STATUS OF SCIENCE AND TECHNOLOGY IN MALAYSIA

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PART I – GENERAL FEATURES

1.1 GEOPOLITICAL SETTING

Geography

1. Malaysia comprises thirteen states namely Perlis, Kedah, Kelantan, Trengganu, Pulau Pinang, Perak, Pahang, Selangor, Negeri Sembilan, Melaka, Johore, Sabah and Sarawak. It lies within the tropics between latitude $\frac{1}{2}^{\circ}$ and 7° North, extending from longitude 100° to $119\frac{1}{2}^{\circ}$ East. Peninsular Malaysia consisting of 11 states is bordered on the north by Thailand, and on the south, across the Straits of Johore by Singapore. To the west across the narrow Straits of Melaka is Sumatra and to the east is the South China Sea. The states of Sabah and Sarawak have a common border with Indonesia's Kalimantan. The capital city is Kuala Lumpur.

2. The total area of Malaysia is approximately 332,952 square kilometres with Peninsular Malaysia covering an area of 131,870 square kilometres, Sarawak 124,968 square kilometres and Sabah 76,115 square kilometres. Peninsular Malaysia extends 740 kilometres in length from the northern tip of the state of Perlis to the southern Straits of Johore, while the greatest length of Sabah and Sarawak from Tanjong Datu in Sarawak to Hog Point on Dent Peninsular in Sabah is 1207 kilometres. The maximum width on the other hand is 483 kilometres in Peninsular Malaysia (the distance between Dinding in West Perak to Tanjung Penunjuk in East Trengganu). In Sabah and Sarawak the maximum width is about 257 kilometres.

Population

3. Malaysia has a multiracial population of 13.4 million in the year 1980. Of this total about 11.1 million are in Peninsular Malaysia; 1.0 million in Sabah and 1.3 million in Sarawak. The population density is about 40 persons per square kilometre. The rate of population growth is 3% per annum. About 39% of the total population live in towns of 1,000 inhabitants or more. With the existence of good infrastructure of public roads, railways and communications there is easy access for the rural population to the urban areas.

Climate

4. Proximity to the equator has given Malaysia a climate of high humidity and uniformly high temperatures with copious rainfall. The equatorial climate is modified by the region's insularity and exposure to monsoonal wind system that originates from the Indian Ocean and South China Sea. The climate on the whole is pleasant and equable with bearable humidity. The average annual rainfall is about 250 cm but this varies from place to place.

Vegetation

5. The vegetation is tropical rainforest in a number of forms depending upon such factors as elevation, soil, moisture and drainage. These factors give rise to three general groups of forest communities. The first includes those conditioned and perhaps controlled by edaphic features. These comprises vegetation on the beaches, mangrove swamps, peat swamps, semi-swamps and riverine fringing forest, as well as forest and swamp vegetation of limestone and quartzite outcrops.

6. The second group consists of the communities of vegetation on the lowland, hill and montane regions including lowland, hill and upper dipterocarp forest, the montane oak forest and montane ericaceous communities. The first category of this second group comprises extensive forest of the plains and foothills up to a height of 305 metres dominated by immense trees. The largest of which are 46 metres to 61 metres or more in height with a circumference of 3 metres or more of large cylindrical trunks and massive crowns at the top forming an evergreen canopy. These trees yield the bulk of commercial timber. Some of these species of trees found in Malaysia's forest are meranti, keruing, kempas, merbau, kapur, jelutong and nyatoh. About 94% of total timber exported from Malaysia are from such species of timber.

Water Resources

7. Due to the abundant rainfall throughout the year the Malaysian rivers are well filled and are potential sources of energy. In Peninsular Malaysia the main mountain range lies approximately parallel to the west of the watershed from the border of Thailand to Melaka. Most of the rivers to the west of the watershed thus have comparatively short courses. Gradients in the upper reaches of the rivers are steep and these with the abundant rainfall serve as excellent sources of energy.

