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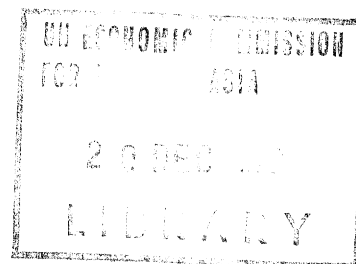
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National Paper of Kuwait

on the

Application of Science and Technology to Development

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INTRODUCTION

I. AIMS AND OBJECTIVES

1. The national paper prepared by the State of Kuwait on the application of science and technology to development covers all sectors of national economic activity and thus deals with all the main topics relating to the role of science and technology in national economic and social development in a realistic, comprehensive and integrated manner.
2. The effort put into the preparation of this report, in addition to the 26 sectoral reports, was aimed at stimulating increased awareness of the significant role played by science and technology in development. This important aim was achieved through the many discussions which took place with the heads and members of the 26 work teams and the results were crystalized during the National Seminar, on the Application of Science and Technology to Development in the State of Kuwait held on 6 and 7 May 1978 in the Kuwait Institute For Scientific Research when all matters related to the subject of the Seminar were discussed in a national open debate. The topics discussed at the Seminar included the role of science and technology in economic and social development, the adverse repercussions of science and technology, scientific and technological dependence, international and regional co-operation and national and sectoral recommendations. It is our hope that this endeavour will be the beginning of a continuing long-term process that will enable us to keep the role of science and technology under constant review and appraisal and thus strengthen the national scientific and technological capability. Such endeavours will inevitably lead to the creation of a fundamental system aimed at the integration of the scientific and technological sector with the other economic activities within a sound economic, social and cultural framework.

II. SUMMARY

3. In the mid-fifties Kuwait initiated an ambitious programme aimed at utilizing scientific and technological methods to overcome geographic, social, economic and demographic constraints within the State through the application of oil revenues, national will and human resources. This resulted in the achievement of significant and tangible progress at all social levels within a relatively short period of time. In effect, the implementation of this programme can clearly be seen, for example, in the existence of the petrochemical industries, sea water desalination plants, oil refineries and communications and solar energy system. It is worthy of note that, as mentioned in the report by the Ministry of Planning, science and technology contributed between 10 and 15% of the growth in national income during the period 1970/75.

4. Looking to the future it is our belief that the State of Kuwait will be faced with various challenges such as the use of modern scientific and technological methods for the diversification of the economy, the improvement of the quality of social services and the reduction of dependence on foreign labour. These objectives differ from those set during the past two decades in so far as the emphasis is shifted from quantitative development to qualitative development. In the past there was a need to obtain a lot of everything but at present the real need is to provide the best services and equipment for specific purpose. Consequently the choice of appropriate technology is considered to be a vital matter of far greater importance than at any time in the past.

5. In general the Kuwaiti economy is dependent on science and technology as represented by capital goods and this is due basically to the small size of the local market, the shortage of scientists and engineers and the inadequacy of the scientific and technological base so vital to industries dependent on research and development. In the case of skilled labour the situation is different since the country is becoming less dependent in this respect. One of the main reasons for this is the influx of skilled personnel since Kuwait is now able to attract many distinguished Arab scientists who have lived and worked for long periods in the United States of America and other western countries. The vast increase in the number of Kuwaiti students studying abroad is also an important factor.

6. The Government has been able to facilitate the transfer and development of technology by creating an open society, promoting the establishment of local scientific and technological institutions and providing the necessary funds for studies directly concerned with the application of science and technology in addition to investment in modern scientific and technological equipment.
7. The shortage of labour and the inadequacy of the infrastructure still constitute the principal obstacles. The shortage of labour in fields related to science and technology poses the main problem in almost all development sectors. In spite of the significant achievements made in the expansion of the educational sector and the eradication of illiteracy, in the case of labour demand still exceeds supply. With regard to the infrastructure the demand for these services (roads - hospitals - ports etc) has grown at a faster rate than these facilities can cope with. Other obstacles include the insufficient role played by values, institutions and public awareness in furthering the application of science and technology to development and also the limited nature of information systems since these are still in the formative stage.
8. The limited use made of scientific methods for the solution of social problems such as the development of the watersupply, problems of traffic congestion and the management of fishery resources constitutes one of the main obstacles.
9. In order to catch up with scientific and technological progress and to be able to strengthen and co-ordinate local scientific and technological institutions there is a need for a national central scientific and technological policy-making body.
10. The main recommendations in this sphere can be summarized as follows:
 - (a) The establishment of priorities with regard to national objectives and scientific and technological policy according to national requirements.
 - (b) A humanitarian approach to science and technology since man must be able to control the machine and not allow the latter to damage the environment or ethical values and institutions.
 - (c) The formulation of short and long-term policies with regard to the development of manpower.

11. At the regional level co-operation between states is one of the most important instruments in this sphere, especially in fields of concern to the states of the region. For example, we would mention the possibility of formulating a strong research and development programme in the field of natural resources (oil - natural gas - solar energy - water desalination - and the management of fishery resources).

12. At the international level the State of Kuwait has supported the principles of the new international economic order and the code of conduct regarding the transfer of technology. The provision of a system for the dissemination of information at international level is one of the main requirements with which the State of Kuwait is especially concerned.

III. INSTITUTIONS WHICH CONTRIBUTED TO THE PREPARATION OF THE SECTORAL REPORTS

13. The following is a list of the institutions and bodies which contributed to the preparation of the sectoral reports and constituted a principal source of reference for this report.

Ministry of Planning, Ministry of Petroleum, Ministry of Electricity and Water, Ministry of Public Works, Ministry of Public Health, Ministry of Communications, Ministry of Finance, Ministry of Education, Ministry of Trade and Industry, Public Housing Authority, Kuwait University, Kuwait Chamber of Trade and Industry, Petro-chemical Industries Company, Kuwait National Petroleum Company, Kuwait Institute for Scientific Research.

Part One: The Economic Situation

I. The economic situation in the past, present and future:

14. In the period prior to the discovery of oil the State of Kuwait was dependent for its livelihood on fishing, pearling and the transit trade. Since oil was first exported in 1946 the country's economic growth has become highly dependent on petroleum and the oil-related sectors. Recent figures show that oil revenues constitute around 70-80 per cent of the Gross Domestic Product and 95-98 per cent of the Government budget. With the exception of petroleum the Kuwaiti economy is facing serious obstacles due to the small size of the country (Population 1.1 million in 1976), harsh climatic conditions, poor soil fertility for large scale agricultural expansion and short supply of fresh water. Furthermore, the limited supply of manpower constitutes a definite obstacle to the process of economic development. In view of these geographic, social, economic and demographic characteristics Kuwait has had to rely to a large degree during the last 20 years on the use of its oil revenues for the acquisition of modern scientific and technological methods as a means of social development to ensure a high standard of living for its citizens.

15. Since the beginning of the sixties Kuwait has witnessed notable economic growth and social activity as can be seen in all sectors of the economy. Available statistics show that the GDP doubled more than 4 times during the period 1965/66 to 1975/76 until it reached the level of \$US 11.83 billion. This

increase dates principally from 1973 when oil prices were modified with the result that Kuwait's financial reserves rose to an unprecedented level which enabled the State to raise the economic and social standards of its nationals who are, after all, the *raison d'être* for development in the national economy.

