produce is possible before the final haul is undertaken to an organized market centre. In Africa the whole problem of transport and marketing in remote areas offers technical challenges of considerable importance for which solutions must be offered if market agriculture is ever to assume its proper place. The magnitude of the task is enormous in technological terms, involving as it does the correct choice of transport medium, the size and type of container or transporter, appropriate to the circumstances, and finally, but by no means least, determination of the standards of road-building, economically justified for a given volume of new trade in any area.

Much of the success of a change from subsistence to market agriculture, a problem involving up to 70 per cent of the land and 60 per cent of the agricultural labour supply in Africa, will depend on participation of the people involved in such change.

The system described as "block farming", more usually associated with mechanized cultivation, might well be applied in a modified way to the grouping of subsistence units under a co-operative, where planning and decision making was left to the collaborators with assistance and guidance from the local extension officer. Participation and collaboration of the people in the production process where the end-product is designed for export or for local processing, could lead realistically to such arrangements as provision of all-weather storage, operated on a co-operative basis, to service spraying where this was necessary, and to co-ordination in the use of local service machinery for which the co-operative would be responsible. Fertilizer could also be ordered through the same channel.

III. The shift from labour-intensive to capital-intensive management

By definition, capital-intensification of agriculture is generally accepted as referring to large-scale agricultural projects. Where livestock is concerned, it may also refer to the pooling of small numbers of animals into larger groups, with the necessary housing and other

management facilities operating on a communally organized basis. Intensification can also be interpreted to mean integration of livestock and arable farming, which is particularly valuable as a medium for providing a regular source of income over the greater part of the working year. Income from crops alone tends to be highly seasonal. Intensive arable farming is usually taken to be that system of farming involving production of a succession of market garden crops for sale throughout the year, probably operating under a system of gravity fed or sprinkler irrigation.

The scope for technical involvement in agriculture generally increases with the rate of intensification and the level of capital involved, and a shift from labour-intensive to capital-intensive systems of agriculture will be only as fast as level of training, and credit inputs permit. Adoption of large scale and/or intensive systems of farm management call for increasing applications of research to maintain the tempo of production. In this connexion scientific research in Africa is reasonably well catered for but in fields which are more properly described as technological, a large gap exists particularly in those areas of common interest to the rural community. A series of sub-regional polytechnic institutes offering courses and training in farm mechanization, farm buildings and structures, land classification and mensuration, water resources irrigation and storage, wood metal and plastics technology, and rural road-building and masonry, all could in time provide a significant and worthwhile contribution to rural development in Africa, including an intensification of agricultural systems.

IV. The change of emphasis in food choice and preference

In the last analysis, the apparent irrationality and uneconomic behaviour of many African farmers with respect to livestock and particularly to cattle, is his concern for security. This attitude, born in earlier times, when disease not infrequently decimated whole herds of cattle or flocks of poultry, almost certainly provided the motivation for a build-up of numbers. These earlier attitudes had underlying economic consideration, though they were obscured at times by the accretion of emotional and social values.

Today, through the impact of general and specialized education, coupled with the slow but sure elimination of some of the livestock "killer" diseases of the past, new attitudes are slowly developing based on the security of better animal health supervision and on an appreciation of livestock quality rather than on numbers. It would be untrue to suggest, however, that moves in the direction of balanced mixed husbandry have been as yet anything more than tentative. From the agricultural point of view, managed mixed husbandry offers considerable advantages and benefits, in addition to providing a wider spread of monetary returns. This is particularly true for instance of modern dairy farming as practised in places such as Kenya and Uganda, the keeping of cattle in tse-tse free areas, frequently leading to development of bullock ploughing and cultivation, also allow a farmer to tend a much larger acreage than is possible by hand hoe and mattock. Mixed husbandry is also an effective means of utilizing farm by-products including the gleanings of grain stubbles after harvest, and while the benefits of animal excrement as regards soil fertility are undoubted, the keeping of cattle only for the benefit of the manure which they leave behind, has no economic justification. Goats and to a lesser extent sheep, have value in a mixed husbandry system as scavengers or "bush clearers", having proved invaluable for this purpose in tall-grass savannas in moderately tse-tse infested country. Poultry and pigs as maintained by the average African peasant farmer contribute only fractionally to meat protein supplies because of the extensive nature of their general management, if in fact they are managed at all. Maintained under control, however, and using improved breeds or hybrids, fed according to a balanced nutritional regime, poultry and pigs in that order, are the most efficient converters of grains and protein-rich oil-seed residues or animal and fish-based offal, into either poultry meat, eggs or pork.