Fisheries

8. Malaysia's fishing potential from its 1,122,300 square kilometres of coastal waters is currently estimated at between 1,060,000 to 1,118,000 tonnes per annum. In 1981 it is recorded that there are 30,390 licensed fishing vessels and the fishing industry provides direct employment to 86,925 fishermen in Peninsular Malaysia. The fish landing has also grown from 306,686 tonnes in 1976 to 649,315 tonnes in 1981. Malaysian fishermen employ a variety of fishing techniques, ranging from efficient gear like purse seines and trawler nets to simple traditional fishing techniques. The majority of fishermen still confine their fishing activity to the shallower waters near the coast. The offshore fisheries resources has not been ascertained yet although the indicators are that the Exclusive Economic Zone (EEZ) area of some 140,000 square miles in the South China Sea and the coastal and inland aquaculture areas provide considerable scope for

development in both Peninsular Malaysia and East Malaysia. The bulk of fish landed in Malaysia is marketed in the wet form without dressing and is for local consumption. The balance is processed into products such as salted fish, dried prawns, indigenous fermented products and fish meal. Frozen seafood industry has been established in Malaysia. One of the main exports are frozen shrimp. The establishment of aquaculture projects has become increasingly important in providing the much needed protein diet for the nation. It is estimated that some 30,000 tonnes of fish are obtained annually from inland waters and aquaculture in Peninsular Malaysia.

Mineral Resources

9. The major minerals mined in Malaysia are tin, bauxite, iron ore and copper concentrates. Of lesser importance are china clay, gold, wolfram, manganese, ferro manganese, barite as well as the mineral by-products such as ilmenite, monazite, zircon and thorium.

10. Malaysia is the largest producer of tin in the world and approximately 80,500 persons are being employed in this country. Gravel pump mining accounted for about 54% of the total production and dredging 32% while other methods such as panning (dulang washing) accounted for the balance. The major tin fields are found in the states of Perak and Selangor, lying close to the western limit of the Main Range. Smaller tin fields are found in Perlis, Kedah, Negeri Sembilan, Melaka, Johore, Pahang and Trengganu. The major lode deposit being mined is at Sungei Lembing, Pahang. Off shore tin deposits are also attracting interest.

11. The most notable development in the mineral resources industry is the tremendous increase in petroleum production in Sabah and Sarawak. Prospects for the petroleum appears to be very encouraging as several oil companies have committed sizeable funds for oil exploration activities off the coast of Sabah and Sarawak. Similar explorations off the East Coast of Peninsular Malaysia has also been started.

12. Another promising mineral in production is copper. The Mamut Copper Mine in Sabah commenced production in May, 1975.

Energy

13. Malaysia has energy resources in the form of oil, gas, coal and hydropower. At the present level of production, the oil reserve is expected to last for 20 years while natural gas will last for 50 years. The coal reserve which is of low quality has not been exploited. Malaysia consumed 200,000 b/d in 1982. Oil supplies 93% of Malaysia's energy needs while hydropower supplies only 3% of the current total needs. However Malaysia is exploiting only 10% of her hydropower capacity which can produce about 6000 megawatt if fully implemented. Malaysia produced about 300,000 b/d and exported about 170,000 b/d in 1982. Natural gas is expected to be increasingly used in substitute for oil and provide power for the country's industrialisation programme.

Transport

14. The main trunk road in Malaysia runs from the border of Thailand in the north to Singapore in the south. Another main road links the west to the east coast of Peninsular

Malaysia. A new east-west highway project linking Kota Bahru in east Peninsular Malaysia to Pulau Pinang in the west is completed and is expected to facilitate more effective and efficient communication across the northern part of Peninsular Malaysia. In Sabah and Sarawak there is an estimated 4,500 kilometres of metalled-surfaced road of which 2,834 kilometres are in Sabah and 1,666 kilometres in Sarawak. The basic infrastructure consists of roads providing linkage between major population centres along the coast. In Sarawak the major trunk road links the town of Kuching and Sibu.

15. The Malayan Railway comprises approximately 2,155 track kilometres of railway track of which 1,666 is route kilometres. The main railway line links Kuala Lumpur, the capital of Malaysia to the Republic of Singapore in the south (398 kilometres). It also serves the Port of Singapore and Jurong. From Kuala Lumpur the railway runs north to Butterworth and Prai at a distance of about 393 kilometres. Butterworth and Prai are ports on the mainland opposite the island of Pulau Pinang and the railway serves the wharves and port facilities there. To the east there is a branch of the railway line running from Gemas which is 178 kilometres from Kuala Lumpur towards the east coast town of Tumpat which is 528 kilometres away. There are also three other branch lines from the main line which connect the three ports of Port Kelang, Port Dickson and Telok Anson.