16. If the GDP measures the level of economic activity then individual consumption measures the level of the citizen's economic welfare. Expenditure on private consumption rose by around 300 per cent in a ten year period (1965/66 to 1975/76). During the same period average individual consumption rose at an annual rate of 3.55 per cent. The increased level of economic prosperity can be seen not only from the average individual income which is the highest average income in the world but also from the wide range of social services provided free by the State to all residents in the country. Kuwait has been able to provide its people with the widest and most complete range of social services in a manner unprecedented anywhere in the world. Education is free and sometimes includes free food and clothing for students. Medical care is also free for every one and the health services in general are of a high standard. The housing programmes subsidized by the State provided homes for most families of limited income.

17. Not only does the Government provide free and subsidized services but it also does not impose any taxes on income or production and customs dues are minimal and sometimes almost non-existent in the case of certain essential consumer and capital goods. Foodstuffs are also subsidized irrespective of whether they are imported or locally produced and all public utilities such as water, electricity and gas are also subsidized whether for individual consumption or for use by industrial institutions. Hence it can be said that the Kuwaiti Government's programmes in the field of public services are unprecedented anywhere in the world.

18. Other prosperity indicators include the high level of national savings and the volume of imports. Whereas the savings rate amounts to 10 per cent in the developing countries and around 15 per cent in the developed countries in Kuwait it reached 32 per cent in the year 1975/76 and jumped to 54 per cent in the year 1976/77. Imports increased more than five-fold in the last 10 years.

19. Although we can designate the present economic situation of Kuwait as "a high consumption economy" both the Government and the private sector are making joint efforts to increase the country's productive capacity by transferring part of their resources to capital formation. Available information shows that gross fixed investments rose from 113 million Kuwaiti Dinars in 1965/66 to 247 million Dinars ten years later. It should also be noted that, although this basic change is a positive step towards economic and social growth, the extent of the change is less than the minimum needed to meet the country's economic capability.
20. The increase in income and the attendant expansion in the field of finance, government and services sectors led to a parallel increase in the number of immigrants into the country due to the shortage of local manpower. The number of arrivals rose from 247,280 in 1965 to 522,749 in 1975, and in each of these two years the proportion of arrivals represented 52.9 per cent and 52.5 per cent of the total population respectively. At the same time the number of Kuwaitis rose from 200,059 in 1965 to 472,088 in 1975 and from 1961 to 1975 the growth rate of the Kuwaiti population dropped from 14.5 per cent to 6 per cent whereas the growth rate among the arrivals dropped from 9.3 per cent to 6.3 per cent and at present the overall population growth rate is estimated at 6.1 per cent which is the highest rate in the world.
21. Among the other important achievements we should mention the following:
- (a) The illiteracy rate dropped from 45.7 per cent in 1961 to 36 per cent in 1975.
 - (b) The number of kindergartens and primary, intermediate, secondary and other public schools rose from 108 in 1961 to 326 in 1975. The total number of pupils increased from 51,090 in 1961 to 201,907 in 1975. Likewise the number of students attending Kuwait University increased from 1988 in 1970 to 5832 in 1975.
 - (c) The number of individuals per doctor dropped from 958 in 1970 to 830 in 1975.
 - (d) The amount of social assistance payments made by the State rose from 2068 million Kuwaiti Dinars in 1967 to 6715 million in 1976.

(e) The percentage of accidents on the public roads per thousand inhabitants dropped from 4.30 in 1967 to 3.62 in 1976.

(f) The number of telephones increased from 26 thousand in 1963 to 155 thousand in 1977

(g) Between 1965 and 1976 the capacity of the water desalination plants increased from 9 to 60 million imperial gallons per day.

(h) Likewise the capacity of the electric power stations rose from 160 million watts to 1445.6 million watts during the same period.

22. In spite of these significant achievements it is important that we be aware of the difficulties which might impede progress in the future so that once these potential problems are identified it may be possible to resolve them by strengthening the role of science and technology.

23. We will begin with the Kuwaiti economy which is suffering from the narrowness of its productive base in the agricultural sector which is very limited in area. The productive capacity of the industrial sector is also, of necessity, basically restricted to the oil-related industries and a few construction material industries with the result that the economic center of gravity revolves around the trade, finance and services sectors the prosperity of which is in turn dependent upon the oil revenues. For this reason and also because of low labour productivity and the elementary condition characterizing most of the non-oil sectors, the Kuwaiti economy is considered as being in the category of developing countries even though the proportional income per single individual causes Kuwait to rank among the most developed countries.

24. Possibly the most urgent national objective is to reduce the country's dependence on oil, by diversifying the industrial sector and broadening its productive base. To achieve this aim it is necessary to conduct extensive research in order to discover the potential capabilities for industrial growth in non-traditional fields such as textiles, food, paper, ferrous and non-ferrous metals, non-metallic products, transport and precision instruments. The challenges that these industries will face will not be limited to meeting the needs of the local market but will also involve competing in foreign markets. In short, this means that the establishment of these new industries

basically requires the ability to compete with their foreign counterparts. This competition should not rely on State subsidies alone but rather on the industry's ability to more than compensate for the lack of expertise and shortage of national manpower etc. by drawing full benefit from the relative advantages available locally such as the absence of taxation, low customs dues, availability of capital, low land rent, industrial loans at low interest and the supply of cheap energy.

25. The identification of the most appropriate industrial activity for Kuwait is, in itself, insufficient. It is more important to select the most appropriate type of technology. In this respect it would appear that the type of technology needed in Kuwait would be one of high capital intensity and small size with a high degree of automation in view of the abundance of capital and shortage of manpower. Accordingly, the choice of appropriate technology involves a serious challenge which we must face with courage.

II. National and sectoral objectives:

A. National objectives:

26. Kuwait's long-term economic objectives are aimed at establishing a society characterized by the following features:

- (a) Auto-motivated economic growth.
- (b) Increasing income and production rates.
- (c) A guaranteed minimum level of prosperity for all individuals.

27. The current economic plan (1976-1981) formulated within the context of the above-mentioned objectives is based on the following strategic factors:

- (a) The development of manpower by training, planning and organizing manpower requirements, promoting female participation in the work force, increasing productivity and linking the latter to wage rates.
- (b) Economic diversification and broadening the productive base through the use of capital intensive technology together with the adaptation of modern technology to local needs, the establishment of a plan for industrialization based on clear development criteria and the creation of a suitable climate to encourage investments in the local sectors.

(c) Economic co-ordination and integration among the various sectors based on the creation of linkages and the facilitation of movement among the various sectors, the reduction of production bottlenecks and the promotion of regional and Arab co-operation in joint development projects.

(d) The creation of a pollution-free society enjoying economic maturity and a social system based on sound values.

28. Thus it is clear that the projects in the current economic plan are aimed at increasing the GDP by 6.5 per cent to bring it up to the level of 5 billion Kuwaiti Dinars in 1981. In accordance with this plan the non-oil sector will grow at an annual rate of 11 per cent while the oil sector will grow at an annual rate of only 5 per cent. This is an indication of the emphasis being placed by the State on the economic diversification policy and the encouragement of the non-oil sector.

