

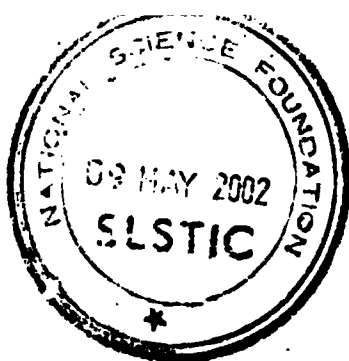
UNITED NATIONS CONFERENCE

on

Science and Technology for Development (1979)

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**National Science Council of Sri Lanka
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Abbreviations

ACAST	Advisory Committee on the Application of Science and Technology, United Nations
ADB	Asian Development Bank
CISIR	Ceylon Institute of Scientific and Industrial Research
CSTD	Committee on Science and Technology for Development
ESCAP	Economic and Social Commission for Asia and the Pacific, United Nations
EPZ	Export Processing Zone
FAO	Food and Agricultural Organization, United Nations
FRG	Federal Republic of Germany
GNP	Gross National Product
IDB	Industrial Development Board
IDRC	International Development Research Centre, Canada
LDC	Less Developed Country
LPG	Liquid Petroleum Gas
NERD	National Engineering Research and Development Centre
NSC	National Science Council
NTIS	National Technical Information Service, USA
OECD	Organization for Economic Cooperation and Development
OPEC	Organization of Petroleum Exporting Countries
PQLI	Physical Quality of Life Index
RCTT	Regional Centre for Technology Transfer, United Nations
SLAAS	Sri Lanka Association for the Advancement of Science
STD	Science and Technology for Development
TIRS	Transportation Information Retrieval Service, USA
UK	United Kingdom of Great Britain and Northern Ireland
UNCSTD	United Nations Conference on Science and Technology for Development
UNCTAD	United Nations Conference on Trade and Development
UNESCO	United Nations Educational Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
USAID	United States Agency for International Development

I. INTRODUCTION

1. Sri Lanka's long and interesting history provides many examples in the use of science and technology for sustaining the cultural, economic and social aspects of life. For example, thousands of irrigation works were built over centuries to develop agriculture. Temples, religious monuments, rock carvings and paintings had the necessary technological inputs to sustain a high level of culture and the arts. In fact, Sri Lanka has historically had a fairly sophisticated, though empirical, science and technology in irrigation, buildings, agriculture and other sectors.
2. Yet, ironically now, Sri Lanka is classified as one of the less developed countries (LDCs) on the basis of its Gross National Product (GNP) per capita which was Rs. 1,754/= in 1976 (US \$ 121). The GNP per capita, however, does not adequately reflect either the socio-economic conditions or the aspirations of the people. This is particularly so in Sri Lanka, where despite the very low GNP, the Physical Quality of Life Index (PQLI), taking into consideration such elements as literacy, infant mortality and life expectancy, is quite high, and only slightly lower than that of many developed countries.^{1/}
3. The unsatisfactory features of the economy are basically the high rate of unemployment (1 million in a population of 14 million), the low income levels particularly in the rural sector, the slow rate of economic growth and the heavy dependence on foreign technology and raw materials.
4. The government is committed to a programme of development that is designed to improve the socio-economic-ecologic environment and create a broad horizon of opportunities for its people and to increase the rate of economic growth in all sectors. In the achievement of these goals, Sri Lanka recognizes the vital importance of science and technology and the need to achieve self-reliance in this field.
5. In this context, Sri Lanka endorses the decision of the UN General Assembly to hold a World Conference on Science and Technology for Development (UNCSTD). This conference should bring a new awareness of the importance of science and technology to achieve the goals of the New International Economic Order with particular reference to the well being of the people of the LDCs.
6. The government of Sri Lanka views with dismay and serious concern the fundamental inequity in the terms of trade and technology transfer creating a growing affluence in the developed countries apparently at the expense of the LDCs. The prices of raw materials of the LDCs have been relatively stagnant while the costs of science and technology and its products from the developed countries have been rapidly escalating. The economic disparity between the industrialized and the less developed nations is widening. While the former are developing exponentially, the latter are suffering from slow growth, often resulting in economic stagnation.

^{1/} The United States and World Development, Overseas Development Council, Praeger, New York, 1977

7. Sri Lanka subscribes strongly to the view that a New International Economic Order based on equity could be achieved only by active co-operation of the developed countries in a meaningful effort towards reducing the existing inequality between nations. The application of science and technology to development needs firstly a fundamental commitment to this goal by the LDCs themselves. But, equally, the developed countries, wherein lies the vast bulk of the science and technology of the world, should be committed to a more positive and active role in its transfer and adaptation to the well being of the LDCs. In this context, Sri Lanka believes that UNCSTD is timely and hopes that it will contribute substantially to the achievement of the New International Economic Order as enunciated by the UN General Assembly.^{2/}

8. Work connected with the preparation of the Sri Lanka National Paper for the Conference started at the National Science Council (NSC)- which was designated as the Sri Lanka Focal Point- in September, 1977. The NSC prepared three circulars based on the UNCSTD Guidelines.^{3/} These were sent to - 1) Ministries, Departments and Corporations of Government, 2) Government Agents in the Districts and 3) Private Industrialists. The circulars were intended to provide information on the programmes of development and to focus attention on the problems relating to the application of science and technology for development.

9. In December 1977, the NSC hosted a series of meetings to which heads of the main government institutions concerned with the application of science and technology were invited. These meetings helped to identify the five subject areas for the national paper as follows:

- (a) Agriculture
- (b) Industry
- (c) Health and Sanitation
- (d) Housing
- (e) Energy

10. Five separate panels consisting of scientists and technologists in each area were then formed to prepare the five sectoral reports on the chosen subject areas. The Acting Secretary-General of the NSC prepared a set of matrices with the subject areas as the horizontal components and aspects of the application of science and technology for development pertinent to conference agenda items 1 - 3 forming the vertical components. These matrices were used as the basis of preparation of the panel reports.

^{2/} General Assembly Resolutions 3201 (S - VI), 3202 (S.VI), 3281 (XXIX) and 3362 (S - VII), United Nations, New York.

^{3/} Guidelines for the preparation of National Papers, UN Publication, General Assembly, A/Conf. 81/Inf.1, New York, 7 March 1977.

11. Sri Lanka was represented at a Sub-regional meeting of experts for the preparation of national papers held in New Delhi in February 1978. This meeting was jointly organized by UNESCO and the UNCSTD in co-operation with ESCAP. At this meeting the methodology used by Sri Lanka in the preparation of the national paper was explained and was well received.^{4/}

12. The draft National Paper was prepared by Mr. L.C.A. de S. Wijesinghe, Acting Secretary-General of the National Science Council, with the assistance of Dr. V. Setty Pendakur, UNCSTD Consultant. It was completed in May 1978.

13. The meeting of the Co-ordinating Committee consisting of government sectoral representatives was held on 11 May, 1978, for discussing the first draft of the national paper. The suggestions of the committee were incorporated into the subsequent draft which is to be presented to the National Workshop on 6 June, 1978.

14. Sri Lanka National Workshop on UNCSTD.

15. ESCAP Regional Seminar on UNCSTD.

^{4/} Sri Lanka Report, Sub-regional Meeting of Experts for the Preparation of UNCSTD National Papers, New Delhi, Feb. 1978, UNESCO Regional Office for Science and Technology, New Delhi, 1978.

II. SCIENCE AND TECHNOLOGY FOR DEVELOPMENT

A. The State of Development

1. Background Information

16. Sri Lanka is a free and independent republic. It is a tropical island with a population of 14 million (in 1976), and a land area of 25,000 square miles. Sri Lanka has an ancient history dating back to the 6th century B.C. In the centuries gone by, the civilization of the country generally prospered in spite of periodical set backs. Since ancient times, the main occupation of the people was agriculture. Thousands of reservoirs were built to conserve and control the flow of water and to provide for irrigation. The villages naturally developed around these reservoirs. This civilization declined after the 12th century A.D.

17. The Portuguese conquered Sri Lanka in 1505. They ruled the maritime districts for 1½ centuries and were replaced by the Dutch East India Co. in 1654. The Dutch were interested primarily in the commercial possibilities offered by the country by way of trade in spices, timber etc. The Dutch rule, which was also confined to the maritime districts, ended with the British invasion in 1805. Sri Lanka's final and complete capitulation to British rule was in 1815. The British rule lasted approximately 150 years (1805 to 1948), and the British occupation has had a profound influence on the development of the country.

18. With regard to the overall progress and development of the country since independence (1948) various attempts were made to estimate Sri Lanka's national income, but a detailed estimate of GNP was first published by the Central Bank in its Annual Report of 1958. The GNP was then Rs. 5,779 million. This increased to Rs. 8,255 million in 1967, to Rs. 9,762 million in 1971 and to Rs. 11,480 million in 1976 (all figures at 1959 prices). The figures for the last decade (1967 - 1976) gave a rate of growth of 4.4% for the first half of the decade which declined to 3.3% during the second half.

19. The state of development of Sri Lanka is outlined below in relation to the five selected subject areas.

2. Agriculture

20. Sri Lanka is, and has always been throughout her long history, an agricultural country. At present, agriculture accounts for 1/3 the GNP. Because industrial output as generally computed also includes value added in the processing of agricultural commodities, the real importance of this sector is even greater than what is reflected above.

