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Forum on Appropriate Industrial  
Technology for Africa

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Dakar, Senegal, 6-10 November 1989

REPORT\*

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\* This document has not been edited.

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## I. INTRODUCTION

1. The Forum on Appropriate Industrial Technology for Africa was held at Dakar, Senegal, from 6 to 10 November 1989. The Forum was organized by the United Nations Industrial Development Organization (UNIDO), in co-operation with the Government of Senegal. The African Regional Centre for Technology (ARCT) had also co-operated in the preparations for the Forum and provided technical and logistic support.

2. The objective of the Forum was to define and establish mechanisms and procedures for the development of technologies in the African context and to examine the technology policy framework within which these mechanisms and procedures might be best applied to enhance technological progress, particularly in the areas of food production and food conservation, agricultural machinery and fisheries. The Forum also provided an opportunity for senior technical personnel, entrepreneurs, representatives of donor organizations, etc., to meet and exchange views on the processes and technologies, both indigenous and foreign, applied in the agro-industrial sector, and on ways and means of fostering co-operation among the various interest groups. The Forum dealt with the following four sectors: fisheries, food processing and preservation, agricultural machinery, and technological capabilities. It was emphasized that the term "appropriate technology" did not necessarily mean low-level technology. It referred to technologies needed to perform given tasks, and it could mean the latest technologies used, on a large scale or on a small scale, the only condition being that the needs and conditions in the country concerned warranted their use.

## II. PARTICIPATION

3. The Forum was attended by experts from African countries, organizations of the United Nations system, non-governmental organizations, intergovernmental organizations and donor agencies. The list of participants is attached as annex I.

## III. OPENING OF THE FORUM

4. The meeting was opened by Mr. Famara Ibrahima Sagna, Minister of Industrial Development and Crafts of Senegal. He warmly welcomed the participants on behalf of Mr. Abdou Diouf, President of the Republic, and on behalf of the Government and the people of Senegal. He thanked UNIDO for having been so kind as to invite the distinguished experts to Senegal to deliberate on the preoccupations of African countries in the important field of industrial technology. He took the opportunity to commend UNIDO for the assistance it had been providing to African States in the implementation of their industrialization policies. He also thanked the African Regional Centre for Technology for its contribution to the organization of the Forum, and its work in promoting technology in Africa.

5. He expressed the conviction that the discussions that were about to take place would be of great value. For its part Senegal would do all it could to merit the honour done to it by the holding of the Forum in Dakar, and no effort would be spared to ensure the complete success of the Forum. He found it particularly appropriate that the Forum was taking place just as the first Industrial Development Decade for Africa was drawing to a close. He noted that the factors slowing down Africa's industrialization were many and varied. At that juncture, he only wished to stress the continent's continuous dependence on imported technologies, which, in many cases, were not appropriate to the dimensions of Africa's markets, the available skilled manpower resources or the characteristics of Africa's raw materials. For these reasons, the choice, transfer and adaptation of technologies tended to be topical issues, especially since they had a great impact on African industrialization policies.

6. Besides, the Minister observed, it was obvious that, given the polarization of technological and trading systems, Africa would continue to import foreign technology. However, it would be better for African States to promote and develop endogenous technologies adapted to their economic, social and cultural environment. It would also be to the advantage of the African countries to increase investments in this field. Those countries had been quick to realize the importance of the technological dimension in their economic development process. It was for that reason that, after independence, Africa had embarked on setting up, at national and regional levels, structures such as training and skill development centres, higher-level schools for technical education, and research and development institutions. The fact remained that Africa still had a long way to go, mainly because of the low level of technological resources, the lack of networking among industries, and the failure to develop, at the industrial level, products stemming from research. Moreover, due to lack of mastery of technologies, the raw materials in the African countries were not adequately processed locally, and this was one of the reasons for the poor performance of these raw materials on the world markets.

7. The Minister stressed that, considering the challenges facing Africa, it was important that great efforts be made, especially in the agro-food industries, to ensure a sustained focus on research on and selection of appropriate technologies. In concluding, he invited the participants to pay special attention to the following topics: techniques which had been tested in biotechnological industries; choice of machinery and technology transfer; opportunities available in regard to the setting up and organization of technological centres; and food quality control.

8. Speaking on behalf of the Director-General of UNIDO, the Deputy Director-General of UNIDO warmly welcomed the participants to the Forum. He expressed heartfelt thanks to the Government and people of Senegal in the person of His Excellency Mr. Famara Ibrahima Sagna, Minister of Industrial Development and Crafts, for hosting the Forum and the excellent work done to ensure the comfort of the participants and the smooth running of the Forum. The Minister's presence among the participants was evidence of the Senegalese Government's keen interest in the very important theme of the meeting, as well as its unflinching support for the cause of industrial development and for UNIDO's activities in particular.

9. He recalled the main objectives of the Lagos Plan of Action and the Industrial Development Decade for Africa (IDDA) proclaimed in view of the crucial role industry would have to play in the continent's economic development. The United Nations had conducted an end-of-decade review of the Vienna Programme of Action on Science and Technology for Development, and a mid-term review of IDDA had been carried out recently by UNIDO as a step towards the proclamation of a second IDDA.