As a society becomes more affluent, demand for meat proteins increases. In Africa, however, there are still too many consumers who rarely ever consume meat, but who subsist primarily on a starchy-based diet assisted on occasion by a modest intake of vegetable foods. Kwashiorkor, particularly in the young, is still too common in many parts of

Africa. With advancing nutritional education, and a greater degree of affluence, agriculture must now gear itself to satisfy this nutritional trend by applying modern technological developments, management techniques, and a considerable amount of nutritional science to increase the quantity and quality of meat and vegetable proteins available for general consumption at prices within reach of a broad spectrum of African society. Levels of protein intake in Africa are also likely to be strongly influenced by a new awakening to the enormous potential of African fish resources, and to improvement of catch made possible by application of new fishing techniques, technologies, preservation processes and enlightened conservation practices.

Provision of adequate levels of supplementary feed for beef and dairy cattle, pigs and poultry raises the problem of supplies of protein-rich foods necessary to balance the animal diet. In this connexion, we are probably at the threshold of a scientific and technological breakthrough of considerable significance, through discovery of the possibility, under certain conditions, of growing yeasts in a medium of mineral oil. Plans are already afoot to develop this process in North Africa and manufacture is already taking place in France and in Scotland. Dried yeast is an excellent protein balancer, having wide application in animal and human nutrition.

V. Conversion of basic foods into readily acceptable forms

As markets shrink for certain tropical and sub-tropical foods and materials of basic importance, we have come to depend on the aids of science and technology to so modify such foods and raw materials that they become again market-acceptable. In certain cases it is merely a matter of processing, such as expressing oils from tropical fruits and crops in Africa with price advantage to Africa in term of transportation costs. In other instances it may be a case of semi-processing such as is taking place now in the hides and skins industry. In yet other instances, conversion may involve almost complete modification. Such an example might be the treatment of molasses, which sometimes becomes a drug on the market, where, by producing industrial alcohol, yeasts and pharmaceutical products, the original commodity again becomes acceptable.

African technologists and scientists have a responsible part to play in this aspect of agricultural development, in fact, the success or failure of future agricultural exports may well depend on the availability of people with such skills and training to ensure survival of the industry.

Agricultural production has come to depend on the skills and contributions of science and technology to a greater extent than almost any other industry of consequence in Africa, and it would seem, that even greater application will be necessary in the future to ensure survival in a highly competitive world.

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TECHNOLOGICAL AND SCIENTIFIC MANPOWER RESOURCES IN AFRICA -
PROBLEMS OF ABSORPTION, EMPLOYMENT AND OPTIMAL FUNCTION

(Notes by the Secretariat)

The public services schemes of several African countries in the colonial days were, in general, geared to the administration of law and order. There was a laissez-faire attitude to economic development. This was not surprising when it is appreciated that the main functions of governments in those days were :

- i. maintenance of law and order;
- ii. the provision of the minimum levels of social services mainly for urban dwellers - pipe borne water, hospitals, and electricity for domestic purposes;
- iii. the provision of infra-structural services, like roads and ports, mainly for use in the evacuation of produce for export to the metropolitan countries, and to facilitate the administration of the countries;
- iv. advisory extension services chiefly in agriculture and particularly geared to the increase in the production of cash crops, with a few window-dressing government experimental farms which made little or no impact on the methods used by the peasant food crop farmers;
- v. the establishment of a few basic public enterprises like railways and mining, usually organized along civil service departmental lines - both in staff and financial management.

X With the attainment of independence African governments have found themselves in positions where they are obliged to provide infra-structural

services on scales which are out of proportion to those in existence in colonial times. They have also had to offer leadership to the private sector in planning industrial and agricultural expansion. All these call for :

- (a) The services of personnel with technical and scientific knowledge.
- (b) The dissemination of scientific information on development.
- (c) Research in agriculture, industry, transport, etc.
- (d) Technical services including extension work in industry and agriculture.

Most of these services are either new or require considerable expansion in human and technical resources. Unfortunately, most African governments have not provided the framework in their public services for the recruitment, deployment and proper utilization of the services of scientists and technologists with the proper orientation to innovation.