21. The output in agriculture is largely confined to four crops namely, tea, rubber, coconut and rice. The first three which are the main plantation crops account for the major portion of the foreign exchange earnings of the country, and consequently, their performance is an important determinant of the country's import capacity. Rice, on the other hand, is the staple food of the country, and local production is still substantially lower than the nation's requirement. Consequently, the volume of production of rice has an important bearing on the volume of total cereal imports.

22. The plantation crops, tea, rubber and coconut have reached a level of excellence in research and productivity, unmatched by any development in other sectors. This is due to the original emphasis upon the development of these crops by the British for purposes of trade and the subsequent importance accorded to them by the Sri Lanka governments for foreign exchange earnings. These crops are serviced by three research institutes that have been in existence for over 50 years and have reached a very high degree of scientific and technical competence.

23. Rice, by contrast, received very little attention during the pre-independence era. Since independence (1948), however, successive governments have given a very high priority to the increase of rice production. The support given to the development of rice cultivation has taken the form of restoration of old irrigation reservoirs and the building of new ones, the introduction of high yielding strains of rice and the use of modern cultivation practices including the use of adequate fertilizer. The highest annual production of paddy was 80 million bushels, recorded in 1977. This is about 75% of the total national requirement.

24. The Mahaweli Ganga Development Scheme - Most of the development in the agricultural sector during 1978 - 1983 is expected to be through the implementation of the Mahaweli Development Project. The Mahaweli is the largest river in Sri Lanka. This project is designed to divert the Mahaweli to irrigate 900,000 acres. Of this, 650,000 acres are uncultivated land, and the balance, though cultivated at present, receives only restricted quantities of irrigation water. The Mahaweli project is a multi purpose one which also includes the installation of a series of hydroelectric power plants.

25. Work on the first part of the project (Stage I Phase I Project I) has been completed but the major part of it, by far, remains yet to be done. The works completed up to now provide enhanced irrigation water to a number of reservoirs making it possible to carry out year round cultivation of 132,000 acres which had earlier received only restricted water supplies.

26. The earlier scheme had envisaged that the completion of the Mahaweli project would take 30 years, but the government has now decided to give very high priority to this project and has reprogrammed the operations so as to complete most of the project within 6 years (1978-1983).

3. Industry

27. Prior to World War II, the manufacturing industries of the country, which had by then been under British rule for nearly 150 years, consisted mainly of the processing of the products of the three main plantation crops, tea, rubber and coconut into a form suitable for export. The manufacturing industry outside the plantation sector was of a very rudimentary nature and confined to a few items like soap, textiles, leather etc. Even in the case of these items the production was far short of the modest local demands.

28. In the post independence period (after 1948), state corporations were set up for plywood (the existing plywood mill being vested in the corporation), leather footwear, cement, oils and fats, caustic soda, chlorine, paper and ilmenite. In the latter part of the 1950s, special importance was accorded to the development of the industrial sector through state corporations, and during this period the packaged technology was transferred from a number of countries through bilateral trade and technical assistance agreements. The industries established included iron and steel, tyre, flour milling and sugar. A hardware factory was also started in 1963.

29. Private sector participation in industry showed a noticeable upward trend in the latter 1950s and early 1960s, particularly with regard to consumer goods industries. The rapidly deteriorating foreign exchange situation at the time resulted in the curtailment of the import of consumer goods resulting in scarcity, and this gave a new impetus to the import substitution phase of industrialization.

30. Industrialization based on import substitution may look attractive in principle, but in practice, if not properly controlled, can lead to a situation where industries may be developed in which the local effort consists merely of assembling components (e.g. radios) or only of packaging the finished products imported in bulk (e.g. pharmaceuticals, milk foods). This results in industries being set up where the import content is very high and the foreign exchange costs of keeping the industries going are unduly high. From the economic standpoint, import substitution of this kind will not bring the expected relief to the balance of payments. With regard to technology, this situation will not boost the science and technological capability of the country towards using local raw materials and/or local talent in place of imported ones. These were the teething troubles of the early phase of the programme of import substitution.

31. Despite the initial setbacks and shortcomings in the programme of industrialization, by the early 1970s, the country had attained self-sufficiency in a number of industrial products notably, cement, salt, steel rolled products, electrical accessories, paints, footwear, soaps and detergents, confectionery and biscuits, tobacco, a wide range of plastic and aluminium products, some lines of machinery and equipment such as water pumps and machinery for the processing of tea, rubber and coconut. Besides these, the installed capacity in various other industries were able to supply a considerable proportion of the local requirements as in the case of textiles, paper, tyres and tubes, caustic soda, plywood, agricultural implements, sugar and wheat flour.

32. The growth of the industrial sector from the early 1970s fell far short of expectations. The contribution of industry to the GNP which had increased from a level of 12.8% in 1967 to 14.2% in 1971 had then declined to 13.0% by 1976. The decline in real terms is even sharper. In real terms, the manufacturing industry which had grown at an average rate of 6.5% per year during the late 1960s had only a 1.5% rate of growth in the period 1971 - 1976 when the GNP had grown by 3%.

33. The poor performance of the industrial sector resulted in shortfalls in the planned targets of production (10% planned growth rate). The main reason for this set back was the chronic shortage of

foreign exchange experienced during this period. As a result of this, the best use could not be made even of the limited foreign exchange since it was released piecemeal and imports had to be made when funds were available, irrespective of the current world prices.

34. In a situation where the imported raw materials constituted about 70% of the total value of raw materials, and where the use of imported raw materials accounted for a proportion of over 40% of the total industrial production (1974), it was obvious that the shortage of foreign exchange had created a major problem for the industry as a whole.

35. For the reasons mentioned above, there was considerable underutilization of installed capacity. However, underutilization which was 60% in 1974 decreased to 46% in 1975 and 36% in 1976.

4. Health and Sanitation

36. In the field of health, Sri Lanka has made considerable progress during the past few decades. This is evidenced by the sharp decline in infant mortality (from 140 per 1000 live births in 1946 to 43 in 1971) and the spectacular increase in life expectancy (from 44 years in 1946 to 64 in 1971).

37. The main public health problems in Sri Lanka at present stem from preventible diseases like bowel infections, poliomyelitis, diphtheria, whooping cough, tetanus, malnutrition and malaria. The recent resurgence of malaria, the incidence of which had dropped to almost zero in 1960, has caused serious concern.

38. The lack of adequate and safe potable water, and poor environmental sanitation are the chief contributory factors for the spread of bowel diseases and the consequent aggravation of malnutrition.

39. Most rural, and a few urban areas, do not yet have safe pipe borne water supplies or central sewerage systems. Even in the capital city of Colombo, the overloaded sewerage system (constructed about 70 years ago and originally projected only up to 1951), the shortage of pipe borne water, and the slums and shanty dwellings continue to be major health hazards.

40. The sharp drop in infant mortality and the increase in life expectancy has brought with it a rapid increase in population. The rate of population increase, however, has shown a healthy decline in recent years from 2.8% in 1963 to 1.7% in 1976. This rate is still considered high. Moreover, as with other LDCs, the highest rate of population increase is among the poorest sections of the community.

41. It is recognized that a fast increasing population without a commensurate increase in the social infrastructures manifest itself in many ways, among which are over crowded class rooms and hospitals, aggravation of the unemployment problem etc.

42. About 80% of the population of Sri Lanka seek indigenous treatment for common ailments. The ayurvedic medical practitioner has better and more intimate contact with the people particularly in the rural areas. Apart from treatment, the services of these practitioners have

not been optimally utilized for other purposes such as health education, family planning and preventive health work.

43. Many indigenous herbs and other plant materials could be systematically collected or cultivated locally but unfortunately continue to be imported. There is considerable scope for development in this area.

5. Housing

44. According to a housing census carried out in 1971, there were 2.5 million housing units and living quarters in the country, of which 18% were in the urban sector, 71% in the rural sector and 11% in the plantation (tea, rubber and coconut) sector.

45. The majority of the housing units in the urban sector are of the permanent type and consists mainly of single detached houses which make up 72% of the total. Multistoried flats (confined almost entirely to Colombo) consist of only 5.4%.

46. The urban sector requirement of new houses to provide adequate housing and to replace obsolescent units was estimated at 244,000 in 1976, increasing to 462,000 by 1986 while the corresponding numbers in the rural sector are 192,000 and 491,000 respectively. The materials used in the construction of the permanent type house are cement, bricks and tiles (out of burnt clay) or asbestos.

47. In the rural areas, the estimated number of housing units (1976) was 1.8 million. A typical rural house consists of 2 or 3 small rooms. It is generally owner occupied. The majority are of the semi permanent type with walls of wattle and daub and the roof of woven dried palm leaves (cadjan) or straw.

48. The slum and shanty problem, widely prevalent in the major cities of the LDCs, is found in Sri Lanka too, but is confined almost entirely to Colombo. Shanty houses are built of materials such as cadjan, wooden planks, jute hessian and old galvanized iron sheets. They are built on private land or on encroachments on government property. There are an estimated 350,000 slum dwellers in Colombo. The total number of shanty living quarters is over 50,000.