10. From these evaluations it could be concluded that, after a decade of intense efforts made on all fronts by Governments, the United Nations system, the private sector, external agencies, donor organizations and Governments, etc., a great number of problems still existed in the industrial sector, for example, technology transfer and development policies, technology adaptation, research and development and their linkages to the productive sector still needed a lot of inputs. Similar problems existed in human resources development and infrastructure building. For these reasons, UNIDO had been carrying out numerous activities to encourage developing countries to strengthen their technological capacities, and exchange the results of their experiences among themselves.

11. He expressed the hope that all participants would contribute actively to the Forum and exchange and share information and experiences, with regard to both successes achieved and failures encountered. He hoped that permanent contacts would develop among participants and that co-operation projects would emerge.

12. He noted that the Forum was being held at an extremely auspicious moment. The African Heads of State and Government, at the Twenty-fifth Summit of OAU held at Addis Ababa, had renewed their pledge to promote regional industrialization by declaring the period 1991-2001 the Second IDDA, and 20 November of each year African Industrialization Day. He reminded the participants that the African Governments had set guidelines for achieving the economic integration of the continent, and that they could play a part in that undertaking by starting immediately to exchange information and experiences in this sector of such primary importance for the economic survival of the continent.

13. The Director of the Industrial Technology Promotion Division of UNIDO outlined UNIDO activities aimed at strengthening the technological capabilities of developing countries as a whole and African countries in particular. UNIDO would like to reinforce, interlink and increase its activities with African countries in the area of appropriate industrial technologies and co-operate with them in their development and utilization. The existence of a variety of technological alternatives in several industrial branches and the need for choices from among those options had been amply demonstrated through earlier UNIDO activities. Subsequent experiences and the need for a closer integration of technological choices and their application in the mainstream of industrial development made it necessary to apply the technologies in question to sectors such as those selected for the Forum, namely food processing, agricultural machinery and fisheries.

14. He described the work of the Industrial and Technological Information Bank (INTIB) and said that UNIDO was prepared to add the question of appropriate industrial technology for Africa to the work programme of the Basic Technologies Unit of his Division (IPCT/TP/BT). To help accelerate developing countries' technology development, UNIDO promoted the development of technology, assisted with its selection, arranged for its adaptation and facilitated its transfer and use. For practical purposes, this work focused on the following five development objectives: enhanced basic technological capacity in developing countries; greater control over and benefits from technology transfer; greater awareness and use of advanced technologies; more effective application of conventional technologies; and easier access to industrial and technological information for industrial concerns.

15. He concluded by saying that UNIDO's projects were directed at developing activities needed at both micro-economic and institutional levels in order to obtain optimal technologies for the needs in each developing country. It followed that appropriate technologies could be small-, medium- or large-scale, and might be low-cost and developed locally or capital-intensive technologies. But the technologist must contribute to the economic and social objectives of development and in particular to greater self-sufficiency in food, rural development, industrial growth and the strengthening of national technological capacities.

16. Mr. Adam Mousa Mohamed, Deputy Under-Secretary, Ministry of Industry of the Sudan, speaking on behalf of the participants, thanked the President, Government and people of Senegal for hosting the Forum and providing every facility to ensure its success. He was convinced that he and his colleagues would rise to the challenge addressed to them by the Minister of Industrial Development and Crafts, Mr. Famara Ibrahima Sagna, analysing the issues on the agenda in depth and coming up with concrete proposals for the consideration of African Governments.

17. After the closure of the opening meeting, it was agreed that the following four working groups would be set up:

- Working Group I: fisheries
- Working Group II: agricultural machinery
- Working Group III: food processing and preservation
- Working Group IV: technological capabilities.

#### IV. GENERAL RECOMMENDATIONS

18. The following is a summary of recommendations that may be applied in all the sectors of activity examined by the various working groups in order to promote their development and/or their improvement. A number of them could be applied nationally, regionally and/or internationally.

Establishment, strengthening and rationalization of research and development (R and D) capability; practical orientation and application of the work.

Promotion and dissemination of appropriate technologies to enable current and potential users to understand the advantages of choosing the technologies that are most suited to the needs and situation of their country, from a technical, economic, social and ecological standpoint.

Enhanced participation by industrialists and businessmen on the management boards of research institutes and higher education establishments.

Strengthening of links between universities and industry.

Application of technologies making the greatest possible use of local and regional raw materials.

Since the technology to be used is imported, it is necessary to ensure that it is tailored to the technical and ecological conditions, human resources, raw materials and financial situation of each country.

Technological programmes and policies should be integrated with industrial policies.

Local technology should be improved.

Craftsmen, technicians, engineers and scientists should be trained.

South-South co-operation and collaboration among entrepreneurs and industrialists through joint ventures, co-operatives or, simply, commercial agreements should be promoted.

Industrial and technological information should be exchanged through contact points (some of which have already been established by INTIB) and the compilation of a data bank incorporating technological information available to African countries.

A scientific and technological training exchange programme should be established.

Industrial capabilities should be strengthened through regional scientific and technological inputs.

Subregional and national technology contact points should be established.

Industrial investment possibilities should be identified, based on resources available locally, nationally and regionally, using appropriate technologies.

National and regional capabilities for the negotiation and acquisition of technology should be improved through programmes tailored to existing needs and conditions.



National and regional technical study and advisory capacities should be developed, strengthened and utilized.

Within the framework of aid to African countries, international and bilateral organizations should buy foodstuffs and equipment that are available locally.

A contact point for African technological development should be created within UNIDO.