1. Availability and deployment of scientific and technological manpower

There is a paucity of statistics on the available number and the deployment of technologists and scientists in Africa. One of the most reliable sources is the UNESCO conference paper (UNESCO/OAU/CESTA/Ref.3)^{1/}.

1/ Deployment of Scientific and Technical Personnel in Selected Countries in Africa, Conference on Education and Scientific and Technical Training in Relation to Development in Africa, Nairobi, 16-27 July 1968 (UNESCO).

SCIENTISTS AND TECHNICIANS BY FIELD OF SPECIALIZATION

Country and year	Total "All Sciences"		Natural Sciences		Engineering		Medical Sciences		Agriculture		Social Sciences	
	A	B	A	B	A	B	A	B	A	B	A	B
Cameroon 1962	...	594	...	262	...	54	...	246	...	18	...	14
Congo (Braz.) 1966	231	646	68	88	23	115	46	90	9	49	85	304
Gabon 1964	243	519	43	68	97	313	70	71	27	59	6	8
Ghana 1966	5,137	33,030	774	810	919	19,702	786	4,979	450	4,067	2,208	3,472
Kenya 1964	2,536	9,429	215	486	949	2,829	930	3,206	166	1,706	276	1,202
Lesotho 1964	...	303	-	-77	...	123	...	23	...	80
Mauritius 1967	554	2,564	80	197	110	433	211	1,490	49	268	104	176
Nigeria 1963	5,618	29,693	567	1,026	1,839	10,685	780	6,772	653	4,998	1,779	6,212
Rwanda 1967	207	661	25	38	13	72	75	273	24	112	70	166
Tanzania 1964	1,346	5,361	82	101	434	1,547	501	1,483	161	1,667	168	563
Uganda 1959	889	2,965	82	97	234	1,126	313	1,032	88	252	172	299
Zambia 1965	1,517	3,234	140	177	600	1,137	353	842	143	216	226	671

of the type of technical and scientific information services which the government must offer. It is also partly due to budgetary limitation in creating the institutional facilities for the type of services required. The result is the glaring absence of different types of scientists and technologists in the Ministries of Industry and Commerce capable of evaluating technical reports on new industrial project proposals, designing and selecting appropriate technology to recommend to investors, analysing cost production processes or of suggesting innovations. For these technical services African Governments commonly resort to hiring the services of consulting firms at considerable expense.

2. Factors which affect the recruitment, deployment and effectiveness of scientists and technologists in the Public Service

Having briefly outlined above the problems of availability and distribution of technological and scientific manpower in African countries one may state briefly some of the major difficulties which affect the recruitment, deployment and effectiveness of these personnel in the Public Service.

One of them is that the authorities responsible for the Public Service structure have been very slow in developing it in order to provide for posts which are needed for the effective execution of the new programmes to which governments have committed themselves. For this reason candidates who are qualified for such posts are not properly placed and consequently, their services are utilized for other jobs, e.g. agricultural economists are used as agricultural officers for pure extension services. The problem here is that very often the officials of the Ministry of Establishments, and the placement officers of the Public Service Commission have no scientific background to their training. Because of this they are not able, on their own, to assess and appreciate the needs of governments in technological and scientific fields without the advice of officials of the appropriate technical departments and of the effective manpower planning machinery. Owing to the absence of such machinery in many countries there is no permanent vehicle for conveying this advice regularly from the technical departments to the

Ministry of Establishments. The result, of course, is that until the odd applicant with a special qualification applies for employment in the Public Service, no attempt is made to draw up a scheme of service for such a post.

This leads to the next difficulty - the development of a new institution which provides scope in the Public Service for the utilization of a new class of technologists. For instance, in one African state in which oil production was commencing for the first time a few years ago, the Government suddenly discovered that it had no petroleum engineer in its service to liaise with the oil companies, even in the elementary task of determining the daily crude oil production. As mentioned earlier, very few Ministries of Industries in African countries have, in their establishments project appraisal units. For countries which have a policy for industrialization to rely almost entirely on the feasibility study reports produced by prospective investors and technical partners is a matter of great concern. One would have thought that these countries ought to have made arrangements for the establishment of project appraisal units for this purpose during the early years of their industrial programmes. In the absence of such units, qualified technologists, such as industrial engineers, chemical engineers, metallurgists, control engineers, etc.. who apply for civil service appointments are usually rejected or given as an alternative, non-specialist jobs which offer very little challenge to their competence or creativity.