6. Energy

49. Energy is a basic requirement for development. Sri Lanka has made great strides in the 30 years since gaining independence in harnessing the hydrological resources of the country for the generation of electric power. During this period, hydroelectric power stations have been installed and a national grid established.

50. Electrical energy is used in the domestic sector primarily for lighting. For industry, it is the main source of energy while it is not used for transport. For domestic cooking, fuelwood is the main source of energy while kerosene is also popular particularly in the urban areas.

51. At present, the total energy consumption in the country is about 10 TWh per annum, and this is met by petroleum products (28%), electricity (hydropower) (12%), and fuelwood and other agricultural residues (60%).

52. Firewood is therefore the most widely used form of energy, and it is mainly used for domestic cooking, particularly in the suburban and rural areas. It is also used for industries like brick and tile manufacturing, for bakeries etc. There are no precise estimates of the annual consumption of firewood in Sri Lanka but it is probably of the order of 4 million tons per year. At present, most of the firewood consumed in the urban areas in the highly populated south western part of the country comes from rubber estates which are taken up for replanting. In the rural areas, the neighbouring jungles are the main sources of firewood.

53. In Sri Lanka no oil or natural gas deposits have been discovered to date. Neither are there any coal deposits. Petroleum products are imported and distributed through a government organization, the Ceylon Petroleum Corporation.

54. An oil refinery was established in 1969. Crude oil is imported in such quantities as to meet the local requirements of petroleum oil products while the surplus fuel oil and naptha are exported. With the completion of the fertilizer plant now under construction, the surplus naptha will be used for the manufacture of urea.

55. In 1976, the total consumption of different oil products in Sri Lanka was : motor gasoline - 101,137 metric tons, kerosene 206,688 metric tons, heavy diesel - 37,004 metric tons and furnace oil - 126,193 metric tons. 2,011 metric tons of liquid petroleum gas (LPG) was also consumed.

56. Kerosene, which is widely used as a domestic fuel and also for lighting in some suburban and many rural houses, is sold at a subsidised price. It is believed that some industries have changed from petrol and diesel to kerosene to benefit from the subsidy.

57. The Ceylon Electricity Board is the authority for the generation, transmission and distribution of electricity in the island. The generation of electricity is mainly by hydropower with some limited back-up from thermal sources. The total installed capacity of the power stations in Sri Lanka now is 400 M.W. By 1977, electricity had been supplied to all main towns but to only 7% of the villages.

B. Goals of Development

58. The degree of development of a country may be measured by the extent to which the basic needs of food, clothing, housing, education and health services, together with the basic appurtenances of a modern society (roads, communication systems and essential consumer goods) are available to the people. There are no ideal indices for measuring the state of development of a country. What is generally used is the GNP per capita, and on this basis Sri Lanka is among the least developed in the world. However, as stated in the introductory chapter, the Physical Quality of Life, as measured by the level of literacy, infant mortality and life expectancy, is high. This would indicate that in development, our efforts have been concentrated on improving the socio-economic conditions of the large section of the less privileged in our society rather than on merely increasing the GNP alone.

59. Despite this redeeming feature of our development effort, however, the growth of the economy has been very slow. Today, there are over a million unemployed and 50 - 60% of the people do not get a living wage. The primary goals of development are therefore to restore the economy to a healthy rate of growth and to provide employment and a better quality of life for all Sri Lankans and more particularly for the poor and the disadvantaged.

60. In order to achieve these goals, the development programme will focus upon a substantial increase in rice production, the general development of the rural sector, the provision of more houses and the expansion of industry. With these developments and with the creation of more employment opportunities, the present high level of unemployment should drop appreciably. The development goals will now be examined in relation to the five subject areas.

1. Agriculture

61. In 1975, 457,000 tons of rice and 545,000 tons of wheat were imported to supplement the locally produced rice and other foodstuffs. The primary aim of the agricultural sector now is to make the country self-sufficient in rice and thereby stem the heavy drain on foreign exchange resources.

62. There are now 1½ million acres of land under rice in Sri Lanka. The increase in rice production will be effected by increasing the area under cultivation by providing irrigation facilities to hitherto uncultivated areas as well as to lands now receiving limited amounts of irrigation water, and by extending the use of improved strains and cultural practices. The foremost among the irrigation projects is the Mahaweli multipurpose development project (paras 24 - 26).

63. Besides rice production, attention will be paid to the development of improved and scientific cultivation practices in a wide range of other crops such as legumes, coarse grains, sweet potatoes, chillies, manioc etc. Dissemination of scientific information among farmers would also obviously form part of the agricultural development programme.

64. Spices, which account for 3% of our foreign exchange earnings and for which our country has been famous for centuries, has also not been given adequate attention in the past. Action will be taken to expand the extants under these crops (cinnamon, cardamon, cloves etc.) and to improve the traditional methods of cultivation and processing.

65. In the plantation sector involving the crops tea, rubber and coconut, agronomic and production aspects have received more attention than those relating to marketing arrangements. All these research institutes have plans for rectifying this deficiency and for enhanced activity in the areas of product technology, marketing economics and quality improvement.

2. Industry

66. The industrial programme of the government falls broadly into 2 major areas of activity:

(a) The Greater Colombo Economic Zone which will include an Export Processing Zone (EPZ). Steps will be taken as far as possible to foster the location of all new major industries within the ambit of

the Greater Colombo Economic Zone. Off-shore banking facilities and a package of incentives will be offered to foreign industrialists for establishing industries within the EPZ. The development of these industries is expected to make a substantial impact on the present unemployment situation in Sri Lanka.

(b) Outside the Greater Colombo Economic Zone small and medium scale industries will be fostered. Every encouragement will be given to the private sector to set up industries both for export as well as for producing essential consumer goods for the local market. The development of industries will be encouraged in the rural areas, and this will form a major aspect of the programme for rural development and increased rural employment. District Development Plans will be prepared and implemented under District Ministers to foster and encourage village scale industries.

67. The public sector will in general confine its activities to the industries now allotted to it, and future development efforts in these areas will be directed mainly to:

- (a) Maximization of output from existing capacity
- (b) The speedy completion of projects already taken up for implementation (e.g. urea plant)
- (c) Technical improvement and expansion of existing units where additional production can be achieved expeditiously (e.g. process improvements at the petroleum refinery and other factories).
- (d) The creation of new capacity in accordance with national priorities.
- (e) The initiation of advance action on projects which have long gestation periods.

68. In licensing private sector industries (other than those in the Export Processing Zone), preference will be given generally to the industries which, inter alia:

- (a) are export based
- (b) depend on local raw materials
- (c) produce essential commodities for mass consumption
- (d) strengthen the industrial structure through the manufacture of intermediate and investment goods
- (e) are dispersed in their locations away from urban metropolitan areas
- (f) increase and diversify the technological capacity of the economy (e.g. electronics, optical glass, instrumentation etc.)
- (g) have high employment potential.

3. Health and Sanitation

69. In the sphere of health, one of the major programmes is the 5 year plan to control malaria with the long term objective of eradicating the disease.

70. The control of childhood infections will be achieved by expanding the current immunization programmes, and it is expected that by 1980, approximately 80% of all infants would be fully immunised against childhood infections. Improved maternity education and care would go hand in hand with improved child care. This programme would be continued with aid from the United Nations International Childrens Emergency Fund (UNICEF) and the World Health Organisation (WHO).

71. With regard to potable water and sanitation, a national plan to provide at least 50% of the population with potable water by 1990 is being prepared and coupled with this, is a programme for central sewage treatment and disposal in the major towns. For rural areas the use of smaller units of basic and intermediate technology is being considered.

4. Housing

72. With a view to easing the housing shortage, the government has formulated a major house construction programme for the period 1978-1982. The housing policy during this period will be mainly directed towards -

(a) expanding the public sector housing programme for the lower income groups

(b) intensifying private housing construction activity through the provision of greater incentives, better facilities (including materials) and assistance from the state.

73. The public sector programme under the Ministry of Local Government, Housing and Construction, consists of the construction of 100,000 housing units in the period 1978-1982.

74. This programme really presents only a part of the expected developments in the sphere of housing. In the rural sector, particularly in the vast area that would come under settlement in the next 6 years under the Mahaweli project, an additional 200,000 rural housing units would be built. In this and other settlement projects the settlers would be putting up modest, semi-permanent rural housing units mostly of the basic level of wattle and daub walls with thatched or straw roof. The government provides limited assistance for the settling families to put up a temporary core structure for a start. In addition to this, credit facilities and other concessions will be provided.

5. Energy

75. In the sphere of electricity, the programme of increasing the power available to the country by the installation of hydroelectric power stations will continue. The programme for the next 10 years will be primarily connected with the Mahaweli multipurpose development project where a number of hydroelectric power stations will be commissioned to increase the electricity supply by approximately 480 M.W. of installed capacity. A power plant with an installed capacity of 120 M.W. will also be set up at the Samanalawawe project. The installation of small power plants which would in particular circumstances be economical, will be considered. Steps will also be taken to carry out preliminary investigations that are necessary to introduce alternative sources of energy to supplement and back up hydro power.

76. The programme of rural electrification will be stepped up. This programme does not appear justified in purely economic terms as the electricity will be used mainly for domestic lighting. The government however, recognizes this to be a basic amenity which should be available to all Sri Lankans. This may also serve as an impetus to the development of small scale industries in rural areas.