29. With an estimated annual growth rate of 6.5 per cent the population will reach 1.42 million persons in 1981 and it is expected that employment will grow at a rate of 6.5 per cent to reach a level of 434 thousand by 1981. It is also expected that the employment of Kuwaitis will increase at a slightly higher rate than the immigrant labour force as a result of which the proportional representation of Kuwaitis in the total labour force is expected to increase from 29.2 per cent in 1976 to 29.8 per cent in 1981 and this is equivalent to the increased proportional participation of Kuwaitis in the work force. At the same time it is expected that productivity will increase by 3.5 per cent per year in keeping with the State's policy of achieving higher levels of training and adopting capital intensive technologies.

B. Sectoral objectives:

30. Oil: With the establishment of a ceiling for oil production there is a need for considerable efforts to be made for the control and maintenance of oil reservoirs. Exploration must also continue even in areas which are defined as explored or dry areas.

31. Solar energy: Although Kuwait possesses vast oil reserves it would be wise to explore the field of solar energy from the point of view of its potential use in:

(a) Solar cooling and heating systems for buildings of all sizes in Kuwait and the Arabian Gulf region.

(b) Solar heat conversion.

(c) Agricultural expansion: through the use of greenhouses with a special heating and cooling system to grow crops throughout the year in Kuwait's hot and humid climate.

d) The development of interlinked food, water and power complexes for isolated communities to meet their needs for fresh water, electric power and vegetables. In the light of the considerable economic potential of solar energy the Government inaugurated and integrated research and development programme in the middle of 1976 at the Kuwait Institute for Scientific research and within 2 years the programme had won world-wide esteem for its qualitative and quantitative achievements.

32. Water: In order to facilitate and maintain the growth process Kuwait must continue its endeavours in connexion with the desalination of the waters of the Gulf and also of brackish ground water sources. The latest forecasts indicate that the maximum rate of consumption will increase from 56.1 million imperial gallons per day in 1977 to 100 million imperial gallons per day in 1980 and, subsequently, to 220 million by 1985. In effect, it is anticipated that the demand for water will reach 774 million imperial gallons per day by the year 2000. This will confront the State with considerable challenges since it will require vast investments in addition to extensive research projects to determine the best methods of water desalination at the lowest possible cost. At the present time all of the existing distillation units operate under the multi-stage distillation system. Further research will be carried out to study the possibility of using cheaper methods such as steam pressure, reverse osmosis or electrolysis. In addition to the increase in the quantities of fresh water there are other aims which require considerable attention. These aims include an expanded programme for the purification of saline water sources and sewage water treatment for use in sanitary distillation, industrial cooling, agriculture and the recharging of ground water. Other objectives include the following:

(a) the recycling of water for other purposes wherever it is feasible to use less pure water for these purposes.

(b) the adoption of more effective measures to prevent water seepage with the aim of reducing wastage of fresh water.

(c) the adoption of policies aimed at measuring consumption and the fixing of suitable prices to discourage consumers from wasting fresh water.

(d) the adoption of measures to prevent water evaporation from cisterns, surface reservoirs and seasonal and rain water catchment areas.

(e) the adoption of measures to introduce methods of modifying the climate and finally,

(f) stimulating increased popular awareness of the importance of water conservation.

33. Fishery resources: This natural resource takes second place after oil in order of importance with regard to availability of natural resources or raw material. The economic output of fishery resources is suffering from severe disturbances and constant decline. There is a constant decrease in the quantities available in the waters of the Gulf and the amount of fish caught at the present time is around 1/5 of that caught at the height of the fishing boom in 1966/67. The economic loss sustained by the State as a result of the excessive shrimp fishing alone over the past 10 years is estimated at 33 million Kuwaiti Dinars. It would have been possible to conserve this resource if there had been wise management of fishery resources at the peak of the shrimp fishing boom in 1976. In view of the fact that the scientific and technological components of the fishery resources sector are similar to their counterparts in the fishery resources sector in other countries what is required here is not the conception of scientific and technological systems in themselves but rather the application of the science and technology already available. In particular it is essential to introduce a wise system of management in the fishing and shrimping industry with the aim of defining the highest yield which it is possible to maintain.

34. The environment: In view of the deep concern being shown for environmental protection and management and the urgent need to reduce air, water and earth pollution the following priorities are urgent requirements to ensure the preservation of a suitable environment for the population:

(a) Environmental awareness or environmental education.

(b) The definition of a minimum level of environmental quality.

(c) Environmental laws and standards.

(d) Control and implementation.

35. In this field the general objective is reflected in the principle that technological development, whether local or foreign, must be accompanied by a study of its effect on the environment. In other words the process of technological selection must, in principle, include "environmental effect". Hence the State will be able to reap the harvest of technological progress with the least possible effect on the environment in general.

36. Agriculture: The agricultural sector in Kuwait contributes less than 1 per cent of the domestic product. In 1976/77 the total area under cultivation amounted to around 907 hectares (around 8 square meters per person). In 1976 the total population in agricultural areas was estimated at 0.3-1.0 per cent of the total labour force. These statistics indicate that at the present time agriculture plays a very minor role in the country's economy. Hence Kuwait relies basically on imports to meet the ever increasing local needs for foodstuffs.

37. In order to narrow the gap between production and local agricultural consumption it would appear that there is a need to:

(a) Prepare a national master plan of the water needs of population centers, industrial projects and the agricultural sector.

(b) Introduce and adapt the appropriate technology to overcome the harsh climatic conditions in Kuwait.

(c) Step up research on animal resources and range management.

38. Petro-chemicals: The petro-chemical industry is the most suitable industry for Kuwait's economic situation since it uses locally available raw materials, namely oil, capital and energy. Furthermore, the sale of refined petroleum products rather than the marketing of oil as a raw material has the result of increasing the State's profit from oil.

Part Two: The far-reaching importance of science and technology

I. The scope of science and technology

A. Science and technology:

39. Science represents mankind's stock of knowledge at a specific time. In general science plays two fundamental roles in the life of nations - firstly in the production of more sophisticated and advanced equipment and machinery

and secondly as an instrument to help nations to overcome their problems through the most modern systems of planning, organization and management. It could be said that one of the main causes of economic backwardness lies in the failure to use science in its second role in the developing countries as extensively and fully as it is used in the developed countries. Technology on the other hand is the outcome of applied research based on the utilization of the results of fundamental research already carried out with the aim of producing material goods for commercial purposes.

40. The modern history of Kuwait in the post-war period leaves no doubt regarding the conviction of the Government and the private sector of the importance of science and technology and of their desire to use them wherever possible. In effect, there are some sectors such as crude oil, petro-chemicals, communications, health, water and electricity which owe their existence to science and technology. While this is the case with regard to the importation and adaptation of foreign technology, full use is still not being made of scientific methods in the management of our natural resources, in our institutes and in our daily needs in general. Further efforts are still required in this respect.

B. National and international responsibilities regarding the development of science and technology:

41. Science and technology cannot be imported from any country and transplanted elsewhere. There is a need for a local national framework developed and consolidated within the boundaries of the country and which must be protected from the delusions of co-operation and foreign aid. Conversely, however, science and technology cannot exist in a country without strong links with the international scientific and technological community as a whole. Any country which isolates itself entirely from international co-operation will soon discover that its scientific and technological capabilities are limited. Hence a kind of balance must be struck between what is national and what is international in scientific and technological programmes and activities.