Generally, the non-development oriented Public Services do not provide scope and encouragement for innovation by technologists and scientists. For instance, funds are rarely provided for research by individual officers who want to branch off into new fields which are not within the framework of established government research stations. There is also no institutionalized form of honorarium for innovation or engineering design by Public Servants.

Sometimes there is unnecessary restriction on publications and contributions by public servants to learned journals. It cannot be denied that such contributions act as a spur to the innovating spirit of these officers and

that the unusually long procedure for obtaining approval for such publications only dampens their enthusiasm.

Sometimes no incremental credits are given for post-graduate research at the time of appointment. This is one of the main reasons why those with Master's or Doctorate degrees prefer to go into the university where their research experience is recognized for the purpose of appointment and is adequately remunerated.

The pyramidal structure of the civil service and the system of promotion which is usually based on criteria of seniority and good behaviour criteria provides very little scope for the rapid advancement for an officer with innovation propensity. This is why a candidate with such a quality prefers to go into private industry or a University where he is likely to have the scope and recognition for innovation.

Schemes of service for technologists in many African countries in relation to those of their counterparts in Administration are not very attractive. This is not to say that scientists and technologists are not given initial salaries which are higher than those of their counterparts in Administration in recognition of the longer period of training and of their scarcity value. This is due mainly to the small sizes of the individual technological cadres which are usually within the confines of single ministries. For instance, the Civil Engineer, because of his specialist training does not normally find any other avenue for advancement within the Civil Service outside the Ministry of Works and Transport. In the same manner, an Agricultural Officer is fairly restricted to the Ministry of Agriculture, unless he abandons his profession for the Administration or the Co-operative Department. On the other hand, the Administrator can be posted to any Ministry or Department within a relatively large cadre of Administrators. Is it any wonder that a number of scientists and technologists have in recent years, opted for transfer to the administrative class of the civil service? It is worth noting that the limited scope for advancement by professional officers is the result of the small sizes of many African states in terms of population and resources which limit the sizes of individual

ministries. Moreover, the activities of these Ministries are fairly limited. For instance, until recently a typical Ministry of Agriculture was mainly concerned with agricultural extension services.

The other problem is the lack of diversification of the economy. This means that very few large public and private economic enterprises exist in each country to provide alternative employment for technologists. Many of the technologists and scientists in public service are, therefore, forced to remain out of frustration in the civil service where they feel that any innovation on their part would bring them no material benefit or pride of place in the service. Even when non-Government employment is available, owing to the lack of adequate management training and the existence of very limited opportunity for orientation courses and experience in the latest technological innovations, some of the technologists and scientists who have been in the civil service for long are sometimes not the best candidates for jobs in their own fields in profit-making organizations. For instance, a B.Sc. graduate in Agriculture who took a subsidiary course in Farm Management would, after 5 years in the Civil Service (without further training), not be the ideal candidate for the post of a manager of a commercial rubber plantation. For one thing, as an Agricultural Officer in charge of a district, he is Jack-of-all-trades, supervising a central multi-crop nursery where rubber may occupy only a small portion. He may spend most of his time touring his district, inspecting the scattered demonstration farms having various crops, and the rest of his time he would spend on pursuing with the Ministry such minor problems as late payment of wages to his workers or the irregular delivery of fertilizers to his station, etc. What is even more serious in the nature of his experience is the fact that Government nurseries and demonstration farms are not operated on a commercial or profit-making basis but rather under the pure revenue and expenditure accounting system. The average field Agricultural Officer has very little opportunity of applying on the job, the rudiments of farm management. He is, therefore, not involved in techniques of economic allocation of his labour force as between the different sections of a farm at different seasons of the year nor is he an expert on the productivity and daily output of the various categories of the farm labour force.

It is, therefore, not surprising that unless a company is prepared to employ him as a manager in training for its plantation and unless he is also prepared to accept such a job, his avenue of alternative scientific/professional employment is limited. Even if he accepts such an offer, there is also the problem of limited scope for advancement in a plantation company's service, unless the company has a complex of a number of large plantations which would necessitate the existence of a large managerial cadre.