77. The Petroleum Corporation's expansion programme involves process improvements and increasing the capacity of the refinery from its present

15 million metric tons capacity to 2.35 million metric tons by 1980. This capacity is expected to be sufficient for our requirements up to 1985, provided the demands for the middle distillate products (kerosene and diesel) do not show an unexpected and sharp rise.

78. The shortage of firewood in many urban and suburban areas has been a problem for some years now. This problem will continue, and will in fact become more acute as the demand increases with the growth of population and the supply dwindles with extensive areas of forest being cleared for agricultural development. The question of firewood availability is a paramount one in the context of the fact that firewood is the main source of energy in Sri Lanka and that alternative sources of energy involve high foreign exchange expenditure. Forestation projects for raising fuelwood plantations have relatively long gestation period (about 15 years) and it is therefore all the more urgent that immediate steps be taken to raise fuelwood plantations to cater for future demands.

79. An extensive reforestation programme is planned for the areas adjacent to the Mahaweli Project Scheme. But the implementation of the programme will depend on the availability of foreign exchange for the purchase of equipment such as water pumps (for nurseries), transport vehicles etc.

C. The State of Science and Technology

1. Background Information

80. When Sri Lanka achieved independence in 1948, science and technology in the country was in a parlous state. The only science and technology that had been developed systematically and well was that associated with the three plantation crops, tea, rubber and coconut. Research on these crops carried out by the three institutes had placed the crops on a sound footing in regard to agronomic practices, cropping, breeding and disease control. The technology, however, had only developed up to the stage of processing the products into a suitable form for export.

81. At that time, science at the secondary school level was taught up to the General Certificate of Education (Advanced Level) only in a few schools in Colombo and in a few main provincial towns. There was a Faculty of Medicine and a Faculty of Science in the only University at Colombo, and the Technical College in Colombo prepared students for engineering degrees of the London University.

82. The technology was equally rudimentary. Besides the technology associated with tea, rubber and coconut referred to above, there were some industries which were based on simple technology like matches, glassware, soaps, beverages etc.

83. The growth of science and technology in the country since independence has, like the growth of the economy, been slow, and today, science and technology remains underdeveloped. The R & D efforts in the country have in fact lagged behind economic development in general. The expenditure on R & D has had to be curtailed due to diversion of funds for urgent development projects, and a survey carried out by the National Science Council (NSC) has indicated that the expenditure on

R & D was of the order of 0.2% of the GNP in 1975. In terms of manpower engaged in scientific and technological activities (graduate and post-graduate level), the most serious problem has been the brain drain. The number of scientists and engineers in Sri Lanka in 1973 was estimated at 5.2 per 10,000 population,^{5/} and a NSC survey now being carried out indicates that there has been an appreciable drop since 1973.

2. Agriculture

84. The staple food of the people is rice. Yet up to the time of independence, the domestic agricultural sector has been virtually neglected. Cheap imports of the main food items during colonial times suppressed the growth of domestic agriculture which, had it developed, would have met most of the country's requirements of food and improved the lot of the rural farmers from the position of impoverished peasants.

85. In the last three decades, special attention has been given to the development of the domestic agricultural sector. A major development in the agricultural sector was the establishment by the Dept. of Agriculture of a Research Station at Maha Illuppallama in the dry zone in which region the major expansion of the extents under rice cultivation was to take place. This station pioneered studies on land and soil characteristics, rainfall pattern and the development of cropping practices suited to the conditions prevailing in the region. The initial work on the development of the 'H' varieties which later heralded the era of improved rice varieties was also done at this institution.

86. A Central Rice Breeding Station was established at Batalagoda, and this station spearheaded the drive for the development of improved rice varieties. The release of H4 in 1958 was followed by the production of a series of other improved high yielding varieties such as BG 11/11, BG 34/3 etc. The concept that research into agricultural problems even of a single crop had to be undertaken in the different climatic regions, came to be accepted, and consequently more rice research stations were established in several parts of the country. Research stations were also opened up for work on other important crops like potatoes, vegetables, legumes, cotton etc.

87. The Central Agricultural Research Institute at Peradeniya carries out research that is mainly problem-oriented, and has links with the research units elsewhere in the country

88. At present the technical manpower at the research officer level in the Dept. of Agriculture is around 115, of which about 1/4 have had post-graduate training. The number of experimental officers is around 60, and the majority of them are graduates.

^{5/} Statistics on Science and Technology: Extracts from UNESCO Statistical Yearbook 1976, UNESCO Publication, Paris, 1977.

89. In spite of the expansion of the research capacity of the Agricultural Department, it has, in the last decade in particular, been severely affected by inadequate funds, particularly the foreign exchange needed to operate at the desired levels of efficiency. It has also suffered from the loss of several of its trained staff who have taken up more attractive jobs elsewhere in the country or left the country for far more remunerative jobs abroad.

90. Research on sugar cane and on other crops like cocoa, coffee, spices etc. has been very limited, but is gaining momentum with the implementation of plans for expansion. Research on sugar is being done by the Sri Lanka Sugar Corporation, and on spices and a number of other crops by the Dept. of Minor Export Crops.

91. There is a Faculty of Agriculture and a Post-graduate Institute of Agriculture where, in addition to conducting graduate and post-graduate courses, research on agricultural projects is carried out.

92. Research and extension work in animal husbandry is carried out by the Dept. of Agriculture. The veterinary section of the Faculty of Medical and Veterinary Sciences conducts graduate courses and is also engaged in research on problems concerning animal husbandry.

93. It is appropriate to mention here that an Agrarian Research and Training Institute was established to study the socio-economic problems affecting the agricultural sector and to conduct training programmes essential for the development of agrarian policy aimed at increasing production.

3. Industry

94. In the field of engineering and industry, there are a few public sector institutions carrying out research, training and development. These include the University Faculties of Engineering, the Ceylon Institute of Scientific and Industrial Research (CISIR), the Industrial Development Board (IDB) and the National Engineering Research and Development Centre (NERD). There are also a few private sector institutions involved in technology development, e.g. tea processing machinery, sugar cane crushers etc.

95. The CISIR is the principal organization engaged in industrial research. Its main functions are testing and research with a view to improving technical processes and methods used in industry and in the development of new industries, the greater use of indigenous natural resources and the training of research workers and technicians.

96. The efforts of the CISIR do not have the full desired results as R & D is still largely on a laboratory scale and there is very little scaling up into industrial prototypes and processes. This is because the efforts are mainly directed to the research component of R & D.

97. The IDB and NERD are two organizations that have more direct dealings with the industrial sector. The IDB is engaged in extension work and helps entrepreneurs in developing prototypes and in project preparation and implementation. It concentrates its efforts on small scale industries. The NERD Centre is a relatively new organization that was installed to bridge the gap between the work done by the CISIR and the IDB.

4. Health and Sanitation

98. In the sphere of health, the quality of doctors, both general practitioners and specialists, is very high, and medical graduates from the two medical faculties would have been adequate to staff the health institutions, had there not been a heavy exodus of doctors from the country. The current inadequacy of doctors is primarily due to this factor.

99. For improving the health services and providing sewerage systems and potable water, the capital investments are heavy. The lack of capital and the shortage of trained engineers will be a serious constraint in implementing the programme of providing improved water supply and sewerage. Recently, it was pointed out that, of the cadre of 25 engineers required for the Colombo Municipality for its maintenance work (roads, water services etc.) there were only 6 (the most senior of whom had only 7 years service) as the others had left and gone abroad for better opportunities.

5. Housing

100. In the sphere of housing, the science and technology will have to be directed in the future to reducing the cost of housing and finding alternative materials for building that could be produced in adequate quantities and at low cost. This would apply to urban housing. In the rural sector research has to be directed towards upgrading the quality of rural houses which are as at present of a semi permanent nature and crudely constructed. A Building Research Institute has recently been established, but it is still in its formative stages.

6. Energy

101. Hydroelectric power plants have to be purchased from abroad. However, in all other aspects like dam construction, installation of power plants, maintenance and repairs, and distribution of electricity, Sri Lanka has the required skill and expertise, but here too, the engineers and middle level technicians are in very short supply.

102. The oil refinery that was installed had a 100% foreign component, the process having being bought as a package. However, the running of the refinery is now being done by local personnel.

103. The expertise in the sphere of forestry that would be required for embarking on a reforestation programme aimed at providing the projected demands of fuelwood is available in Sri Lanka.

7. Education and Training

104. Five of the six campuses of the University of Sri Lanka have science faculties covering the basic sciences. There are two faculties of engineering and two of medicine. Besides these university departments there are two post-graduate institutes, one in agriculture and the other in medicine.

105. The science, engineering and medical faculties provide mainly under-graduate courses but also take in a few post-graduate students. In general, teaching takes up most of the time of the staff of these institutions, but a certain amount of research is also carried out.

The post-graduate institutes naturally focus on training and research at the post-graduate level only.

106. The Accelerated Mahaweli Development Scheme has created a considerable demand for the services of middle level technicians. The sudden increase in demand cannot be met by the present rates of output of the existing technical training institutions. The Government is seeking ways and means of increasing the output of these grades to meet the requirements of the accelerated programme. The movement of these grades to the Middle East has considerably worsened the position.