42. The best example of this balance may well be seen in the research to develop solar energy carried out at the Kuwait Institute for Scientific Research. In the early stages of this programme it was decided that the production of models of the equipment required to develop and produce solar

energy locally would be excessively costly and time consuming. Hence a Montrose environmental control unit for temperature regulation using solar energy was produced in the United States in accordance with specifications established by the Kuwait Research Institute. An American institute was also commissioned to make a study of the capacity of various salts to store solar energy on the understanding that scientists from the Kuwait Institute would conduct part of this study in the United States. This strategy was adopted in order to enable us to keep abreast of other activities in other countries and to carry out a programme in which due regard would be paid to the proportional cost benefit. In the field of solar powered water plants well known foreign installations were examined to study their heat output and ability to stand up to the atmospheric conditions in the Kuwaiti environment. As a result of these endeavours and based on a mathematical model produced by researchers at the Kuwait Institute using computers a design was created for local production in the Kuwait Institute. There are plans to adopt the same procedure in other projects. There are, for example local national prototypes of green houses for use in agriculture.

C. Intersectoral linkages:

43. Since we use science and technology as an input in the production process the improvement of science and technology in one sector will have an inevitable effect on sectors which use the production of this sector as an input in their production processes. For example, the new technology which is reducing the cost of water desalination units will benefit the agricultural sector and all water uses by reducing production costs. In Kuwait there are several examples of this interlinkage. The clearest example of this can be seen in the health-sector where intensive investment in science and technology will be reflected in the rest of the economy since it will:

(a) Increase the sized of the national labour force by reducing the number of cases of premature mortality and lessening absenteeism from work due to sickness.

(b) Make a positive contribution to labour productivity since illness has an adverse effect on the strength of workers and also on their ability to concentrate.

(c) Also meet a fundamental human need and thus raise the community's standard of welfare.

II. The role of science and technology in accelerating the pace of development:

A. The contribution of science and technology to economic growth in Kuwait:

44. The economic development process derives its strength or weakness from the quality and quantity of production factors (capital, labour and land). Modern theoretical research has shown that there is a difference between growth in production and growth in production factors and this discrepancy is in reality the result of the contribution of science and technology. Hence we could generally define the role of science and technology as comprising technological progress in methods of work and management and including better health and working conditions for the labour force. A lot of research has been carried out in the United States and elsewhere to determine the aforementioned discrepancy, namely the effect of science and technology on economic growth.

45. The Ministry of planning conducted similar research the results of which showed that the contribution of science and technology between the years 1970 and 1975 after deduction of the elements of labour and capital growth amounted to an estimated 10 per cent of the overall growth rate in the domestic product. If we exclude the oil sector (mining and quarrying) the contribution of science and technology rises to 15 per cent i.e. science and technology make a relatively high contribution to the non-oil sectors such as the petrochemical, transport, utilities and other sectors. The following table shows the proportional contribution of each production factor to the growth in GDP in the period from 1970-1975:

	<u>real growth in GDP</u>	<u>real growth in capital</u>	<u>growth in labour force</u>	<u>growth in science & technology</u>
All sectors	17.4%	11%	4.7%	1.7%
Non-oil sectors	16 %	5%	8.5%	2.5%

B. The adverse effects of science and technology:

46. The application of science and technology is accompanied by adverse effects. Every community must carefully monitor the effect of science and

technology on the formation of society and national values, institutions and the environment. An example of this is the strong adverse effect of science and technology on the petro-chemical industries which takes place as follows:

(a) Although the petro-chemical industry is basically more dependent on capital than on manpower its expansion may lead to an increase in demand for migrant labour and although the non-Kuwaiti labour force has played a major role in the development of all sectors it is obvious that the rapid population growth resulting from the increased demand for labour in various sectors including the petro-chemical sector has given rise to unforeseen pressures on services and public utilities. (b) The effect of pollution from this industry has come to present a problem and the Petro-chemical Industries Company has taken steps to reduce the effect of pollution in the water. If care is not taken in the organization and management of these plants certain future projects may cause an increase in pollution. For instance, as a compound, gasoline is closely associated with the disease leukaemia.

C. Science and technology and national aspirations:

47. The furtherance of the national scientific and technological capability is, in fact, conducive to a greater feeling of ability to determine ones own destiny and achieve equality, a feeling which normally carries with it the assurance that the Government is capable of making an independent choice with regard to its political, social and cultural aspirations. Although the State of Kuwait has been able to achieve many of these aspirations since its political independence in 1962 a great deal of effort must still be made to strengthen the local scientific and technological capability.

48. The order of priorities for national objectives is one of the main requirements needed to plan development operations. It has already been seen from this report that science and technology have been used in all spheres of economic activity at a relatively rapid rate. The availability of financial resources, the existence of a free economic system and the strong desire to catch up with the developed countries have led to the rapid growth of the national scientific and technological framework. However, this process has entailed certain adverse repercussions which make it necessary for the State to pause to evaluate the benefit derived from the applications of science and technology in the various fields of national economic activity in the past so

that it may be able to choose wisely with regard to the future application of science and technology and thus determine the order of priority for national and sectoral objectives. It might be argued that Kuwait has no need to set an order of priority for its national objectives on the basis that it has sufficient financial resources to enable it to achieve all of these objectives at the same time. However, this would be a great mistake since, just as some countries need to set an order of priority for their national objectives in view of their lack of sufficient financial resources, Kuwait also needs to set an order of priority for its national objectives by virtue of the lack of manpower resources with which it is faced.

49. The establishment of a welfare state is one of Kuwait's main national aspirations. Consequently there has been a quantitative and qualitative increase in the services sector by, inspite of this, greater concern should be shown for science and technology to improve the quality of social services.

D. Science and technology and society:

50. It is essential that cultural awareness keep place with economic development since cultural backwardness and also cultural precocity both hamper the process of economic development. Cultural backwardness is a well-known social phenomenon caused by values and institutions which are no longer suitable to keep abreast of the times, while cultural precosity is caused by the imposition of foreign values and institutions on local systems with which they are incompatible. In Kuwait we find indications of cultural precocity since the absorption and dissemination of science and technology in Kuwait during the last decade has been too rapid for the national cultural capability, values and local methods. The situation has been aggravated by the need to import large numbers of foreign labour to help implement national development programmes. In consequence local institutions have faced the problem of adaptation, harmonisation, receptivity and co-existence with dynamic socio-economic changes.

Part Three: Scientific and Technological Dependence

I. Dependence on foreign human resources and capital goods:

51. In general the Kuwaiti economy relies on science and technology as embodied in capital goods. There are many reasons for this but the principle factors that led to this state of affairs can be attributed to the following:

(a) The small size of the local market which for economic reasons does not justify the establishment of a capital-intensive capital goods industry.

(b) The type of equipment required is normally capital-intensive development and research equipment needing a basic scientific and technological framework, especially highly skilled scientists and engineers, which is not locally available.

(c) The lack of basic raw materials. Although a sincere national will and an abundance of financial resources are two prerequisites for the establishment of a capital-intensive scientific and technological industry they are insufficient to create this type of industry.