UNIDO should organize forums, meetings and/or workshops to enable African countries and African specialists to exchange views and experience concerning technological development in different priority areas.

International support and UNIDO assistance should be sought to help the countries achieve the aims set out above.

## V. WORKING GROUP I: FISHERIES

### Observations and conclusions

#### A. Aquaculture

19. Studies conducted on different fish species in the lagoons of the Layo Aquacultural Station have helped in the identification of the existing aquacultural potential and provided more information on the biology of the species' reproduction.

20. The main species of considerable aquacultural importance - namely (1) C. nigrodigitatus, (2) S. melanotheron and (3) H. longifilis - are being studied under regular research programmes aimed at promoting their speedy but effective popularization among producers and at meeting, as far as possible, the objectives of the policy on food self-sufficiency.

21. In this context, the spreading of breeding over the whole year will enable the mâchoiron catfish, C. nigrodigitatus, whose natural reproduction season falls only between July and November, to supply private fish farmers with the required quantities of juveniles, with the help of the development organizations which engage in the prefattening of fingerlings and the training of fish farmers.

22. The large-scale production of S. melanotheron (lagoon tilapia) by means of the "acadja-enclosure" technique should enhance the development of this species which is highly appreciated by consumers, although its production by means of the "gallery hatchery" and "raceway" technique has not yet yielded satisfactory results. Plans are being made to experiment also on the large-scale breeding of the male alone in ponds, in order to optimize the production of S. melanotheron.

23. H. longifilis (African catfish) is a good product of fish farming despite the fact that the rate of survival of the young fish is relatively low (50 per cent). Efforts are currently focused on the search for more simplified techniques that would ensure a survival rate similar to that of C. nigrodigitatus (70 per cent).

24. Generally speaking, while the reproduction of these three species poses no difficulty, a few problems arise when they are stocked in ponds with a view to ensuring their production on a large scale.

25. A number of problems have prevented this industry from attaining its optimum potential, prominent among them the inadequate supply of fingerlings. Although efforts have been made to produce fish seed in some countries, demand still exceeds

supply. An innovative "gallery hatchery" and "raceway" system has been developed by the Baobab Fishfarm in Kenya. This has been improved and successfully applied in Zambia and other tropical countries. In Côte d'Ivoire, the Oceanic Research Centre (CRO) has made it possible to popularize aquaculture through the production over a period of some five years of tens of millions of juveniles (catfish, mâchoirons and tilapia). Much interest in the industrial supply of fingerlings has been shown by CRO. However, the production of fingerlings has been influenced by high feed costs. This operation must therefore be an integral part of an industrial mass hatchery system, i.e. cost-efficient manufacture of suitable fishfeed from agro-industrial by-products.

## B. Boat-building

26. Ghana boatyards have made considerable progress in the construction of wooden planked boats. The method of construction still remains labour-intensive. The only part of the boat-building process using machines is the preparation of elements for assembly. Operations like planking, caulking, puttying, etc., are still done manually.

27. The two hardwood species acceptable for boat-building are "Iroko" (locally known as Odum) and "Opepe" (locally known as Kusia). "Opepe" is used for the underwater portion of the vessel owing to its impervious qualities, and "Iroko" is used above water because of its ability to withstand weathering.

28. The cost of a standard 50-foot vessel has risen to 26.5 million cedis (300 cedis = 1 United States dollar) as a result of escalating costs of building materials. This has discouraged new investors and, as a result, orders for new boats are slow in coming.

29. Some of the problems encountered by this industry are:

- Obsolete woodworking machinery
- Outdated technology
- Deterioration in slipways.

30. There has been general agreement that dug-out canoes should be replaced gradually by planked canoes, as a measure to promote the efficient utilization of wood. The needs of small-scale, artisanal fishermen must be taken into account by making the planked canoes affordable for them. It may also be necessary to consider design improvements to include catch stowage, power take-off and buoyancy.

31. The Somali GRP Products Company has also considerable experience in the construction of fibreglass vessels. The main production at present is concentrated on 9.5 m and 6.7 m boats, equipped with 2 cylinder and 1 cylinder SAAB diesel engines respectively. The boatyard has a production capacity of 50-80 fishing boats annually.

32. The biggest problem confronting this industry is the shortage of hard currency for importing the raw materials. It must be pointed out that all the raw materials needed have to be imported.

33. Owing to the high rate of inflation in Somalia, the construction of 8.5 m vessels for the local market did not prove to be profitable.

## C. Fish processing and packaging

34. The advances which have been made by Ghana's Atomic Agency in food irradiation were discussed. However, participants raised concerns over costs, logistics and maintenance of the equipment. There was also doubt whether the technology was

suitable or appropriate for African conditions. The participants considered that there was a need for further studies to reassure fish processors about the feasibility and appropriateness of this technology in Africa.

35. The advances made by the Food Technology Institute (ITA) in the use of solar driers were also discussed.

36. Solar rays enter the plant through transmission surfaces. The radiation is absorbed in the form of heat by the black polyethylene sheet. The sheet then re-emits rays, especially infrared rays, most of which can no longer filter through the transparent film. A calorie trap is thus created by the hothouse effect. This heat is sent into the air by conduction, by radiation and mainly by convection. The reheated air dilates inside the drying chamber, absorbs moisture from the product in between and leaves through the escape hatch. Solar drying techniques have also been tried in the Gambia.