A new trend of senior scientists and technologists, wanting to function permanently as administrative heads of Ministries which are related to their respective professions, is creating a new problem. This is that there might be a tendency on their part towards conservatism which leads them to brand as "rebels" young dynamic technologists who try to suggest innovations. This is particularly so if these young technologists put up their proposals with the tactlessness which is usually associated with youth and inexperience in civil service procedure. If a narrow-minded professional-turned-administrator, on account of this, blacklists such an officer, by a process of subjectively written adverse confidential reports the officer's career is marred and naturally he might, out of frustration, get out of the service. On the other hand, if a non-scientist administrator is at the head of a technical Ministry, he is usually, under the British-oriented civil service, not permanently posted to one Ministry. He, therefore, cannot constitute a permanent stumbling block to the career prospects of a dissident, but progressive technologist. Even where the technologist disagrees with his professional director, he has the administrator at the head of his ministry to appeal to. Moreover, the administrator realizes that when he is not a technologist himself, he will be more willing to listen to and accept the technologist's proposals for innovation and to give him every possible support than would be the case with the experienced technologist-turned-administrator who usually has his own ideas in his field of speciality.

12 November 1969

CRITICAL MANPOWER DEVELOPMENT AND UTILIZATION PROBLEMS IN
AFRICA

(Note by the secretariat)

1. Africa's major manpower problems

African countries want accelerated economic and social development in order to achieve better living standards for the masses of the people. To this end it is necessary to mobilize fully the region's human and material resources for the development effort. However, the contribution of human resources to national development can reach optimum only when available manpower is developed to acquire the right skills and attitudes and when the labour force is fully and effectively utilized.

Unfortunately, African manpower suffers from a number of drawbacks:

- (i) An overwhelming proportion of the labour force is untrained and lacking in skills needed to raise productivity.
- (ii) A good part of even that small proportion of the labour force that has had some training also lacks the ability to comprehend and apply modern scientific and technical knowledge to production process and business management.
- (iii) Workers' attitudes to work and income are rooted in traditional social values and the social status accorded to some categories of work is hardly reconciled with the socio-economic values and prerequisites of a modernizing economy.

In terms of manpower needs for accelerated economic development, the following manpower development and utilization problems are of priority concern to most African countries:

- (i) Shortages of middle- and high-level managerial, professional and technical personnel, especially in fields concerned with direct production in agriculture, industry, natural resources, etc. The most acute of the manpower bottleneck is the shortage of personnel with training in science and technology and having the capability to apply modern techniques to production processes.

To illustrate the problem, take the case of the Ministry charged with promoting industrialization in an African country. The typical situation is that such a Ministry often lacks the technical and professional personnel capable of evaluating technical reports on industrial project proposals, designing and selecting appropriate technology, analysing and costing production processes or of conceiving appropriate solutions to technical production problems. The result is that these technical services are usually contracted to foreign consulting firms at considerable expense.

- (ii) A politically explosive and socially undesirable problem is what to do with the jobless educated primary and secondary school leavers whose numbers are rapidly increasing in all major cities. They demand white collar jobs that are hard to come by and a fair standard of living, but they lack either the attitude and the technical skills for engagement in non-clerical duties or the means to continue their education.
- (iii) Lack of financial and institutional capacity for manpower development such as could effectively make good quantitative shortages and qualitative deficiencies in manpower requirements, and to provide facilities for the further education and vocational training of unemployed school leavers.

- (iv) The problem of educational programmes which are not adequately related to development needs, especially in terms of manpower requirements for industrialization, agricultural modernization and the supporting services and in terms of the need to cultivate attitudes that are receptive to, and eager to apply development innovations.
- (v) The shortage of qualified teachers, especially science teachers and technical instructors, that are needed to implement programmes aimed at increasing substantially the proportion of school leavers with technical and science-based education and for the reform of the educational systems to cope with the challenge of development.
- (vi) The inefficient utilization of available trained manpower often due to factors such as political and social constraints, inappropriate and unwieldy administrative structures, lack of proper manpower planning machinery, and the prevalence of wage policies and wage structures inherited from colonial practice and which do not adequately reflect development needs in terms of the place of technical personnel in national development efforts.
- (vii) The seeming neglect to develop appropriate training programmes for the bulk of the labour force - the untrained and unskilled manpower whose production efforts determine, to a very considerable extent, the size of the national income. Thus, the attempt to modernize the rural sector cannot achieve the desired objective if due attention is not paid to training programmes aimed at raising the productivity and living standards of rural workers and to creating new economic opportunities. Rural modernization requires the injection of a substantial amount of technical skills, capital and receptive and innovating attitudes.