52. Most of the sectoral reports have shown that, from the practical point of view, Kuwait is entirely dependent on foreign equipment and machinery and other imported capital goods. The dependence of the oil sector, for example, is as high as 100 per cent and the same is true of the telecommunications, agriculture, oil refining, petro-chemical, water, fishery resources, transport, construction, health and other sectors and even of the non-oil industrial sector, in which the country possesses a very wide and varied range of choice, since most of the equipment used therein is imported.

53. Although this is the case with regard to equipment the situation is different as regards skilled manpower since the degree of dependence in this sphere has clearly diminished in the last decade and particularly in the past five years. The main reason for this change is Kuwait's ability to attract Arab scientists, engineers and technicians in almost all fields. Kuwait has succeeded in reversing the brain-drain by attracting a group of eminent Arab scientists and engineers who had previously settled in America and other European countries. Another important factor is the considerable expansion which has taken place in educational facilities at all levels and especially at the university, technical institutes and training colleges. A third factor, although its effect will take some time to appear, is the extensive Government sponsored scholarship programme aimed at sending talented students to study and receive higher training abroad.

54. As a result of these endeavours Kuwait has been able to reduce its dependence on foreign skilled labour. For example, all the designs, specifications, and project execution work in the electricity and water sector are

being undertaken by local scientists and engineers. In the petro-chemical industry the dependence on foreign technology has diminished in certain fields in which local manpower has acquired greater operational know-how as a result of the technical training acquired in the industry. Due to the availability of engineers with suitable training local staff have developed and improved industrial processes which are gradually being set up. National research institutions are conducting applied research into new, as yet untested processes. In short, while this industry was dependent in its early stages on foreign personnel for the solution of start-up problems, operational control and modification and design work, this is now being carried out by local and Arab staff although occasional recourse is made to foreign experts to solve major problems.

II. National measures to facilitate the transfer and development of science and technology:

55. The following are the principal national measures taken to facilitate the transfer of technology:

(a) Certain steps were taken to encourage local production which is normally accompanied by the transfer and development of technology. These are exemplified by the following: the absence of customs dues on tools, machinery, spare parts and raw materials, the absence of export taxes and State legislation giving preference to local products over foreign imports even where the cost of local goods is 10 per cent higher than that of their foreign equivalent. In view of the huge volume of State expenditure this law has led to a boom in local production. Other concessions granted to local industry include the exemption of income from taxation in addition to symbolic land rents and the supply of water, electricity and gas at suitable prices subsidized by the State.

(b) The establishment of a National Committee on Technology in 1975 with the aim of developing the local scientific and technological capability.

(c) The establishment of Kuwait University in 1966 to promote higher education and basic research.

(d) The establishment of the Kuwait Institute for Scientific Research in 1967 which is an indication of the Government's desire to create a national body specialized in the transfer and adaptation of foreign technology to suit local needs and also in the conduct of applied research.

(e) The establishment of a National Centre for Scientific and Technological Information in the Kuwait Institute for Scientific Research in 1976 with the aim of supplying the information and services required to meet national needs.

(f) The setting up of a number of government research centres specialized in water resources, construction material and agricultural experiments.

(g) The transfer of technology is also being facilitated by the invitation extended to institutes in all parts of the Arab world to establish their headquarters in Kuwait. The Government has encouraged this idea and provided funds for its implementation, as a result of which Kuwait is now hosting a number of institutions of this type such as the Organization of Arab Petroleum Exporting Countries, the Arab Fund for Economic and Social Development, the Arab Planning Institute and the semi-regional Fisheries Training Centre. Other similar research centres are currently under study such as the Arab Institute for Sea Water Desalination, the proposed headquarters for which would also be located in Kuwait.

(h) Representatives of Government institutions also have the opportunity to attend scientific and technological meetings abroad and they are permitted to participate in meetings of the specialized agencies of the United Nations and other international organizations. The State is also active in hosting regional and international conferences on science and technology. Through these opportunities Government scientists, engineers and officials meet and exchange information with their foreign counterparts regarding the latest developments in science and technology.

(i) The establishment of the Kuwait Fund for Scientific Progress in 1976 with contributions estimated at around 5 per cent of the total profit of registered companies. The Fund's budget is currently estimated at around US \$.25million.

(j) The establishment of the Sabah Al-Salem Al-Sabah Philanthropic Organization aimed at the furtherance of scientific research and humanitarian work.

(k) The conclusion of agreements with countries of the region with the aim of co-operation in strengthening scientific and technological capabilities.

(l) The provision of sufficient aid to all Government bodies for studies concerned with modern technology.

(m) And finally one of the main factors promoting technology is the creation by the Government of an open society with characteristics conducive to facilitating the influx of modern technology.

III. National scientific and technological institutions:

56. In order to increase the country's capability in the field of science and technology the Government has established a number of research centres which are held in high esteem at both the regional and international level. These institutions include Kuwait University, the Kuwait Institute for Scientific Research, the Water Resources Development Centres and the Government Experimental Station. Kuwait University teaches and trains students up to Baccalaureate and higher educational level using curricula and methods in keeping with national and regional development needs. The professors also undertake research and numerous studies in the field of oceanography, petrochemicals, food substitutes, energy, medicine and the environmental sciences. In addition, the University provides numerous advisory services to various Government organizations such as the Ministry of Education (development of scientific curricula), the Ministry of Electricity and Water (nuclear energy) and the Ministry of Health (pharmaceutical use of desert plants, nutritional problems and cancer research).

57. In 1978 the Kuwait Institute for Scientific Research employed around 80 scientists of which 41 held a Ph.D. qualification. The Institute conducts applied studies in the field of solar energy, its potential use for cooling and heating and its application in agriculture, water and electricity. The Institute also carries out applied studies in the field of food and natural resources, in particular oil and fishery resources, in addition to environmental research and studies on the economics of technology. In its capacity as a national centre for scientific and technological research the Institute studies scientific and technological developments abroad with a view to their

potential application at local level after their adaptation to economic and industrial conditions in Kuwait.

58. In addition to these institutions efforts are also being made by other independent institutions to develop and adapt foreign technology to suit local conditions, especially in regard to the climate and soil of Kuwait. For example, the construction industries had to change the foreign standard specifications for reinforced concrete since these foreign specifications were designed on the basis of the European climate which differs to a large extent from local conditions.

IV. Patents:

59. After the first endeavours in 1883 a further attempt was made in 1967 to adopt an international system of patents at the Paris (WIPO) Conference to promote the protection of intellectual property and ensure administrative co-operation among government federations.

60. Although Kuwait is not a member of the Paris Conference it was represented at a number of WIPO meetings and there is an office for patent rights in Kuwait attached to the Ministry of Trade and Industry with the following main functions:

- (a) Maintenance of local patent files.
- (b) The dissemination of information on modern technology for use in the public and private sectors.
- (c) Advising users on the choice and application of appropriate technology.