37. The need has been shown for collecting information on the capabilities of these technologies (irradiation and the solar drying tent) and for disseminating it within the region.

38. The traditional technique of braising-smoking-drying presents a first disadvantage: it does not adjust easily to produce a product of uniform quality.

39. Another disadvantage is that the smoke-houses have limited capacity (less than 1,500 kg of fish/day); during the major fishing campaign there is often a surplus catch that can be neither braised nor utilized in any way by the fish processing industries.

40. The "Chorkor" oven has proved to be more efficient and has been widely adopted in Ghana. The advantages include the following:

(a) Heat efficiency is good;

(b) Productivity is high because several trays can be stacked one upon another;

(c) The oven can be used directly as a storage bin if it is covered to protect against pests and insects;

(d) It uses less wood, which is important given deforestation problems.

This oven has been improved in other countries, notably Sierra Leone and Benin.

#### Recommendations

##### A. Aquaculture

41. It is recommended that aquaculture should be developed both in land-locked countries and in those having access to the sea. UNIDO should conduct studies on the experiences of Côte d'Ivoire and Swaziland in the field of aquaculture.

42. UNIDO should organize the gathering of information on the techniques of aquaculture for the benefit of African countries.

43. It should establish exchange networks in order to facilitate intra-African commerce.

44. It should assist in the training of aquaculturists.

45. It should help in the development of fish feeds, with the participation of the Abidjan Oceanic Research Centre.

46. It should help in the development of aquacultural methods other than fish farming.

**B. Boat-building**

47. The artisanal aspect of fisheries and the construction of vessels should be maintained and rationalized.

48. A data bank should be set up within UNIDO to facilitate and enhance South-South co-operation.

49. Technicians should be trained in the construction and utilization of fishing vessels.

50. UNIDO should co-operate with boat-builders so as to reduce costs and enable fishermen to acquire fishing equipment.

51. Emphasis should be laid on the sociological aspect in view of the fact that the attitude of fishermen varies with the types of vessels proposed to them. This will help to involve users in decision-making.

52. UNIDO should conduct feasibility studies on the use of wood or glass fibre for the construction of fishing vessels.

53. Consideration should be given to the production of glass fibre in countries using that raw material.

54. Rope-making co-operatives should be established for the manufacture of fish nets (as in Morocco).

55. The use of fishing gear should be supervised in order to ensure a better protection of halieutic resources.

56. Assistance should be given to economic agents willing to engage in activities relating to the collection and processing of seaweeds.

57. In view of the fact that the use of boats had disadvantages such as those relating to engine breakdowns, the expensiveness of fuel or the scarcity of spare parts, boat-builders should be encouraged to provide supplementary installations for the use of sails as an extra security measure.

**C. Fish processing and packaging**

58. Governments of African countries should be urged to encourage the establishment of small- and medium-scale enterprises for making and distributing ice.

59. Governments of African countries should be urged to encourage the establishment of small- and medium-scale enterprises for the marketing and distribution of fish.

60. UNIDO should assist in the management of fishing activities by organizing seminars and forums for fishermen in order to familiarize them with management problems.

61. Encouragement should be given to the setting up of a cold chain, with the participation of the private sector or co-operative bodies, in order to supply fresh fish to the populations living outside the coastal areas.
62. UNIDO should evaluate fish conservation methods used in each African country.
63. UNIDO should identify two centres for applied research in Africa which carry out pilot projects in fish conservation technology for the purpose of financing their activities and placing the results of the centres' activities at the disposal of all interested African countries.
64. Exchanges should be organized on small-scale fish conservation techniques.
65. Fish-curing techniques used in various African countries should be assessed.
66. UNIDO should conduct feasibility studies on fish curing by means of irradiation, in collaboration with IAEA.
67. Systems for monitoring fishing efforts should be developed.
68. UNIDO should develop methods of packaging taking into account methods that are peculiar to each country.
69. UNIDO should identify a pilot project for "Chorkor smokers" developed by Ghana for the purpose of popularizing the products.
70. African Governments should be urged to provide their surveillance services with the necessary means to enable them to improve their aerial and maritime surveillance operations.

D. Review of specific technologies

71. The consumer's tastes and preferences should be taken into account.
72. Smoking and drying methods should be adopted which are effective and simple for the user, e.g.:

The solar drying tents used by Senegal's Food Technology Institute;

The improved "Chorkor smoker" originally designed in Ghana and now used in Benin and Sierra Leone.

E. Co-operation and information

73. Co-operation:

South-South partnership should be promoted, without North-South co-operation being rejected;

Technical assistance should be developed (practical training courses).

74. Information:

Periodic economic bulletins should be published to ensure a constant flow of information.