- (viii) The sheer lack of clear national policies and programmes on population, manpower utilization, income and employment as integral elements in national overall economic and social development policy and programmes, sanctioned by total national commitments to the realization of development objectives.

2. ECA's approach to resolving Africa's manpower problems

ECA considers Africa's human resources as the continent's most valuable asset for realizing the objective of economic and social development - the improvement of the people's standard of living. Consequently, this valuable asset has to be developed, mobilized and rationally deployed for accelerated economic development. Its employment has to be planned and integrated with overall development plans and programmes. ECA is, therefore, concerned with programmes that aim at encouraging member States to identify and plan their manpower and training needs, evolve policies and programmes that will develop adequate manpower to meet requirements, devise appropriate machinery for manpower and employment planning, orientate educational programmes to cope with manpower needs and, at improving performance capability of their personnel.

ECA's manpower development programme includes activities in the following main fields:

- (i) advice to member States in developing appropriate manpower policy and human resources development strategy and in evolving effective administrative machinery for manpower planning and the translation of manpower policy into concrete employment-creating development projects;
- (ii) identification and assessment of manpower and training needs, overall and sectoral, especially for the requirements of multinational development projects, and thus provide guidelines for multinational co-operation in education and training;

- (iii) the training of African administrators and executives in specific areas of development planning and administration, including the training of statistical personnel, manpower planners and trainers, and the dissemination of information on training opportunities open to Africans;
- (iv) seeking scholarship and fellowship facilities and co-ordinating programmes for the training of Africans in priority areas of development;
- (v) the promotion of multinational institutional facilities for specialized training and research in priority areas of development needs and assistance in seeking external aid for the establishment and/or development of these institutional facilities;
- (vi) the promotion, establishment and operation of an African scholarship and fellowship fund within the scope of the proposed Special Trust Fund for African Development, such as will make it possible to take advantage of specialized training and research facilities in Africa as well as in other parts of the world for the purpose of training Africans for the implementation of multinational and economically strategic national development projects;
- (vii) initiation of studies and evaluation surveys on specific areas of manpower, employment, educational and training problems such as will provide guidelines for the rational development of manpower and employment programmes and policies in member States;
- (viii) promoting international co-operation and concerned action in developing programmes aimed at ameliorating Africa's manpower and employment problems at regional, multinational and national levels by acting as a co-ordinator and catalyst of efforts to assist Africa within the United Nations system.

3. Highlights of ECA's Human Resources Development Programme, 1969-73

The ECA organizes annually, and in collaboration with interested organizations and specialized agencies, seminars, courses, workshops and study tours, aimed at improving the performance capability of personnel in the public and private services of member States and at giving course participants an opportunity to consider new ideas and approaches in grappling with their countries' development problems. These training activities are undertaken in relation to identified urgent training needs in the region and in direct response to enabling resolutions adopted by Sessions of the Commission and the recommendations of its subordinate bodies.

For the period 1969-73 the main highlights of the training activities are as follows:

- Regional seminar on education for development in Africa, including a consideration of education for rural modernization (1970).
- Training courses in the techniques and methodology of manpower planning and training programming (annual).
- Seminars on human resources planning for policy-making officials (1969, 1971 and 1973).
- Trainers' Workshops on modern training methods and teaching aids (two workshops annually).
- Promotion of sub-regional and/or regional centres for the development of training materials, for trainers' workshops and manpower planning courses and for research in human resources development problems.
- Seminar on the role of private employers and trade unions in the education and training of workers (1971).
- Seminar on correspondence education for the development of personnel in Africa (1971).
- Sub-regional training courses on rural extension and community development (1969, 1970).

- Training of social work personnel: development of indigenous teaching materials (1970/71).
- Seminar on the administrative framework for development (1970).
- Orientation seminar on administrative training for professional and technical civil servants (1971).
- Sub-regional seminars on personnel administration and training in public corporations.
- Seminar on modern administrative systems for rural development (1973).
- Training course for supervisory building personnel (1972).
- Sub-regional training course for Building Contractors.
- Training courses for census personnel.
- Seminar on employment policy and economic growth (1973).
- ECA/UNESCO Regional Symposium on the utilization of science and technology for development in Africa (1969).

It is obvious from a consideration of the above projects that ECA's programme of human resources development is largely one of indicating the direction member States should be moving in developing national manpower and employment programmes and policies. The main action and responsibility for human resources development and utilization has to be taken at the national level. ECA programmes can do no more than encourage and guide African Governments to take the desired action.