Part Four: Obstacles to the Transfer and Development of Science and Technology

61. In this part an attempt will be made to identify the main obstacles impeding future progress in the field of science and technology. Kuwait deems it essential to find solutions to these obstacles in order to strengthen the national capability to apply science and technology on the basis of a proper selection within the framework of economic and social development programmes. The main problems facing the State can be divided into two categories: The inadequacy of manpower and infrastructure. Each of these two problems will be dealt with separately below:

I. The development of manpower:

62. In the year 1975/76 the Government allocated 11.5 per cent of its budget to education. This was equivalent to 3.1 per cent of the national income and this is no small figure even by comparison with certain developed countries such as West Germany (4 per cent) and the United Kingdom (5.6 per cent). The illiteracy rate dropped from 45.6 per cent in 1965 to 39.2 per cent in 1970 and 36 per cent in 1975 while the proportion of graduates from Kuwait University in relation to the total population rose from 1.6 per cent to 3.9 per cent in 1975 as a result of the greater appreciation for the importance of higher education. Between 1975/76 and 1976/77 the number of registered students increased by 30 per cent while the number of Kuwaitis studying abroad at Government expense reached 3000 in 1976/77 of which 200 were pursuing higher studies. The educational level of the labour force also rose considerably in the period between 1965 and 1975. Among the working class the illiteracy rate dropped from 45 per cent in 1965 to 34 per cent in 1975 while the number of persons holding primary and secondary school certificates increased from 14 per cent to 33 per cent during the same period.

63. In spite of these achievements national manpower requirements constitute a bottleneck for economic and social development. In general, all the economic sectors state that this factor is an impediment to the application of science and technology. An idea of the dimensions of this problem can be obtained by a glance at the forecast made by the Ministry of Planning to the effect that technical manpower requirements will amount to 167,500 whereas it is not expected that available manpower will exceed 67,500 in the year 2000. Other aspects of the manpower issue can be summarized as follows:

(a) A considerable increase is taking place in the number of graduates from schools and colleges.

(b) The educational level of the labour force is lower than it should be.

(c) Although the illiteracy rate is dropping there is still a large number of workers who are unable to read and write.

(d) The standard of competence of graduates from technical institutes needs to be improved.

(e) The number of students at technical institutes is very small in relation to national needs.

(f) It will be difficult to find a sufficient number of highly skilled individuals to operate the capital-intensive means of production imported from abroad.

(g) The slow rate of economic development in the non-oil sectors is partly due to the lack of infrastructure which, if adequately available, would require the importation of large numbers of technical and non-technical labour which would disturb the delicate balance in the national manpower structure.

64. Customs, traditions and values tending to disparage manual trades and crafts also constitutes a serious social obstacle to the elaboration and development of a socio-economic system. This phenomenon is shown by available statistics. For example, in the 1970 census the number of Kuwaitis in the Government and public services sectors noted for their low proportion of manual jobs amounted to 57 thousand as against 7700 non-Kuwaitis while the number of Kuwaitis engaged in manual work in the construction and industrial sectors was relatively small. In the construction industry the number of Kuwaitis was 1800 as against 31 thousand non-Kuwaitis, and in the industrial sector the proportion was 2300 Kuwaitis to 22 thousand non-Kuwaitis.

65. In all fields requiring highly skilled technical and technological staff the lack of this type of manpower in most national sectors constitutes a bottleneck partly due to the insufficient number of scientists and technologists injected into the labour force, the manpower potential wasted in marginal or even external jobs such as administration and other fields and also the insufficient measures taken to maintain the expertise and abilities of the existing manpower and to keep it abreast of the latest developments by providing opportunities for suitable research and contacts with the scientific and technological community throughout the world.

66. In this connexion particular reference should be made to the acute shortage of technicians and technical assistants engaged in scientific and technological activity and which, in certain cases, has the result of wasting the time of highly skilled technicians in simple manual work. Furthermore, the lack of technicians means that less maintenance is carried out on research and production equipment, thus leading to the loss of both equipment and time.

67. Kuwait's success in attracting highly skilled labour from other countries to bridge the gap in scientific and technical manpower has had certain adverse repercussions since the majority of these skilled technical workers coming from neighbouring Arab countries or from Iran, India, Pakistan, Bangladeshi and other Asian countries exhibit differing educational, cultural, religious, political and social characteristics and all of them received their technical training in their own countries in accordance with different standards, concepts, methods and aspirations. The problem of co-ordinating these different groups and transforming them into an effective homogeneous team for the achievement of a common objective in accordance with uniform standards is far from being an easy task. In such an environment the productivity and efficiency of the human elements is invariably affected by ethnic, cultural, political and other differences. In addition, the composition of these ethnic groups within the technical labour force is marked by its fluid and ever changing nature since the absence of a feeling of stability among the foreign labour force as well as the financial incentives and better working conditions elsewhere leads to a constant turnover in the labour force. It should be noted that it is mostly the better and more experienced and useful personnel who resign since it is these who obtain attractive offers from other employers. Hence the effort put into training and instructing new workers is wasted. To this should be added the inconvenience of trying to recruit, train and instruct replacements for those resigning.

II. Other obstacles:

68. In this section we will briefly define the main difficulties facing the Kuwaiti economy with regard to the transfer and development of technology.

A. The management of natural resources:

69. The Kuwaiti economy is basically dependent on the availability of certain natural resources such as oil, natural gas, fishery resources and solar energy and there is thus a need to begin the implementation of a programme for the management, distribution and utilization of these natural resources. The objectives of such a programme should include the following:

(a) A survey of the area to determine the available quantity of these resources as a necessary basis for sound planning and optimum utilization.

(b) Strengthening the national capability to make efficient use of modern scientific and technological methods to locate, manage and exploit these resources.

(c) The establishment of an integrated training centre with the aim of enhancing national endeavours with regard to the exploitation and conservation of these resources.

(d) The promotion of regional and international co-operation in the implementation of research and development programmes concerned with the development of these resources.

70. The absence of proper planning and modern administrative methods is a phenomenon affecting not only natural resources but also most development fields and here lies the problem of the failure to use scientific methods to formulate a comprehensive and co-ordinated plan for the solution of specific problems. For example, up to now there is still no detailed manpower policy scientifically formulated on the basis of a logical economic and demographic evaluation of supply and demand for each manpower category. Another example is the lack of a comprehensive plan for the proper management of water resources based on scientific estimates of water availability in relation to the requirements of various consumer groups. Such a plan should take into account waste water and seepage together with the possibility of the storage and re-use of industrial and domestic liquid waste. A third example is the traffic problem in Kuwait where the absorptive capacity of the road network is incompatible with the number of vehicles imported each year. In short, the purchase of modern equipment is one thing while the utilization of modern scientific methods to solve certain specific problems is quite another matter. The State has made intensive efforts with regard to the purchase of modern equipment but a lot of effort still needs to be exerted in connexion with the other aspect, namely the use of modern scientific methods in management and planning.

B. Infrastructure:

71. Despite the superficial growth of the national infrastructure (road network, ports, communication systems, banks, health care) during the past decade the demand for these services is still on the increase. Furthermore, the services sectors using modern sophisticated equipment have not made maximum and optimum use of this equipment in the public interest and this shortcoming is due to a number of reasons, primarily the lack of proper training.

C. Information systems:

72. One of the main requirements to facilitate the choice of the most appropriate technologies available in the world is the establishment of a system to ensure the flow of scientific and technological information to technology uses in Kuwait. The availability of this information is especially important for a proper choice of technologies in view of the rapid and extensive developments in the information field in recent years. The success or failure of any information system depends on three principal factors:

(a) The suitability of the information from the point of view of the user.