107. In the primary and secondary level, science is now taught in most of the schools in the country. However, inadequacy of laboratory equipment and of qualified and trained teachers is very often a serious handicap.

108. One of the most serious problems in all scientific fields from school level through University and at the research institutes is the grave shortage of scientific information. The import of journals was severely restricted because of foreign exchange problems, and the position could worsen if the cost of books, journals and periodicals continues to escalate. Lack of access to the R & D literature on work being carried out elsewhere in the world could, more than any other factor, stifle the growth of indigenous R & D. This is a very real constraint here in Sri Lanka.

109. The NSC has recently established the Sri Lanka Scientific and Technical Information Centre. The basic objective of this Centre is to collect, process and disseminate information in relation to science and technology. In order not to duplicate the resources already available, the initial emphasis will be on the subject areas: Science Policy, Science Education and Environment. Adequate assistance in the form of equipment and training courses for the staff is provided under a United Nations Development Programme (UNDP) project.

110. The urgent need to set up an International Centre for STD Information Exchange under the auspices of the United Nations or one of its agencies has been spelt out in Chapter IV of this paper (paras 180 - 189). The Sri Lanka Scientific and Technical Information Centre will cooperate with such an international Centre in procuring books, journals, extracts etc. required by local scientists and exchange information with scientists abroad.

8. The National Science Council (NSC)

111. The NSC was formed in 1968. It is a statutory body of government and is attached to the Ministry of Industries and Scientific Affairs. It receives funds from the government. Its main functions are :

(a) Advising the government on matters related to science and technology policy, scientific manpower, the environment, science education etc.

(b) Providing research grants to scientists in the university and in research institutions for both pure and applied research, but with special emphasis on research of local relevance.

(c) Publishing a scientific journal and a science bulletin. A Social Science journal is due to be started soon.

(d) Organizing and administering a scientific and technical information centre for local scientists.

(e) Maintaining liaison with international science and technology organizations and similar foreign national organizations.

(f) Collaborating with the Man and the Biosphere National Committee in the preparation and implementation of selected environmental projects.

9. Learned Bodies

112. The Sri Lanka Association for the Advancement of Science (SLAAS) is the largest multidisciplinary scientific body in Sri Lanka. It was formed in 1944 by a voluntary group of scientists. Since then, it has increased its membership (which now exceeds 1500) and expanded its activities. It holds an annual session at which the members present the results of their research work in the form of papers. Besides this annual event, seminars and public lectures etc. are regularly held by the different sections of the association (medicine, agricultural sciences etc.)

113. It also plays a leading role in drawing the attention of government to matters of national importance concerning science and technology. The formation of the NSC was in fact mooted and strongly advocated by the SLAAS. A committee of the SLAAS - Committee for the Popularization of Science - is actively engaged in cultivating an interest in science and technology among school children and adults, particularly in the rural areas.

114. There are also a number of professional bodies interested in science and technology, e.g. The Institute of Chemistry, The Institute of Engineers, The Sri Lanka Medical Association etc.

D. Achievement of Development Goals through Science and Technology

115. The main goals of development envisaged for Sri Lanka for the next few years have been outlined in Section C of this chapter. The implementation of these programmes is expected, inter alia, to make the country self-sufficient in food, the import of which is now a serious drain on the economy; to strengthen the industrial sector and to alleviate appreciably the present state of unemployment.

116. It is recognized that science and technology are essential instruments for the attainment of the desired economic goals. Without the judicious application of science and technology, no development plan could succeed. It is further recognized that development cannot be confined to a mere transfer of science and technology from an advanced country to a LDC like ours. Such a transfer if done indiscriminately, far from bringing about development, can be economically disastrous to the recipient country. What is required is that science and technology should develop within the country nurtured and sustained by our indigenous scientists and technologists and adapted to our social milieu. An adaptation of the science and technology that is available all over the world is an essential part of this process, since no indigenous science and technology could flourish if isolated from the mainstream of scientific and technological development.

117. Science and Technology should be adapted to our specific needs and fashioned to use our indigenous resources and local talent. An indigenous science and technological capability is a sine qua non for national development.

118. The nucleus of a science and technology capability exists in Sri Lanka. It is strong in certain fields and weak in others. But a beginning has been made and the potential for growth is there.

119. Scientists and technologists have always delivered the goods if there is national recognition of the concept that the development of science and technology is essential for socio-economic progress. The government of Sri Lanka has accepted that our goals of economic and social development can only be achieved through the application of science and technology, and will therefore do everything possible to encourage the development of a strong scientific and technological capability within the country.

120. The application of science and technology for development will now be examined in relation to the attainment of the development goals in three of the five subject areas. Many of the problems on the application of science and technology for development are common to two or more subject areas and hence only three areas are used in this section for illustration.

1. Agriculture

121. The planned expansion of agriculture will depend very heavily on the implementation of the large multipurpose irrigation project - the Mahaweli Development Project. Only the very first stage has been completed. The bulk of the work remains to be done including the construction of 11 reservoirs and the installation of 10 hydro power stations, extensive tunnelling and channel construction, the settlement of thousands of family units and the building of the infrastructures associated with settlement like roads, schools etc.

122. With a few exceptions, the science and technology required for designing and constructing the irrigation system is available in the country. But the most serious problem is the scarcity of scientific manpower required for implementing the project on the accelerated time scale. The government has decided to implement several stages simultaneously and to use all the available expertise. Four separate organizations, the Central Engineering Consultancy Bureau, the Irrigation Department, the Mahaweli Development Board and the River Valley Development Board have been commissioned to implement different parts of the project simultaneously. Foreign governments and the World Bank and its allied agencies are also expected to participate in the financing and execution of the project. The resources of finance, technical and engineering personnel and equipment will thereby be partly supplied by the donor countries and agencies.

123. The exodus of experienced engineers for employment abroad, primarily to the fast developing wealthy nations of the Middle East (at salaries, in hard currency, several times more than what they earn here), has been very heavy in the past few years. It is because of this brain drain that there is a sudden and serious shortage of skilled manpower. The government has taken cognisance of this problem and, rather than attempting to stem the brain drain by coercion, will offer incentives for trained scientific and technical persons to remain in the country. Though the financial incentives offered can in no way match those offered by other countries, it is hoped that the challenge offered to Sri Lankans to participate in national development will draw some of them back.

124. The effects of the brain drain which has also drawn out of the country thousands of middle level technicians and skilled workers can be mitigated by increasing the output of engineers and middle level technicians. In this area, developed industrial countries and the rich developing countries of the Middle East, we feel, have a natural obligation to assist the LDCs like Sri Lanka from whom they receive a large number of technical human resources which in turn create serious gaps in the development process of their homelands. The countries benefiting by this brain drain or "aid in reverse", so to say, could make a contribution towards increasing the training capacity of the LDCs. A plan for such assistance must be considered as a matter of urgency by the United Nations (see paras 170 - 177).

125. In the field of agricultural production in the Mahaweli Project the success of the scheme will ultimately depend on the availability of the necessary inputs - tractors for ploughing, seed paddy, fertilizers and pesticides and adequate machinery for collecting, storing and milling the paddy. A strong extension service is also required to take the message of scientific agriculture to the farmer.

126. The scientific and technological know-how with regard to these inputs is, for the most part, available but requires strengthening in certain fields such as rational use of fertilizers and pesticides, the use and management of irrigation water, the production of seed paddy etc. The extension service will have also to be strengthened both in numbers and in scientific capability.

2. Industry

127. Almost without exception, the technologies of the rich countries that were transferred to the LDCs are those that evolved in the developed countries and were subjected to continued innovation to suit the conditions of those countries. For example, industrial technology has in the past decade or two been increasingly automated to cope with the continued increase in the cost of labour, and with this change, the economic scale of production increased. The technologies of the industrialized countries have therefore tended to be capital intensive and labour saving. Moreover, because of their complexity, great skill and elaborate equipment are required for repair and maintenance.

128. We in Sri Lanka striving to gain the benefits of industrial development have been slow to realize that even in developed countries a technological innovation is not transferred from one developed country to another without a careful appraisal of the cost effectiveness of the innovation. Traditional methods are not thrown overboard merely for the whim of introducing a novel innovation.

129. The LDCs, and Sri Lanka among them, that are desperately short of foreign exchange, need capital saving production methods. These countries are also short of skilled workers but have practically unlimited unskilled labour. Choice of technology must consider these limitations and the chosen technology must rely heavily on indigenous skills and raw materials. Under these conditions, cost of procurement and of repairs will be low and operation and maintenance easy.

130. As the technology of the advanced countries grows more complex and sophisticated, the problems of transfer and adaptation will

also become more complex. This makes it even more urgent that the scientific and technological capability of the LDCs be increased and the cooperation between LDCs themselves be strengthened.

131. In Sri Lanka, the problem of unemployment is a very serious economic one and has to be solved hand in hand with industrialization and agricultural advancement.

132. There is also the question of raw material. The manufacturing technology in advanced countries have been developed to use the raw materials of those countries. Transfer of such technology to the LDCs would, unless adapted to use locally available raw materials, eventually prove a financial burden to these countries.

133. Another problem of paramount importance, particularly to the smaller LDCs like ours with restricted local markets, is the economics of scale of modern production units. Probably in a month, we could produce all the toothpaste and electric bulbs we need for a year. In this context, it is fundamental that the scale of technology be appropriate to our needs.