## VI. WORKING GROUP II: AGRICULTURAL MACHINERY

### Observations and conclusions

75. The importance of agriculture as an economic activity involving the majority of the population and the impetus which it gives to the other sectors of the economy render it a priority sector in the development policies of Africa.
76. Added to this is the goal of food self-sufficiency, considered by each of the African countries to be a necessary prerequisite for Africa's development or at least a necessary accompaniment and stimulant. Hence the crucial role of farm machinery industries and, at the same time, the need to have recourse in this field to appropriate technology for Africa, given the sociological, agro-climatic, technical and financial specificity of African conditions.
77. The suitability of a technology is judged by the extent to which it can adapt to the activity to which it is applied.
78. Agricultural mechanization, through an appropriate choice of machines and equipment to be used, must be oriented towards permitting an improvement of agricultural productivity and production.
79. Each country, depending on its own specific needs, must study the best agricultural and economic conditions which will enable a traditional agricultural production system to attain a given level of mechanization using a minimum of power.
80. The following major features are taken into consideration.
- A. Traditional techniques, tools and technologies
81. The variety of cottage farming systems in Africa is such that traditional tools and technologies play an important role, given certain conditions.
82. It is therefore important to seek ways to rationalize and improve the performance of these tools and technologies through:
- (a) Structural organization of local cottage industry;
  - (b) Improvement of training and of equipment used in work, in collaboration with manufacturing industry if it exists;
  - (c) Organization of a supply system for quality work material for the manufacture of certain components, it being understood that, for components requiring special materials such as moving parts, one must, in the farmer's interest, encourage the use of industrially made parts.
- B. Improvement of equipment
83. One of the shortcuts to an appropriate technology is to improve technologies which already exist in the field. This calls for four conditions:
- (a) Accessibility to these technologies via technical co-operation agreements with the technology being turned over free or for a price;
  - (b) Existence locally of testing and experimentation structures capable of testing a technology and identifying the features to be improved to match consumer needs;

(c) Local or outside capacities for manufacturing the improvements decided on;

(d) Establishing and developing research institutes, using local expertise and integrating experience and farmers' reactions to the technologies proposed.

84. The exchange of information and experience must be encouraged through organizations and structured farmers' associations.

C. Strengthening of bonds between research and engineering institutes, small and medium-sized industrial enterprises and farmers

85. Applied research on farm machinery is a key condition for revitalization with a view to the rational mastery of this important factor of production in agriculture.

86. However, the high cost of research and the insufficiency of research capacities at the human and scientific level in Africa call for the co-ordination and rationalization of the efforts of the various African countries.

87. This rationalization should at the minimum involve better circulation of technical and scientific information, and of the positive and negative results obtained. It should also be accomplished through co-operative links in the field between research and development structures and the small- and medium-scale industrial enterprises in the sector, at the national level and at the South-South and North-South levels.

D. Area of co-operation and joint ventures

88. Owing to the limited size of the solvent farm equipment market in African countries when taken individually, it is difficult to see how industrial plants can be made profitable in each State unless they co-ordinate and co-operate with one another.

89. This co-operation must take concrete form in the promotion of joint ventures on two fronts. On the one hand, at the horizontal South-South level, between two or more African countries subregionally, leading to specialized industrial units with an expanded market. On the other hand, at the vertical North-South level, between African subregional industrial units and small- and medium-scale industries in the North with implications in regard to technology transfer adapted to local needs.

Recommendations

A. At the national level

**Recommendation No. 1**

90. The farming equipment manufactured or proposed must be adapted to the true needs of the farmers. This means close collaboration between:

Manufacturers at the local level, the African subregional level and the international level;

Research and development agencies;

Farmers using the products.

**Recommendation No. 2**

91. There should be adequate training and skill development of extension agents concerned with farm machinery and mechanization, and sensitization of farmers to the need to accept the new adapted technology so as to create the best conditions for efficient use of equipment and development of agricultural production.

**Recommendation No. 3**

92. The establishment of a maintenance programme which is easily understood by the farmer must be promoted. In this area, rural craftsmen and village mechanics can play major roles as local auxiliaries to national or subregional industrial units.

**Recommendation No. 4**

93. With regard to manufacturing, the development and rationalization of traditional tools and technologies should be promoted, with optimum use of suitable local raw materials.

94. With regard to the transfer of technology, it is important to check whether it is technically, humanly and financially suitable, considering the need for competitiveness on the foreign market of products which have been manufactured using the transferred technologies.

**Recommendation No. 5**

95. Efforts must be made to develop a largely decentralized national distribution network. The acquisition of farm machinery must also be made easier for the various categories of farmers, particularly for smallholders, through a structured and truly functional farming credit system.

96. A system of tax relief, specific not only to agricultural machinery but also to spare parts, together with an appropriate policy in the area of subsidies and credit facilities, would help to make mechanization accessible, particularly for small farmers.

**Recommendation No. 6**

97. In order to make up for the rainfall shortage in some regions, and in view of the known existence of vast underground water reserves that can be tapped, recourse to a mechanized irrigation system using wind energy is recommended, especially in agricultural regions.

**B. At the subregional level**

**Recommendation No. 1**

98. Generally speaking, it is obvious that the solvent market for agricultural equipment in each African country taken individually is relatively limited; this suggests well-organized regional co-operation in the setting up and/or development of farm equipment industries through joint ventures, equity swaps or simply technical and trade co-operation agreements.

99. It is also worth noting that the introduction of certain technological processes cannot be envisaged economically except for a large market bringing neighbouring countries together in subregional or regional economic co-operation groupings.



100. In this line of thought, the forthcoming proclamation of the Second IDDA should, in the framework of the Lagos Plan of Action, focus on promoting concrete projects within the various African subregional groups backed by existing industrial capacities, in order to bring about the joint manufacture of certain farm machines and equipment items now being imported from non-African countries.