(b) The amount of time needed to provide the information.

(c) The cost of obtaining the information. In a country such as a Kuwait which is largely dependent on technology the availability of a good information system is essential.

73. In order to reduce the cost of the provision and exchange of information among a number of parties the process must be centrally controlled. This centralization can be achieved at national, regional and international level. In accordance with this principle in 1976 the Government established a National Scientific and Technological Information Center which is run in co-operation with the Patent Documentation Office of the Ministry of Trade and Industry with the aim of furthering the dissemination of scientific and technological information.

D. Values and institutions:

74. To ensure a constant evolution of economic and social changes scientists and technologists must remain in close contact with the scientific community as a whole. There is also a need for integrated values and institutions in order to ensure the utilization of the scientific and technological output of these scientists. Hence their endeavours to define national problems and their attempts to solve them must be supported by an increased public awareness of their research programmes. In this context the stimulation of popular awareness serves two main aims:

(a) Keeping scientists and technologists informed of public opinion which must be taken into account when formulating research programmes.

(b) Supporting the scientists' views and providing them with moral encouragement. In short, there are four principal requirements, namely:

values, institutions, mutual responsiveness between scientists and the public and the stimulation of public awareness. All of this requires close examination in Kuwait with a view to reaching a more efficient standard in keeping with the rate of scientific and technological development in the country.

Part Five: Regional and International Co-operation in
the Application of Science and Technology

I. Co-operation at the Gulf level:

75. There are numerous examples of co-operation among the Arabian Gulf States in the field of education, sport, environment, industry etc. In this connexion there are certain fields in which co-operation is essential such as the management of fishery resources in the Gulf, environmental protection and the standardization of communications' equipment, etc. In general, co-operation in the application of science and technology will prove of benefit to all parties if consideration is given to the need to avoid duplication and repetition of effort. On this basis, therefore, and realizing the similarity in the socio-economic structure of the Gulf States, by virtue of which they are facing more or less the same problems and difficulties, Kuwait has been extremely active in supporting all forms and types of co-operation in this field.

76. In connexion with co-operation in the application of science and technology between Kuwait and the Gulf States it might be said, for example, that the Kuwait Institute for Scientific Research and the Water Resources Development Centre are among the most important institutions engaged in this field. The National Scientific and Technological Information Center attached to the Kuwait Institute for Scientific Research has prepared a list of scientific documents available in the Gulf States and the Institute is currently preparing a joint research programme with Bahrain in the field of solar energy. The staff at the Water Resources Development Centre have consulted and exchanged views with their counterparts in the Sultanate of Oman, Qatar, Bahrain, the United Arab Emirates, Saudi Arabia and Iran.

II. Co-operation at Arab level:

77. Kuwait is participating in numerous joint Arab projects with Arab organizations and other specialized agencies and is also a headquarters for

some joint Arab organizations. If we examine most of these projects we find that they are geared to the achievement of an increase in the capability to absorb modern science and technology for use in the furtherance of development activities in the economic and social fields in the Arab World in general.

78. One of the aims of the Euro-Arab dialogue is the establishment of co-operation with the European Community with a view to narrowing the technological gap between the Arab countries and the countries of the European Community. The dialogue and discussions between the Arab and the European sides has resulted in the following:

- (a) Increased Arab awareness of the importance of co-operation and co-ordination in the utilization of European scientific and technological expertise.

- (b) Familiarization with the scientific and technological expertise needed for the development of economic and social fields.

- (c) inducing certain Arab and international specialized organizations to undertake a more positive role in developing the Arab scientific and technological capability.

- (d) Wider co-operation and closer working relationships among the Arab States.

79. At the conference of Arab Ministers responsible for the application of science and technology to development (Castarab-Rabat 1976) Kuwait played a positive role in emphasizing the importance of co-operation in this field and in drawing up recommendations and proposals most of which were generally aimed at developing the scientific and technological potential of the Arab World and furthering endeavours aimed at implementing scientific and technical programmes and projects at regional and Arab level. Kuwait also participated with its Arab sister States in financing a feasibility study on the establishment of an Arab Fund to finance scientific research and studies which the conference proposed to undertake. Kuwait University and the Kuwait Institute for Scientific Research agreed with a number of

scientific research institutions in certain Arab countries to undertake joint scientific and technological projects, especially in Egypt, Syria and Jordan.

III. Co-operation at international level:

80. Kuwait's endeavours with regard to the transfer and adaptation of technology transcend the regional level. At international level there are three different methods by which the State can select and specify foreign technology: the private sector, the public sector and scientific and technological institutions.

81. The first method made it possible to transfer a good deal of technology although the effectiveness of this co-operation was relatively small due to the sector's weak bargaining position and the monopoly exercised over modern technological methods by corporations in the developed countries.

82. The second method, namely the Government method proved effective in the achievement of scientific and technological progress either through the importation of modern scientific methods or by effective participation in international conferences on the transfer of science and technology.

83. With regard to the third method the Kuwait Institute for Scientific Research has been able to achieve co-operation in the field of joint scientific research with international organizations concerned with science and technology such as the Batel Institute in West Germany, the Petroleum Institute in France, Efes in Sweden (for the study of enzymes), the Japanese Institute for the Study of Marine Biology, the Institute for Desert Studies in Nevada in the United States, the Chicago Gas Institute and other universities in the United States such as the University of Colorado, the Georgia Institute of Technology, Stanford University and the Massachusetts Institute of Technology.

Part Six: Measures for the Implementation of National
Scientific and Technological Policy

I. The present situation:

84. The shortcomings of existing measures towards appropriate scientific co-operation can be summarized in the following points: (1) The existing measures do not permit a sufficient amount of co-operation among the three principal components of the economy, namely the Government sector, the private sector and scientific research institutions. (2) Current endeavours do not place sufficient emphasis on the development of the scientific and technological infrastructure. (3) The absence of a scientific body to act as an "aerial" to monitor scientific and technological institutions throughout the world in order to find out about the latest scientific and technological developments that have either been discovered or are still in the research and development stage with a view to their transfer to users in Kuwait. (4) Current endeavours have not clearly defined the role to be played by science and technology in achieving the national objectives specified in the Five-Year Plan.

II. Prerequisites for the establishment of a new system:

85. The formulation of a framework for a new system stems basically from the list of shortcomings already mentioned in the previous section and the main principles in the possible format of the new measures are as follows: (1) The new measures do not necessarily mean the formation of new institutions since we can achieve a great deal of progress through new forms of co-operation with already existing institutions. (2) New institutions should definitely not be established unless it has been proved that there is a need for them. (3) Since any new institution will divert manpower and financial resources away from existing scientific and technological activities the matter must be carefully studied to ascertain that the benefit which it is hoped will accrue from the new activities will exceed the anticipated loss in existing activities which will have to be curtailed.

III. The need for a national scientific and technological policy:

86. The need for the formulation and improvement of scientific and technological policies is determined by these policies' successful contribution towards economic, social and cultural development and also by the constraints imposed by existing methods on the application of science and technology in a manner consistent with the structural transformation and growth of society.