4. Prospects for the future

For the next decade, as most African manpower programmes have shown, the supply of trained manpower will fall short of demand by substantial margins. The manpower shortage envisaged will be particularly critical for science and technology based disciplines at the middle- and high-level categories. But the exploitation of Africa's natural resources, and the achievement of the set goals of industrialization and agricultural modernization depend to a considerable extent on the application of appropriate

scientific and technical knowledge and skills. To fail to have an appropriate measure of these vital inputs would mean failing to achieve the desired development targets.

While a quantitative shortage is envisaged during the 1970s in the supply of certain types of skills, qualitative deficiencies in available and prospective manpower supply will further accentuate manpower bottlenecks. Similarly, the inefficient deployment of available trained manpower will worsen the situation. If future manpower supply is to cope effectively with the need to apply science and technology to development, educational and training programmes must be evolved which would emphasize the vital factor - scientific and technological knowledge and the skills to apply it. All African Governments are committed to such a programme, but they lack adequate means for realizing the objective and the capability for implementing the programme. It is in this respect that multilateral and bilateral external aid has an important role to play in rendering such assistance that will have the right impact as desired by African Governments.

Granting that the financial resources, including external aid, and a sense of national commitment will be available to support an expanded programme of science and technical education, including research for the application of acquired knowledge, the implementation of such a programme may be wrecked by the present shortage of science teachers and technical instructors. Therefore, the training of science and technical teachers and the development of appropriate science teaching aids should form an integral part of any science and technical education programme and of any external assistance in aid of such a programme.

Middle and secondary schools in an increasing number of African countries are producing school leavers who are finding it difficult to obtain gainful employment because they lack the type of skills required by the growing sectors of the economy. Given an appropriate vocational and technical training and the right attitude to blue-collar work, these same jobless school leavers could become the vital link in the production process that is, as middle-level industrial skilled and semi-skilled workers, agricultural extension workers, and technicians for the transport industry and other

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services. But African Governments, faced with the current heavy burden of expanded primary and university education and with the slow rate of increase in their national income, find it extremely difficult to mobilize additional resources for the further education and vocational training of these unfortunate school leavers. However, to turn the surplus educated persons to meet the shortage of skilled and semi-skilled workers, it is of the utmost importance that the will and the means to do so be mobilized for the vocational and technical training of school leavers, and that such a training should be directly related to the potential job opportunities in the economy.

It needs to be realized that the future well-being of African countries depends as much on the modernization of the rural economy as on industrialization. There cannot be the one without the other; the development of both these major sectors as much as other sectors, depends so much on the application of science and technology.

The rural sector presents peculiar problems that are not so easy to determine and solve. It is in the rural sector that some 75-80 per cent of the total population live and earn a living. It is the sector where production processes currently rely on the most primitive techniques and where innovation is not readily understood and willingly applied because of deep-rooted socio-cultural and economic constraints. It has been described as the "majority economy" which contributes most to the national income. This major sector of the economy must be modernized in order to give gainful employment to the great bulk of the active labour force. This means that not only must agriculture be modernized to yield higher productivity and give full employment to fewer workers, but also other economic activities, ranging from rural crafts, commercial services to agro-allied industries, must be developed to give new employment opportunities for an increasing number of rural inhabitants, particularly for the graduates of rural schools, including rural agricultural and technical schools. This further requires a new approach to the structure and content of education for rural development and a consideration of the type of science and technology programme appropriate for rural development and which should

be infused into the curricula of the educational system as applied to rural communities.

Subject to the availability of funds and personnel, ECA will give due consideration to the above critical problems and will intensify action aimed at ameliorating, and if possible, resolving some of them during the United Nations Second Development Decade. In particular, efforts will be made to promote more effective inter-agency action for an integrated approach to rural development. Action oriented studies will be made on the re-structuring of educational programmes and the allocation of educational resources in order to make education serve as a more effective instrument in fostering development. Similar studies will be made in collaboration with the appropriate agencies, on the problem of employment creation and the pre-vocational training of young school leavers. Special programmes will also be mounted, in collaboration with interested agencies, to promote the development of national programmes for science policies and science popularization, including science education in schools as well as out of school. Special attention will be given to the promotion of regional and/or sub-regional institutions for applied science and technology closely designed to cope with the challenge of economic development.