**Recommendation No. 2**

101. The promotion of adapted technologies for Africa through the creation of local industries in African countries is hindered by the near-total absence of horizontal South-South co-operation, with a lack of information on the respective experiences of countries in the different fields of technology and also the absence of minimum standardization for the products of these countries.

102. Efforts to mitigate this situation should be undertaken with UNIDO's assistance, for example in the setting up of a technology unit for each subregion, installed either in existing industrial units or in centres and institutes for research and experimentation on agricultural equipment.

**C. At the international level**

**Recommendation No. 1**

103. In order to promote appropriate technologies for the development of the agricultural machinery industry in Africa, increased and better co-ordinated international assistance is required, under the aegis of UNIDC, in the following fields:

Creation and/or strengthening of basic services and installations at national level in the African countries;

Organization of exchanges and co-operation between existing production units through technical and technological information meetings between the technical and commercial executives directly involved;

Training and improvement of skills for the technicians involved at different levels in the design, testing and manufacture of agricultural machinery.

**Recommendation No. 2**

104. It is very important to ensure that Governments, industrialists and farmers take account of impact on the environment as a decisive criterion in the planning of development and in the choice of the means of production in order to ensure harmonious and lasting development.

**Recommendation No. 3**

105. UNIDO and the other agencies of the United Nations system concerned should help in the establishment of an African technology information network to assist research and development centres, manufacturers and other economic operators involved.

**Recommendation No. 4**

106. Equipment programmes financed by bilateral or multilateral aid, as well as African and international funding institutions, should give priority to the acquisition of agricultural equipment produced in Africa, bearing in mind local supply possibilities.

107. This would help to reduce the many technical problems encountered at the level of the farmer and encourage the development of industrial technologies in Africa.

**Recommendation No. 5**

108. Food aid to African countries, with the exception of emergency aid in response to disasters, should, at least in a certain proportion, be made available by the donor country in the form of financial resources permitting the purchase in the African countries themselves of local cereals and other foodstuffs and locally manufactured agricultural equipment and machinery for the development of agricultural production.

**VII. WORKING GROUP III: FOOD PROCESSING AND PRESERVATION**

Observations and conclusions

109. The Working Group on Food Processing and Preservation agreed that the upgrading of traditional technologies was basic to and essential for the development of appropriate industrial technologies, but the extent of upgrading should depend on the resources available in each country and such technologies should be tailored to the needs of the people.

110. The Group also considered that appropriate technology must be understood to mean the technology mix which took into account developmental objectives of each country and was appropriate inasmuch as the socio-cultural and economic aspects of the country were fully integrated. Thus, appropriate food processing technology must aim to:

Provide the population with food products which were of good nutritional value and consistent quality at costs which were affordable;

Accelerate rural industrialization;

Generate productive employment;

Increase exports and foreign exchange earnings;

Strengthen national technological capacities;

Generate backward and forward linkages with other sectors of the economy;

Contribute to the improvement of the environment.

111. It was appreciated that rural women were the key actors in traditional food processing and any programme of technology development and adaptation must give due consideration to the role of rural women.

112. The constraints inhibiting the development of appropriate industrial technology in the food processing subsector were noted. These included inadequate, unreliable raw materials supply, lack of storage facilities, and lack of adequate information on technology and processing, marketing and distribution, skilled technical personnel and management, research and development, financing and investment.

113. However, many of these problems could be overcome were African countries to translate into concrete action the letter and spirit of the various recommendations already adopted, especially the Lagos Plan of Action. The need for co-operation

between developing countries at national, regional and international level in regard to research and development, marketing, training, technology development and information dissemination in the areas of production, processing, packaging and quality assurance was highlighted.

114. A further problem was the fact that the critical economic situation in African countries today no longer permitted the importation of machinery and equipment. The challenge facing the R and D institutes and engineering centres was therefore the development of appropriate equipment for food processing.

115. The Group agreed that by-products of raw materials processing and food processing should be regarded as raw materials for further processing. Their utilization would not only eliminate certain problems of environmental pollution but would also lead to more value addition. Sugar mill by-products could be used in animal feed, paper, textile fibres, cellulose derivatives, fibreboards and other products.

116. It was realized that packaging was a central issue in the choice of appropriate technology for food processing and preservation, accounting as it did for 50-60 per cent of product ex-factory costs. The Working Group felt that there was a need for research and development work on alternative packaging materials if the food processing and preservation subsector was to be transformed.

#### Recommendations

##### A. At the national level

###### **Recommendation No. 1**

117. Formulation and application of explicit technology policies that emphasize private-sector small-scale industry initiatives and provide for fiscal and monetary incentives and scientific and technical support in a commercially oriented environment.

###### **Recommendation No. 2**

118. Conduct of surveys and collection and evaluation of data on available industrial food-processing technologies (small-, medium- or large-scale), and establishment of an inventory of locally fabricated food-processing machinery; evaluation of data needed for planning decisions on technological options and development of technological capacities; establishment of a comprehensive data bank; setting up of farmers' and small-scale processors' co-operatives.

###### **Recommendation No. 3**

119. National post-harvest technology centres should be established or existing centres mobilized so as to develop appropriate technology and machinery for reducing post-harvest losses; traditional technologies for products closely reflecting consumer demand should be upgraded, and consumer awareness should be encouraged through education.