134. During the past few years, Sri Lanka has experimented with a scheme of District Development Council (DDC) projects. These are small scale industries and agricultural units developed in the districts using local raw materials and locally available skilled and unskilled labour. The scheme of DDC projects, in general, has had a dismal record. But notwithstanding this, the idea is conceptually sound, and if properly implemented could be a powerful instrument for rural development. What went wrong is that the scientific and technical knowledge required for identifying the viable projects, planning them and finally implementing them was lacking in many of the personnel who were responsible for the projects.

135. For small and intermediate scale industry, it is important that the technology should be :

- (a) simple, requiring a minimum of skill for operation and maintenance.
- (b) suitable for manual operation in as many stages as possible and be labour intensive.
- (c) cheap to purchase and to run and maintain - particularly in terms of foreign exchange required.
- (d) adapted to use local raw materials as far as possible.
- (e) generally small units enabling dispersal in rural areas.

136. Science and Technology in the industrial sector will in general be directed towards these goals in respect of the existing industries and in transferring and developing new technologies throughout the country. In spite of the efforts of the CISIR, the IDB and the NERD Centre, the technology now used in Sri Lanka is unfortunately still heavily dependent on imported machines and imported raw materials. The state of dependency is indicated by the fact that (in 1974) 70% of the total value of raw materials was imported, and the imported raw material accounted for over 40% of the total value of industrial production. It is of paramount importance, therefore, that Sri Lanka should undertake a vigorous drive to improve its science and technology capability, for it is only by so doing that any effective thrust could be made in reducing our dependency on imported technology and raw materials.

137. Concerted efforts would also be made for improving and upgrading traditional techniques in arts and crafts in rural industries, etc. Our agro-based industries in particular would benefit considerably by more R & D efforts being directed towards their improvement.

138. Most of the large scale industries will continue to be set up with foreign collaboration. Foreign collaboration in the industrial sector particularly in relation to more sophisticated goods that have a ready overseas market will be more or less confined to the Export Processing Zone which is to be established (discussed earlier in para 66).

139. In regard to the areas outside the Greater Colombo Economic Zone, in the sector of heavy industries, the main effort will be directed towards process improvement (e.g. in the oil refinery), the increased use of local raw materials and the completion of projects in hand.

3. Health and Sanitation

140. In the sphere of health and sanitation, the main drawbacks are the

- (a) lack of adequate funds, both local and foreign, for obtaining material, equipment and replacements,
- (b) lack of easy access to scientific information, and
- (c) inadequacy of in-service training courses and workshops to update knowledge.

141. Although there is at present a shortage of trained personnel in the health services at the higher and middle levels, the position should improve with the increased training facilities to be provided under the expanded university educational system. However, in the area of health and sanitation, as in other spheres of development, the improvement of the science and technological capability of the country has been hindered by the lack of adequate scientific and technical information. Access to the science and technology both of the developed countries and the LDCs is extremely important for a fruitful development of our indigenous science and technology capability.

III. INSTITUTIONAL ARRANGEMENTS AND NEW FORMS OF INTERNATIONAL
CO-OPERATION IN THE APPLICATION OF SCIENCE AND TECHNOLOGY

A. Domestic Institutional System for Science and
Technology (S & T)

1. Human Resources

144. In Sri Lanka, there is generally a very high value placed on education and, consequently, a very high proportion of secondary school students aspire to gain entrance to the university, particularly to the medical and engineering faculties. There are now six Univ. campuses only in two of which medicine and engineering are taught. The number of campuses is to be immediately increased by two to accommodate the increasing demand. The framework of Scientific and Technological research institutions was discussed earlier (paras 80 - 114).

145. The graduates in Science, Agriculture, Medicine, Veterinary Science and Engineering of the University of Sri Lanka are naturally recruited to the scientific and technological institutions and enterprises. Their training in research generally takes place after recruitment. Available research training facilities are limited, and very often, those recruited for research posts are sent to universities abroad for post-graduate education.

146. The scientists from Sri Lanka carrying out post-graduate research in developed countries use sophisticated and advanced techniques, and naturally work on problems most often unrelated to the problems of Sri Lanka but related to advancing the science and technology of those countries. Quite often, such scientists find it difficult and disturbing to return home, where funds allocated to scientific research are low, the apparatus and equipment available are of a basic nature and scientific literature is scarce.

147. The bureaucratic delays in obtaining research equipment and materials which scientists find irksome have, in essence, been a disincentive. This has now been reduced considerably by the government by making adequate foreign exchange available and the abolition of the tedious import licencing.

148. There is an acute shortage of skilled science and technology personnel in Sri Lanka today. Historically, Sri Lanka has been able to develop adequate human resources for Scientific and Technological Development (STD), though not on a scale comparable to any of the developed countries. The educational and training institutions have been generally able to keep up with the personnel needs of the country until very recently. The emigration of trained personnel until 1974, though a drain on the meagre sources, was not seriously affecting the skilled manpower needs of the nation. The problem of brain drain has now reached quite serious proportions (see paras 83, 99, 106, 170, 176).

2. Technology Transfer

149. Transfer of technology from abroad, both for public and private enterprise, is institutionally handled by the Ministry of Industries and Scientific Affairs. In the past, the tendency has been

to look at the narrow economic benefits without carefully analysing the impact on domestic industry, local raw materials and long range drain on foreign exchange by means of royalties, dividends and purchase. Sri Lanka is aware of the fact that many developing countries e.g. India, Mexico etc. have developed modern approaches uniquely suitable to their own development context 6/. Sri Lanka's policies are yet evolving but the basic approach will be to positively encourage the inflow of foreign capital for development purposes coupled with meeting the national goals of employment, utilization of local raw materials, creating multiplier effects in the economy and decreasing the long range technological and economic dependency.

B. Foreign Institutions and Science & Technology for LDCs

150. Many universities and research institutions in developed countries have pursued research on developing countries for many years. Universities and research institutes in France, UK, FRG, USSR, USA, Canada and Australia continue to be involved in basic research related to LDCs but research in STD is rather new even in developed countries, especially in the context of intermediate and appropriate technology.

151. The Ford Foundation and the Rockefeller Foundation have been active and their presence recognized for over 30 years in the ESCAP region in pursuing development oriented research. In recent years, some countries have established institutions whose primary objective is research in STD applicable to the LDCs. Two of these institutions are the Swedish Agency for Research Cooperation in Developing Countries (SAREC) and the Canadian International Development Research Center (IDRC). The latter has supported about 300 research projects costing US \$ 67 million during 1970-76. IDRC is unique because research grants are not awarded to Canadians but to the nationals of the LDCs to pursue research in their own countries on indigenous problems. Sri Lanka believes that this unique approach is in the interest of developing fully the human resource potential in the LDCs and urges other industrialized nations to mount similar programmes.

152. In addition to the universities and institutes, the governments of several developed countries have been historically involved in education and training of nationals of the LDCs, (USA, Australia, UK, FRG, USSR etc.) For example in 1977, the Ministry of Overseas Development of UK spent US \$ 10 million on research and development problems of the LDCs supporting almost 600 projects in a variety of countries and subject areas. Although there have been positive efforts by a few developed countries in the study of STD for the LDCs, the resources allocated have been meagre indeed. It is the view of the Sri Lanka government that the developed countries ought to allocate substantially more funds on a long term basis to assist the LDCs to achieve their goals by developing fully their science and technology potential.

153. Most of the LDCs have an abundance of solar energy but they do not have the technological know-how to use this energy as a substitute for the traditional energy sources. Solar energy technology in the western industrialized countries is on the verge of commercial

6/ National Approaches to the Acquisition of Technology, No.a,
Development and Transfer of Technology Series, UNIDO; Vienna, 1977

application. The governments of these countries have been encouraging and assisting the R & D institutions there in this regard. It is of great importance to Sri Lanka, especially because of its total import dependence on certain types of energy, e.g. oil, coal etc. that solar energy technology be available easily and at low cost. Sri Lanka strongly urges these advanced developed countries to make sure that solar energy technology when available does not follow the unfortunate historic patterns of the past which would make it difficult and costly for LDCs to obtain its transfer. In essence, Sri Lanka hopes that the ownership of these technologies will rest with their governments and/or that the governments will have the capacity to make it easily available to the LDCs without fiscal or other constraints. An attitude of this kind, it is argued, will contribute substantially to the achievement of the goals of the New International Economic Order.

C. Information Exchange for Scientific & Technological Development (STD)

154. STD information available in LDCs is not well documented because of the shortage of skilled manpower that can devote enough of their time to articulation and the lack of financial resources for collection, selection and dissemination of even available information. STD information produced in the industrialized countries is not easily available to the LDCs because of high cost, hard currency requirements, copy rights and patents. There is an urgent need for international cooperation in this area to provide easy low cost access to all available STD information. Sri Lanka believes that the United Nations must take effective measures in this regard as discussed later (Paras 170 - 177).

D. Technology Transfer and International Cooperation

155. Major issues arising from technology transfer have been studied and documented by UNCTAD 7/, 8/. The issues raised and the conclusions are generally applicable to Sri Lanka.