87. Economic and social conditions in Kuwait make it necessary for any organization concerned with the formulation of the new national scientific policy to attempt to achieve an independent development capability as one of its principal objectives. This can be achieved by: (a) The introduction of scientific and technological planning as an integral part of socio-economic planning. (b) Supporting local activities in connexion with the acquisition, dissemination and application of scientific know-how. (c) Organizing and monitoring the transfer of foreign technology and its proper integration with local science and technology.

88. In order for science and technology to make an effective contribution towards Kuwait's overall development the responsible authorities should bear the following in mind when formulating scientific policy: (1) The need for close contact with the higher national development authorities which must be responsible for the provision of advice at government level and also be linked although not subordinated to the body responsible for economic planning. (2) Monitoring technological developments (national or foreign) in Kuwait and helping the private sector to modernize its operations. (3) The need for a body to monitor the implementation of recommendations and plans concerned with science and technology. (4) The integration of its policies and plans with other policies such as the manpower development policy and the industrial, agricultural and environmental policies. (5) Ensuring a certain amount of stability in the discharge of its functions and the achievement of its long-term objectives regardless of the possible effect on these authorities of administrative changes which inevitably take place in the Government from time to time. (6) The formation of bodies to establish and maintain a firm foundation for science and technology in Kuwait while stressing the need for active participation and co-operation with the private sector. (7) The formulation of policies and the establishment of the bodies needed for the adaptation and transfer of science to other developing countries through Kuwait aid, loans and private investment.

(8) The provision of suitable financial support by the Government.

Part Seven: Recommendations

I. National recommendations:

89. On the basis of the findings of the sectoral reports and the outcome of the discussions held with the work teams the recommendations at national level can be summarized as follows:

90. The first recommendation revolves around the need to draw up a list of national economic and social objectives to be discussed with a view to evaluating each objective and subsequently defining the order of priority of these objectives in a manner consistent with national requirements.

91. The second recommendation concerns the organizational structure of the national authority responsible for co-ordinating scientific and technological policy. This subject has already been discussed in detail in the previous section.

92. The third recommendation, which appeared time and time again in the sectoral reports, deals with the question of humanitarian approach to science and technology. The importance of this concept derives from the fact that a great many achievements were made in the transfer of science and technology during the last decade and the time has now come to direct out attention towards a better utilization of science and technology for the benefit of the community. In other words the Government should concentrate not only on increasing the amount of services available but also on improving their quality.

93. The fourth recommendation is connecting with development of manpower. Many solutions have been proposed to deal with the problem of the shortage of manpower and these solutions at local, regional and international level will be reviewed in the following paragraphs.

94. There is an urgent need to construct a model for the planning of highly technically skilled manpower in Kuwait and which would define the supply and demand in each scientific profession. In the case of Kuwait it is highly possible that demand will exceed supply for many years in the future. Hence the importance of a model to serve as a planning instrument to help the Government to make

appropriate decisions to fill this gap by increasing the size of the foreign labour force, modifying the educational system in its various stages in a manner consistent with the country's technical manpower needs or by increasing the financial incentives to encourage human resources to enter the requisite field of employment.

95. Bilateral and regional co-operation: One of the principal features of successful co-operation in the field of science and technology is the establishment of close links at bilateral and regional level between experts and scientists in the developed countries and their counterparts in the developing countries. The success of these links depends to a great extent on the creation of a highly flexible administration in the scientific research units of these countries and on the extent of the desire of the researchers in these units to achieve the objectives of this co-operation.

96. These links should be organized on the basis of personal and scientific contacts among researchers rather than relying exclusively on the cumbersome technical bureaucracy and these links should be of paramount importance in all scientific and technological fields, especially chemistry, physics, biology, geology, oceanography, meteorology, agriculture, animal production, civil and electronic engineering and computer technology.

97. With regard to the prospects for international co-operation in developing skilled manpower there are a number of methods which could be used such as:

- (1) A programme of co-operation with foreign universities for the development and expansion of curricula and specialized courses at Kuwait University in a manner consistent with development needs.
- (2) For foreign universities to develop curricula and specialized courses in fields in keeping with Kuwait's needs although there may be no need for these fields in those countries.
- (3) The provision of positive incentives for graduates returning home after completion of their studies abroad to continue scientific co-operation with the universities from which they graduated so that they can keep up to date on the latest developments in their fields of specialization.
- (4) The establishment of training centres for technicians to assist in scientific research and related service fields.

98. In addition to the national recommendations referred to in this section we would like to note the following recommendations formulated during the discussions which took place at the national seminar on the role of science and technology in the development of Kuwait: (1) The extension and consolidation of local scientific and technological capabilities, especially in the field of natural resources such as oil, natural gas, fisheries' resources and solar energy, placing particular emphasis on theoretical and applied research. (2) The application of the most modern scientific and administrative methods to raise manpower productivity in various sectors. (3) The provision and development of an infrastructure and a suitable scientific climate to attract and retain Arab scientists in Kuwait. (4) The utilization of the best and most modern scientific and technological methods to ensure food security. (5) The utilization of science and technology in development and social services while, at the same time, protecting the environment. (6) The need to ensure maximum safety and security in the applications of science and technology and the importation of the necessary techniques to this effect. (7) The initiation of scientific research into the uses of nuclear energy for peaceful purposes. (8) The provision of sufficient financial resources for the implementation of the above-mentioned programmes for the application of science and technology to development.

II. Recommendations at regional and international level:

99. The establishment of regional institutes responsible for carrying out theoretical and applied research in the field of natural resources available in the region such as an institute for petroleum, solar energy, fishery resources, natural gas and environmental protection.

100. The establishment of a clear and equitable formula for international co-operation in the field of science and technology for development.

101. Emphasizing the importance of implementing the terms of the proposed new international economic order, especially those relating to science and technology.

102. The establishment, development, extension and consolidation of national bodies with research and technology in developing countries and the strengthening of their institutional and human capability in the field of international co-operation.

103. Strengthening and consolidating the scientific and technological framework in the developing countries and training the requisite national cadres to enable them to absorb appropriate modern technology and to use it for the furtherance of socio-economic development operations.

104. Giving attention to informational programmes aimed at convincing the peoples of the developing countries of the importance of improving their scientific and technological structures.

105. Making efforts for the adoption of the "international code of conduct" put forward by the United Nations Conference on Trade and Development for the regulation of dealings involving the transfer of technology.

106. The promotion and development of scientific and technological co-operation among the developing countries along the following lines: (a) An exchange of information and of the results of research on subjects and problems of common concern. (b) An exchange of local experts, scientists and technicians. (c) The compilation of a catalogue containing the names of specialists and national institutions in the field of science and technology to which reference could be made when necessary. (d) Inviting development funds in certain developing countries to set aside part of their aid and loans for scientific and technological purposes. (e) Supporting scientific and technological programmes and research in regional organizations and organizations whose membership includes developing countries. (f) Strengthening the developing countries' negotiating capability vis-a-vis transnational corporations, especially those involved in the transfer of technology.

107. The provision of assistance by the developed to the developing countries to build up and develop their national scientific and technological potential and the undertaking of research and studies on problems affecting the developing countries.

108. Inviting the United Nations, international organizations, regional commissions and specialized agencies to step up their efforts to achieve scientific and technological development in the developing countries and to place all of the expertise, information, research and studies which they have accumulated at the disposal of these countries by ensuring their publication and distribution in a regular and appropriate manner.