###### **Recommendation No. 4**

120. In order to make a significant breakthrough in the development of an effective technological capability for food industries and agriculture, African Governments should be urged to make every effort to devote at least 1 per cent of their gross national product to the development and promotion of science and technology in the area of food and agriculture. The development of the engineering and machine tool industries and of a maintenance culture should be a matter of top priority.

**Recommendation No. 5**

121. A national focal point should be established which will be responsible, among other things, for:

Identifying investment opportunities based on available local and national resources;

Carrying out pre-investment and feasibility studies for industrial projects;

Participating in negotiations and conclusion of agreements on technical co-operation or technology transfer matters, turnkey contracts, licensing and registration of industrial establishments, in line with the Government's priorities;

Collecting data concerning industrial production and provision of assistance in the dissemination of information on technical and technological matters.

**Recommendation No. 6**

122. The training of personnel for food processing and preservation activities should be restructured to make it practically oriented.

**Recommendation No. 7**

123. Given the heavy dependence on imported packaging materials, each developing country has an interest in finding technologies that utilize more fully its own natural resources in terms of metals, natural fibres, timber, etc., to develop appropriate packing systems.

**Recommendation No. 8**

124. In order to increase indigenous research activity concerned with food processing and preservation, private sector industries should co-operate with Governments in funding mission-oriented research programmes, and private entrepreneurs should be encouraged to use locally developed technologies and pilot prototype equipment in their industries.

**B. At the subregional level**

**Recommendation No. 1**

125. Institutions set up to promote the technological development of the region need to be funded adequately to perform the key role for which they were set up.

**Recommendation No. 2**

126. Co-operation should be promoted among the research centres and similar research and development institutions of the various countries. This would cover the exchange of scientific experience, research findings, inventions and innovations and of the scientists themselves. Joint scientific research work should lead to the promotion of subregional specialization and co-operation in the manufacture of agricultural and food processing and preservation machinery.

**Recommendation No. 3**

127. The countries should participate in fairs and exhibitions organized within the region to promote the marketing of technological inventions/innovations.

**Recommendation No. 4**

128. Joint ventures should be promoted to optimize transfer of technology and use of national resources, especially human skills and natural resources.

**C. At the international level**

**Recommendation No. 1**

129. Once a multisectoral information network has been developed for the dissemination of information on appropriate industrial technologies, this should be linked with the data banks of UNIDO, FAO, the Intermediate Technology Development Group (ITDG) and Appropriate Technology International (ATI), and other relevant data banks.

**Recommendation No. 2**

130. Arrangements for technology acquisition should be such that:

Local engineers can design the technology;

Engineering shops in the country can build part of the equipment and can be serviced, leading to capacities for repairing and producing spare parts;

Part of the technological package will allow local engineers to upgrade local competence in the field of the transfer of technology;

The technology responds to priority basic needs and a general development option;

It is productive.

**D. With international organizations**

131. Efforts and activities at all levels in the transfer of technological know-how and the development of appropriate indigenous technology for food processing and preservation should receive strong support and assistance from international organizations such as UNDP, UNIDO and FAO.

(a) UNIDO should issue a compendium of new technologies developed in or for and used by developing countries in the field of food processing as a means of exploiting their local materials; the compendium would describe the technology concerned and indicate the conditions in which it can be used (scale or range), the raw materials and equipment needed, any materials the technology can replace and the technology source;

(b) UNIDO should continue to organize international forums, consultations, solidarity ministerial meetings, round-table meetings, ministerial and high-level meetings for co-operation, advisory services, study tours and training, and to implement other joint industrial programmes;

(c) A focal point for technology development should be set up in UNIDO, with particular emphasis on the industrial development of Africa.

VIII. WORKING GROUP IV: TECHNOLOGICAL CAPABILITIES

Observations and conclusions

A. Capacity building

132. The Group examined the importance of capacity building in the acquisition of technological capabilities, considering human and infrastructural development.

133. The observations made and conclusions arrived at on this subject are detailed below:

It was noted that the level of scientific and technological awareness of Africans is low. This was attributed to the lack of emphasis placed by African Governments on training in science and technology.

Scientists, engineers and technologists are not adequately rewarded when compared to other professionals.

Most engineers, scientists and technologists do not go through formal management training programmes. As a result of this, technologists are usually limited in their career prospects in industry.

The lack of basic physical and institutional infrastructures is a major constraint in the acquisition of technological capabilities by most African countries.

B. Technology development

134. Under this heading, the Group examined the following topics:

Upgrading of local technologies;  
Importation of appropriate technology;  
Unpacking of imported technology;  
Adaptation of imported technology;  
The role of a well-articulated national science and technology policy.

135. The following observations were made and conclusions reached:

(a) Africans have the capability to process most of their materials. However, the local technologies have not been upgraded to meet modern economic and social demands;

(b) In an attempt to industrialize, African countries have been acquiring machines and equipment which are not appropriate to their level of development. The result of this is that many projects are grounded only a few years after the installation of the plants. There is a tendency for African nations to favour turnkey projects for which adequate local expertise is usually not available;

(c) Local experts and consultants do not usually participate in the process of choosing the imported technology;

(d) There is no well-defined science and technology policy in most African countries. Usually emphasis on science and technology is politicized and hence dependent on the Government of the day;

(e) There is a complete neglect of the environment because of the concern to acquire technological capability and industrialize. As a result, environmental pollution is uncontrolled in many African countries;

(f) There is a great agricultural potential which is not being optimized owing to inadequate processing and preservation technologies for the quantities produced; there are also natural and man-made ecological constraints;

(g) There is inadequate provision of service workshops attached to each factory or industry to produce spare parts and take care of maintenance and repair;

(h) There is inadequate capability to follow up on agreements for increasing local value-added in terms of components, spare parts and engineering services.