156. Basic issues in technology transfer to Sri Lanka up to now have been in terms of trade, adaptation of technology, technological economies of scale and repatriation arrangements. This experience is not dissimilar to other LDCs 9/, 10/.

157. Guidelines for the study of the transfer of technology have been adopted by UNCTAD 11/. Sri Lanka, as a member of UNCTAD, subscribes to these guidelines.

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- 7/ Major issues arising from the transfer of technology to developing countries, UN Publication, TD/B/AC.11/10/Rev.2, New York, 1975
 - 8/ Technological dependence, its nature, consequence and policy implications, UN Publication, TD/190, New York, 1975.
 - 9/ Major issues arising from the transfer of technology: A case study of Sri Lanka, UN Publication, TD/B/C.6, Geneva, 1975.
 - 10/ The transfer and development of technology in Sri Lanka, Report by UNCTAD Mission, UN Publication, UNCTAD/TT/5, Ge76-71465, Geneva, 1976
 - 11/ Guidelines for the study of transfer of technology to developing countries, UN Publication, TD/B/AC. 11/9, New York, 1972.

158. The industrial development goals of Sri Lanka were discussed earlier (paras 66 - 68). The government believes that both capital and technology from developed countries is an essential ingredient in its efforts to accelerate development and therefore welcomes such investments as a positive part of Sri Lanka's economic progress. At the same time, technology transfer must assist in -

- (a) creating and providing new employment to Sri Lankans
- (b) strengthening the scientific and technological capacity
- (c) the use of local raw materials in a variety of processes
- (d) strengthening and expanding the export base of the nation
- (e) providing multiplier effects to the economy as a whole, and
- (f) decreasing the technological dependence.

E. Technology Transfer and Regional Development

159. The vast bulk of world STD, including that required for processing basic human requirements, has been developed in the capital intensive industrialized countries. Any further adaptation of such technology generally has been in the direction of making it more capital intensive and labour saving i.e. in a direction contrary to what is often required by the LDCs. The owners of such technology would prefer to transfer it without adaptation to suit the conditions of the LDCs for reasons of maximising profits and safe-guarding their industrial monopolies.

160. In this situation, there is an urgent need for international agencies to pursue vigorously the complex task of transfer and adaptation of STD with a focus on regional needs and priorities, particularly in relation to the LDCs. It is therefore necessary for multilateral aid giving agencies e.g. Colombo Plan, to include STD research as an important component of their aid programmes. Similarly developed countries could also play a vital role in this regard by providing a specific STD research component in bilateral aid programmes.

161. Much of the innovation and improvements in STD in the industrialized countries has come about by a strong commitment by governments to basic research and by industry to applied research. In essence, the translation of basic science and technology for development has always been through the medium of industry irrespective of its ownership patterns. Because of lack of resources for development per se and for research in general in the LDCs, it makes sense to examine the possibilities of a group of LDCs within a region aiming for self-sufficiency within the group rather than for self-sufficiency in the individual countries in respect of certain selected areas of R & D. and manufacture. By so doing more rational use could be made of the limited manpower and capital resources available for R & D and it would also result in economies of scale.

162. An idea, such as sharing of industry and manufacturing, is not an easy one to put into practice because of the great need in all the developing countries for further development and the complexities involved in establishing bilateral and/or multilateral equity in these arrangements. Nevertheless, Sri Lanka believes that this is a concept worth pursuing as there is an urgent need for cooperation among the LDCs leading to the establishment of industries in these regions where production and the benefits are shared between the countries. It should be noted here that the ESCAP region provides ample opportunities for trying this idea

because of common resources and common needs between the member states.

F. STD and International Financing Institutions

163. In the past, International Financing Institutions while giving generous aid for development projects in the LDCs left the area of R & D as a purely domestic matter. This is easy to understand as, until very recently, the role of these institutions has been basically one of lenders in the narrow economic sense.

164. The total lending to date by the International Financing Institutions (excluding mercantile institutions) is nearly 100 Billion US \$. While making such large investments of capital on development projects we think it is pertinent to impress upon those institutions the importance of making adequate R & D funds available in addition to the development project aid for assisting the LDCs in improving their R & D capabilities.

G. STD and International Aid Programmes

165. Sri Lanka appreciates the aid and assistance provided by developed countries on a bilateral basis, and that provided by multilateral aid and cooperation agencies (UNDP, Colombo Plan etc.) over the past few years. However, because of the urgent need to go ahead with the chosen development projects, the overall strategy of study, transfer and adaptation of STD does not seem to materialise easily. The focus in the case of most aid programmes seems to be either the project or the sector. This is a natural result of the current aid planning and processing methods where elements regarding the transfer of very specific STD for the particular project under consideration are carefully considered within the context of that sector and programme, but the overall strengthening of the scientific and technological capability through aid agencies does not receive the same emphasis. For example, several past aid projects have included adequate training components for the project itself (US Aid - surveying; Netherlands - Housing; USSR - Steel Corp; UK and India - Irrigation; FAO - Agriculture).

166. Sri Lanka government believes that the strategies adopted during the next decade will have to place a high priority for training and developing the human resources infrastructure necessary for full utilization of STD. This means incorporating effective training components in all plans and programmes, and making the full use of experts (foreign and local) in special training programmes bringing to the forefront the problems, prospects and solutions regarding STD. The tremendous resource of available experts must be used more efficiently in the future.

H. STD and Education and Training Abroad

167. Historically people from developing countries have gone to the developed countries for higher education and training. Unfortunately, for the most part, and naturally so, the educational institutions in the developed countries are organized primarily to cater to their problems. This is particularly true in STD with their educational programmes emphasising high technology often unsuitable for immediate use and adaptation in the LDCs.

168. A concerted effort should be made to have students from LDCs to do most of their essential research within their own regions and on regional problems. Later on they could proceed to developed countries, if necessary, to complete their post-graduate degrees or for post-doctoral work.

169. Developed countries in their turn should mount programmes in STD and socio-economic planning primarily focussing upon developing countries. What is necessary is a plan of action which assures a flow of a critical mass of trainees that can justify and sustain a special emphasis on STD. This means mobilization of resources on a planned basis by both the LDCs and the developed countries. Further, there has to be a change in the policy of developed countries to provide assistance to their own institutions for this specific purpose. Therefore there is an urgent need. -

(a) for coordinating programmes relating to training and education of persons from developing countries,

(b) for developed countries to effectively assist in the mobilization of their resources for programmes relating to special needs of STD in developing countries.

I. Brain drain and the Reverse Transfer of Technology

170. Outflow of trained personnel from the LDCs to the developed countries has reached significant proportions in recent years. Scientists, engineers, doctors and other skilled personnel seem to be leaving in large numbers their homelands in search of better opportunities elsewhere, particularly in the USA, Canada, Australia, Africa and the European countries. In recent years, the Middle East has also attracted a large number of skilled Sri Lankans. For the LDCs, this is a significant loss of human capital and a substantial reduction in their technological capacity. For the receiving developed countries, such an inflow has helped to increase and diversify their own technological manpower base. Brain drain of this kind is essentially a Reverse Transfer of Technology. It is ironic that through this process, the poorer LDCs pass on a substantial part of their technological assets each year voluntarily to the rich countries. Problems, prospects, not costs and gains of brain drain have been studied by UNCTAD and are well documented 12/. The concerns expressed by UNCTAD are shared by Sri Lanka.

171. Historically, Sri Lankans also have migrated in search of better opportunities or even adventure. But what is not clearly recognized and put into proper world context is the cost to an LDC like Sri Lanka of brain drain. A recent study of brain drain from Sri Lanka shows that about 1,000 skilled professionals migrated to the UK during the period 1968-1974. Using the analytical methodology developed by UNCTAD, it is possible to compute costs and benefits of such brain drain 13/. The net social gain, after discounting for costs, to the receiving country - UK is estimated at 56 million US \$ for the period 1968-1974. 14/

12/ Reverse Transfer of Technology: Its dimension, economic effects and policy implications, UN Publication, TD/B/C.b/F, New York, 1975.

13/ ibid.

14/ Lalitha Gunawardena, 'The Drain to the UK', The Economist, Colombo, February 1976.

172. The problem of exodus of skilled manpower has taken a new turn in recent years with technicians and skilled labour leaving in large numbers for employment in the Middle East. The institutions and workshops available in Sri Lanka for training this grade of manpower are quite inadequate to produce them in the numbers required to compensate for the loss.

173. While recognizing that brain drain is a serious problem faced by Sri Lanka, the government feels that freedom of movement is a fundamental freedom, and coercion will not be used to check the brain drain. Adequate incentives and challenges to professionals and opening up a broad spectrum of new opportunities is the chosen policy instead.

174. To mitigate the problems of brain drain and to further build an adequate S & T infrastructure is by no means a small task, especially in view of existing shortages in research and adaptation infrastructure. This will require time and money.

175. The government strongly believes that the countries receiving skilled personnel from Sri Lanka have a basic obligation, in return, to assist and aid Sri Lanka to develop and replace adequately the departing social human capital. It is, therefore, necessary for at least the member states of Organization for Economic Cooperation and Development (OECD) and Organization of Petroleum Exporting Countries (OPEC) to set aside a fair portion of their earnings to assist and aid in the development of social/human/technological infrastructure in those countries from which they receive vast skilled manpower resources to sustain their own current economic growth.