16. There are three main ports in Peninsular Malaysia. Pulau Pinang is located in the north, Port Kelang is centrally located and Johore Port located at the southern tip of the peninsular, northwest of Singapore island. Another port which is located on the east coast, called the Kuantan Port has been completed but has yet to be commissioned.

17. Kuala Lumpur International Airport and the expanding Pulau Pinang Airport are gateways for travellers on international flights. At present 20 international airlines operate through Kuala Lumpur providing connections to various points in the world. Most towns have their own domestic airports which are linked to the federal Capital.

Federal Government

18. The Malaysian Parliamentary system consists of the Head of State, the Yang Di Pertuan Agong and two Houses of Parliament, known as the Senate (Dewan Negara) and the House of Representatives (Dewan Rakyat).

19. The Yang Di Pertuan Agong is elected to hold office for a period of five years among the nine hereditary Malay Rulers of the nine states; Perlis, Kedah, Kelantan, Trengganu, Perak, Selangor, Pahang, Negeri Sembilan and Johore. The Timbalan Yang Di Pertuan Agong (Deputy Supreme Head of State) is also elected in a similar manner. The Senate consists of 58 members of whom 2 are elected by Legislative Assembly of each state and 32 are appointed by the Yang Di Pertuan Agong. The term of office of the members of the Senate is six years and is not affected by the dissolution of Parliament. The House of Representatives consists of 154 members of which 114 are from Peninsular Malaysia and 16 from Sabah and 24 from Sarawak. Members from Peninsular Malaysia are directly elected by the people. Those from Sabah and Sarawak are elected indirectly by Legislative Assemblies of the states though ultimately they will also be directly elected. The maximum term in the House of Representatives is 5 years. The

legislative process in passing of bills have to be passed by both Houses and assented by the Yang Di Pertuan Agong.

20. The Yang Di Pertuan Agong appoints as Prime Minister a member from the House of Representatives, who, in his judgement, is likely to command the confidence of the majority of the members of this house. On the advice of the Prime Minister, he also appoints other Ministers from among the other members of either House of Parliament. Every member of the cabinet has the right to take part in the proceedings of either House of Parliament but may not vote in the House of which he is not a member.

State Governments

21. Each state has its own constitution which must be compatible with the constitution of the Federal Government. The constitutions of all the states are similar except in Sabah and Sarawak. There are certain differences in the nomenclature of these two states and these are mentioned in the articles of their constitutions.

22. There is a Head of State in each state. In nine of the states of Malaysia, the Head of State is a Malay Ruler. In the other states the Head of State is appointed by the Yang Di Pertuan Agong and is known as Yang Di Pertua Negeri.

23. The executive authority in a state is vested in the Head of State and he is advised by an Executive Council (Cabimet in Sabah and Supreme Council in Sarawak) in the exercise of his functions. The Executive Council is headed by a Chief Minister (Menteri Besar) who is also a member of the State Legislative Assembly and who is likely also to command the confidence of the majority of the members of the Assembly.

1.2 ECONOMIC SETTING

24. Malaysia showed an impressive economic growth since its formation in 1963. For the last ten years from 1971 to 1980, the Malaysian economy recorded a growth rate of 7.8% per annum. This resulted in the increase in per capita Gross National Product (GNP) from M\$3,200 in 1979 to M\$3,600 in 1980. This also resulted in a decline in the unemployment rate from 7.8% in 1979 to only 5.3% in 1980.

25. This overall growth resulted in major structural changes of the various sectors in the economy. Basically the four main sectors that contributed to the GNP are the agriculture sector, the mining sector, manufacturing sector and services sector. The relatively faster rates of growth of the non-agricultural sectors led to a decline in the share of the agricultural sector in total GDP from 30.8% in 1970 to 22.2% in 1980. Its contribution to total export earnings in that same year is 44%. A major part of this export earnings are from rubber which formed 16.6%, palm oil 9.3%, sawn logs 9.2% and sawn timber 4.8%. The remaining 5.1% comprises earning from palm kernel oil, fish, pepper, coconut oil, cocoa and others. In terms of employment, this sector accounts for 40.6% of total employment.