### C. Technology transfer

136. The Group considered the transfer of technology from three perspectives: intercontinental transfer, interregional transfer and national or local technology transfer.

137. The following observations were made:

(a) It was noted that many African countries had not managed technology transfer in ways that enabled the imported technologies to contribute to sustained industrial and technological development;

(b) Most of the industrialization efforts in the African continent had actually only served unpatriotic elements in the public and private sector, enabling them to make massive transfers of foreign exchange from which the benefit had not accrued to the region;

(c) It was noted that a wide variety of technological developments were taking place in many African countries. Unfortunately, dissemination of information on those technological developments was usually inadequate or, in some cases, non-existent.

### Recommendations

#### Recommendation No. 1

138. African Governments should pay more attention to the training of craftsmen, technicians, engineers and scientists.

#### Recommendation No. 2

139. Engineering and related training should include practical work in industry.

#### Recommendation No. 3

140. Local industrialists and businessmen should be included in the governing boards of research institutes and institutions of higher learning.

#### Recommendation No. 4

141. Opportunities should be created for industrialists with relevant experience to share their knowledge with the institutions of higher learning.

#### Recommendation No. 5

142. African Governments should provide special inducements to discourage the exodus of technologists, scientists and engineers.

**Recommendation No. 6**

143. (a) Scientific and technological education should be encouraged through the award of scholarships and grants;

(b) Science education should be compulsory up to the end of secondary education.

**Recommendation No. 7**

144. Science and technology training at the subregional level should be encouraged through exchange programmes.

**Recommendation No. 8**

145. Management training should be included in the curricula of all science and technology training programmes.

**Recommendation No. 9**

146. African Governments should put in place the physical infrastructures such as electricity, water supply, roads, railways, etc., needed to facilitate industrial and technological development.

**Recommendation No. 10**

147. African Governments should put in place institutions/structures such as national standards organizations, data bases for information acquisition and dissemination and national design and technology transfer centres.

**Recommendation No. 11**

148. Socio-economic studies should form an integral part of technology development programmes in African countries.

**Recommendation No. 12**

149. Local consultants should be involved in the design and execution of local projects.

**Recommendation No. 13**

150. Technologies developed by R and D institutions and universities should be related to national needs.

**Recommendation No. 14**

151. African Governments should seek and acquire technological capability from any source and by all means at their disposal with a view to their technological emancipation.

**Recommendation No. 15**

152. Governments should draw up an inventory of existing local technologies and expertise with a view to upgrading them to meet modern economic and social requirements.



**Recommendation No. 16**

153. (a) Governments should encourage local industries to use locally available materials;

(b) The export of scrap metals should be discouraged and the local recycling of scrap metal and other materials encouraged.

**Recommendation No. 17**

154. Governments should encourage women to participate fully in the technology development process.

**Recommendation No. 18**

155. Governments should encourage the establishment of new basic engineering production facilities and the rehabilitation of the existing facilities, especially in the area of metalworking (foundry and fabrication).

**Recommendation No. 19**

156. Governments should ensure that there is close collaboration between R and D institutions on the one hand and the formal and informal industrial sector on the other.

**Recommendation No. 20**

157. Co-operation between African countries and other countries with similar industrial development problems should be encouraged within the concept of the South-South dialogue.

**Recommendation No. 21**

158. Environmental protection should be given priority in any science and technology policy.

**Recommendation No. 22**

159. Efforts should be made to use what African countries possess to produce what they need and, where possible, what other countries need (export).

**Recommendation No. 23**

160. The principles of the division of labour within the framework of a properly integrated regional industrial development programme should be optimally applied, as a possible avenue for promoting industrial development.

**Recommendation No. 24**

161. African Governments should involve potential users in deciding the technology to be imported.

**Recommendation No. 25**

162. African Governments must: (i) ensure that thorough investigations are conducted in order to increase the range of supply sources for alternative technologies; (ii) improve their ability to negotiate with technology suppliers for better terms; (iii) develop the capacity for unpackaging imported technologies with a view to adapting them to local conditions.

**Recommendation No. 26**

163. African Governments should establish control mechanisms to screen imported technologies and tailor them to the actual needs and conditions of the country.

**Recommendation No. 27**

164. UNIDO should intensify efforts to develop the African section of the Industrial and Technological Information Bank.

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Annex II

LIST OF DOCUMENTS

- Agricultural machinery: case studies of Ethiopia, Morocco and Zimbabwe (prepared by Juan A. Angulo Chueca, UNIDO Consultant)** ID/WG.493/1(SPEC.)
- Fisheries: case studies of Kenya, Somalia, Zambia, Ghana and Côte d'Ivoire (prepared by W. H. L. Allsopp, UNIDO Consultant)** ID/WG.493/2(SPEC.)
- Technology profiles (prepared by G. Appelgren, UNIDO Consultant)** ID/WG.493/3(SPEC.)
- Food processing and preservation: case studies of Egypt, Cameroon and the Congo (prepared by Oluniyi Babatunde Omosaiye, UNIDO Consultant)** ID/WG.493/4(SPEC.)