176. Emigration is generally a free process but immigration to OECD and OPEC countries is naturally controlled to achieve their own national goals. What is required here is a tacit recognition of the contribution made by LDCs like Sri Lanka to the development of OECD and OPEC countries and a determination on their part to provide substantial aid and assistance in a tangible way in this regard. Since the receiving countries are not poor by any measure, it is a basic obligation on their part which must be recognized.

177. Under these circumstances, Sri Lanka urges the United Nations to establish a Special Fund to assist the LDCs specifically in this area; and that

(a) the rich countries, (both developing and developed) receiving substantial skilled manpower from the LDCs, make substantial contributions to this Fund;

(b) the Fund be utilized in the LDCs, suffering from brain drain, specifically for education and training purposes so that the gaps in the trained human resources can be filled sooner than otherwise.

IV. UTILIZATION OF THE EXISTING UNITED NATIONS SYSTEM

AND OTHER INTERNATIONAL ORGANIZATIONS

A. The UN System

178. As a natural consequence of the course of history, the STD efforts within the UN system reflect directly the narrow mandates of its Committee on Science and Technology Development (CSTD) and specialized agencies (UNESCO, UNIDO, UNCTAD). Each of these agencies

is concerned with primarily one particular aspect of S & T, for example, UNESCO with Education, UNIDO with Industrialization and UNCTAD with Trade. If the goals of the New International Economic Order are to be achieved at all, there has got to be a pulling together of the various sectoral and segmental efforts within the UN System for the purpose of adapting with ease STD with particular reference to the needs of the developing countries.

179. Notwithstanding the fact that the CSTD, ACAST, UNIDO, UNCTAD, UNESCO and others have made a large contribution to world development, the present efforts are not adequate. The UN itself does not yet have clearly enunciated STD policy. It is hoped the 1979 UNCSTD will provide the outlines of an STD policy for the UN and a number of well thought out programmes in STD for action by the General Assembly so that the resources of the UN System can be better mobilised to assist and aid the LDCs.

B. STD Information Exchange

180. The transition between technology, whether imported or otherwise, and creative domestic effort does not mean that technology must be reinvented in every country from scratch; but rather than the creative effort must be focussed upon the full utilization of available knowledge from all sources in the process of development and the elaboration of new ideas to the domestic environment. It is a prerequisite to the development of LDCs that they need to have :

- (a) full access to S & T information available world wide,
- (b) the necessary talent and equipment for evaluation, selection and transfer of this information to suit the needs of their own development goals,
- (c) the necessary resources to enable them to adapt this information and assimilate it properly.

181. The information explosion taking place in the industrialized countries and the ease with which information is distributed is to a large degree responsible for the large scale R & D efforts of these countries. The oft quoted criticism that more information does not necessarily mean better information may be true, but yet without easy access to STD information, there will be substantial duplication and waste and the proverbial "reinventing the wheel" situation.

182. Much of the STD information available in the LDCs, is not well documented because of the shortage of skilled manpower that can devote enough time to articulation, the lack of financial resources for adequate information dissemination etc.

183. STD information produced in the industrialized countries in the form of journals, books, papers, tapes (both audio and video) etc. is available for dissemination, but unfortunately its high cost makes it very difficult for LDCs to obtain it on a continuing basis. The high cost is further complicated by :

- (a) the mercantile aspects such as copy right and patents,
- (b) the availability only upon payment of foreign exchange,
- (c) in some cases, the high cost of translation.

If this information was copiable and reproducible freely, and if such copying is done in the LDCs, the cost of information could be reduced substantially. This is especially true of books and journals which are

produced in the industrialized countries and often needed in developing countries.

184. The importance of STD information has been given particular attention in the Lima Declaration and in The Plan of Action in Section B III on 'Cooperation between developed and developing countries' 15/. The General Assembly has already specifically requested the developed countries to contribute to the establishment of information banks 16/.

185. Consequent to several General Assembly resolutions and in pursuance of the Programme of Action, constituent units of the United Nations have begun to establish information exchange systems in their own mandated areas of activity. For example, Food and Agricultural Organization -UN (FAO) started to operate an International Information system for the Agricultural Sciences and Technology (AGRIS) in 1975. The system hopes to provide references to current world literature relevant to research and development in food, agriculture and allied fields.

186. UNIDO has recently established an Industrial and Technological Information Bank 17/. This bank will not only collect technological data but also assess it. It is not supposed to be a mere archive or a mechanical dispenser of information but an active component of the work of UNIDO with emphasis on providing information to member states.

187. Even though various organs of the UN are trying to establish information exchange systems, efforts are somewhat narrow, fragmented, and often not adequately funded. The wealth of information available at the international financial institutions (World Bank, ADB etc.) is not assessed and distributed adequately. UNESCO, UNIDO, UNCTAD, FAO and other agencies have been trying more recently to fill the gap within their own limited mandates pursuant to the General Assembly resolution on the Programme of Action on the Establishment of the New International Economic Order 18/. These efforts are all in their embryonic stages yet. The Committees of the UN system (CSTD, ACAST) have also been trying to grapple with the problem. There is an urgent need to consolidate these efforts and focus on STD for the LDCs.

188. The General Assembly has already reaffirmed the 'need to enable developing countries to have access to specific information on advanced and other technologies requested by them, as well as on the new uses of existing technology, new development, possibility of adapting them to local needs, and the need to select technologies which meet their requirements' 19/.

189. Adequate information dissemination can save a large amount of resources for each member state by avoiding duplication. Sri Lanka believes that it is necessary therefore for the UN to establish a Global Centre for STD Information Exchange, especially for the LDCs. In addition, Regional Centres should be established under the umbrella of

15/ Official Records of the General Assembly, XXXI Session, Supplement No. 16, part 2

16/ General Assembly Resolution, 3362 (S - VII)

17/ Establishment of an Industrial and Technological Information Bank, ID/B/183, UNIDO, Vienna, April 1977

18/ General Assembly Resolution 3202 (S - VI)

19/ General Assembly Resolution 3507 (XXX), operative paragraphs 2.

UN Regional Commissions (ESCAP) to further emphasize the information exchange unique to the region. The objectives of this effort should be to :

(a) make available to the LDCs all the available STD information to assist in their development.

(b) produce STD information in developing countries to reduce the cost e.g. books could be reprinted in the ESCAP region for distribution to English language developing countries.

(c) distribute STD information, on a shared cost basis, to member states, individuals and organizations.

(d) create and produce a journal and an abstract primarily concerned with STD.

(e) assemble a global STD information file available for retrieval by members for their own R & D efforts on an at cost (non-commercial) basis.

(f) become a global depository for all published STD information.

(g) negotiate with mercantile STD information owners (commercially produced books, tapes etc.) for reproduction in and distribution to the LDCs.

C. STD and the International Lending Institutions

190. The record of the International Lending Institutions with regard to assisting in developing to the full potential STD in LDCs has been less than satisfactory (paras 163 - 164). In addition to convincing the rich countries to devote a higher proportion of their resources to assist the LDCs, the UN has a fundamental obligation to mobilize its own resources to the fullest extent with regard to STD. It is the position of Sri Lanka that at least 5% of the total lending by the Banks within the UN System should be set aside to assist the LDCs to develop the adequate human and material infrastructure necessary for the full exploitation of STD. These expenditures must be within the LDCs primarily for and by their nationals, and should not become reverse aid to the developed countries.

D. Regional Centres for Transfer of Technology

191. Pursuant to UNCTAD resolution 87 (IV) 1976, several Regional Centres for Transfer of Technology (RCTT) have been established. The RCTT for the ESCAP Region has just recently been established in Bangalore, India. The funding for these RCTTs is rather slim and the initial efforts will probably be concentrated on regional problems. Sri Lanka strongly supports the concept of the RCTTs and urges that the efforts of these Centres be further decentralised to the countries themselves.

E. STD Efforts by UNCTAD and UNIDO

192. Sri Lanka believes that UNCTAD and UNIDO have made good progress during the last five years in the assessment of the problems related to STD. Furthermore, the government supports the continuation of these efforts with the best resources possible.

F. Technology Transfer Training

193. There is an urgent need to train the management personnel in LDCs in the analysis of technology transfer and subsequent negotiations with governments and private corporations from developed countries. It is

necessary to pull together the resources of several UN units, namely the World Bank, ADB, UNIDO, UNCTAD, UNESCO and UNITAR, together with the rich human resources available in some IDCs like Sri Lanka to train additional persons to become familiar and competent to deal effectively with the complex problems of transferring STD.

G. Future of UNCSTD

194. The idea of the effective use of STD must be nurtured fully and it will be a mistake if the whole momentum built up by the member states leading to the 1979 UNCSTD were allowed to vanish immediately after that. Sri Lanka believes that S & T efforts are essential to achieve accelerated development and urges the United Nations to:

(a) continue the Secretariat of the UNCSTD for five years 1980 - 85 to achieve the recommendations made in this chapter and subsequently by the Conference and the General Assembly with the co-operation of agencies and departments within the UN System, and

(b) convene a 2nd UNCSTD in 1985 to assess the progress made by the member states and take further action as necessary.

Sri Lanka further urges the member states to commit themselves fully to the programme of action proposed by the General Assembly to achieve the New International Economic Order.