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21 November 1969

SOME ASPECTS OF THE ROLE OF TECHNICAL ASSISTANCE
IN AFRICA

(Note by the secretariat)

In the Note submitted by the Executive Secretary to the Eleventh Session of the Committee and in the speech of welcome to this Session stress has been laid on the conviction of the ECA that the highest priority for science and technology in Africa is the creation of the conditions precedent for its development. Indeed the issue is much broader since the capacity to utilize science and technology is also in part the capacity to make optimum use of capital and other resources.

Commission

As the Pearson/report succinctly puts it : "The over-riding shortage in Africa is still trained manpower" (p. 268). It goes on to observe that "It will take many years for the multiplying effects of education to change appreciably the proportions of skills in the labour force" (p. 278) having pointed out earlier that "High-level graduate training institutions are also essential prerequisites to African self-reliance" (p. 276). These assessments, together with the paper ECA has submitted on Critical Manpower Development and Utilization Problems in Africa, constitute the background to the problem of technical assistance to the African Region. Some critical aspects of this subject have been selected for brief review in the following paragraphs.

In the past, three main features of technical assistance have been noted. One, the problem of recruitment and delivery, has proved particularly difficult in terms of defining with exactness the specifications of the work to be done, the identification of the most suitable expert, securing his release from present commitments and delivering him at the point at which his services were required. This is a problem of time. The other was represented

by the complementary costs to be met by the host country. These were sometimes quite high in relation to the ability of governments to seek for as large a number of such experts as they genuinely needed. A third related to the conditions of reception and operation which, in many cases were such that the expert was unable to perform with full effectiveness. But perhaps the most important problem was the inability of many governments to provide the most suitable counterpart to work with the expert. This was sometimes due to shortage of persons with the particular basic education and training for attachment to experts but were ^{more} often to a total lack of such persons. In consequence repeated pleas were made by African governments for the extension of the services of experts. In the meantime the unrecognized problem : the need to arrange for basic education and training of the local personnel required often continued.

These difficulties are likely to be intensified and extended in the 1970's as a result of several factors.

As efforts are made to accelerate the rate of growth and more particularly the structure of the African economies so will the demand increase and the range of specialist knowledge required expand. There may thus arise situations in which, as a result of persistent shortages in advanced countries, these demands cannot be met and serious bottle-necks in development plans and processes will arise. Already, in spite of new approaches by the UNDP to the programming of technical assistance, increasing pressures are being put upon the ECA to provide services of a technical assistance nature to African governments.

When attention is directed towards the first half of the Second Development Decade during which, for many African countries, the foundation for a broad and rapid forward thrust will have to be laid and taking note of the continuing shortage and rising cost of experts in advanced countries, it will be seen that the problem of technical assistance is likely to intensify sharply. It is believed that some of the most acute needs will arise in subjects such as natural resources exploration and evaluation, in industrial production technologies, in transportation, in regional (physical) planning, in marketing, and in high-level management and business advisory

services. Other areas of high priority may include food science and technology and food safety, preventive medicine, labour productivity, and a range of activities connected with the adaptation of existing (and in some cases the invention of new) technologies for promoting rural development.

It is clear that overcoming the counterpart bottle-neck will place unprecedented strains on technical assistance in the field of education. It is ECA's view that, notwithstanding the importance of middle level education, the greatest difficulties in drawing up realistic plans and achieving them in the past have been due to the shortage of Africans capable of conceiving, designing, programming, installing and managing productive business enterprises. Since there are severe limits to the use of foreign consultancy services for these purposes, efforts will have to be made to develop as rapidly as possible facilities within the Region for the education and training of Africans in the skills these functions require. A considerable expansion of technical assistance in the form of new university chairs (e.g., in metallurgical engineering, in engineering design, in the science and technology of materials, fuel science and technology, chemical engineering and industrial chemistry, in high level management, operations research and computer science, in transport planning and transport technology, in production engineering, in fibre technology, in business finance and so on) will be required. Associated with these will be assistance in the form of visiting professorships, post-graduate fellowships, specialized equipment, libraries, research facilities, etc.

The above are only illustrative lists but they do, in ECA's view, bring out the scope of the technical assistance problem in terms of work specification, recruitment, delivery and cost. The crucial long-term factor appears to be the resources, energy and imagination which are applied to the rapid development of suitable local counterparts. Without a major effort in this direction during the first half of the 1970's the technical assistance problem in Africa in the second half of the 1970's and in the 1980's may well become unmanageable.