26. The mining sector is another important sector in the economy, even though its contributions towards the total GDP has been declining lately. However during the last decade there are significant developments in this sector due to the emergence of

petroleum as a major export commodity. The increase in crude oil production coupled with rising prices has pushed up the share of crude oil in this sector. Output increased from 29% in 1970 to about 63% in 1980.

27. The manufacturing sector is the leading sector in the economy. It provides the main stimulus to modern sectorial growth which plays an important role in the achievement of the two-pronged objective of the New Economic Policy (NEP) as elaborated in para 36. The overall manufacturing output has been growing at a rate of 12.5% annually during 1979 to 1980. Exports of manufactured goods in 1980 amounts to M\$5,935 million or 21.1% of the total export earnings. The most important manufacturing industry, the electrical machinery and appliances industry contributed 47.0% of the total export earnings of this sector in the year 1980. In addition to this, the resource based industries and intermediate goods industries have grown in importance.

28. The nature of the imported goods in Malaysia indicated the emphasis given to developing the manufacturing industry and modernising the agriculture sector. In 1980, for instance, 27.6% of the total imports are of intermediate goods while 10.3% are of machineries. However looking at classification by end use, intermediate goods form the bulk of the Malaysian overall imports, while in 1980 it formed 48.2% compared to 30.5% for investment goods and 19.6% for consumption goods. About 70% of our total imports are from Japan, the United States, the European Economic Community (EEC) and the Association of South East Asian Nations (ASEAN).

29. A good export performance, in terms of volume as well as prices during the 1971 to 1980 period resulted in a trade surplus of M\$26,042 million. This however was offset by the deficit in the services account mainly due to the repatriation of investment income and also due to the increase in freight and insurance charges. With the maintenance of this favourable investment climate in Malaysia, there is an increasing inflow of foreign investment resulting in an overall balance of M\$3 million and an accumulation of external reserves of M\$10,304 million at the end of 1980.

1.3 DEVELOPMENT SCENE

30. Political stability is an essential ingredient for the continual growth of Malaysian economy. This stability provides the necessary foundation for acceleration of investment and economic activities. In addition to this the Malaysian government is committed to maintain a favourable investment climate to encourage local and foreign investment that are consistent with the national objectives. Presently, private sector investment accounts for about 60% of total investment in the economy. In addition to this, institutional information network and forums have been established to provide the necessary feedback information from the people so that they can participate in the national development process. There is also strong cooperation between the public and the private sectors and frequent consultations are held with the private sector on matters affecting private sector investments. The government, in addition to expanding the productive capacity of the economy has also placed considerable emphasis on improving the general well-being and quality of life of the people such as the improvement of the environment, providing better housing facilities to the low-income earners as well as improvement in the health and educational facilities.

31. The achievement of the objectives of the NEP is expected to come through the rapid growth of the economy. Investment especially from the private sector is encouraged through fiscal and monetary policies, improved infrastructural facilities and various administrative measures.

32. Development efforts in Malaysia also includes social development geared towards the improvement of the quality of life of the people. During the implementation of the Fourth Malaysia Plan Period, about 16.2% of the Federal Development Expenditure will be spent on the improvement and development of education, health, cultural and social programmes.

33. The success of the development efforts outlined above depends on how well the country can implement the plans and reduce the effect of recessionary tendencies in the major industrial countries. One of the several factors that will give rise to implementation problems will be the lack of trained manpower especially in science and technology. Furthermore, the uncertainty in the world economy has resulted in fluctuating commodity prices and protectional attitudes of the western market. These, together with the worsening of the inflationary situation will be among the problems faced by the country in achieving the two-pronged objective of the New Economic Policy.

PART II – SCIENCE AND TECHNOLOGY POLICY FRAMEWORK

2.1 DEVELOPMENT POLICY FRAMEWORK

34. Malaysia's socio-economic development is based on the NEP. The overriding objective of the NEP, adopted in 1971 is to achieve national unity through a two-pronged development strategy of:

- (i) reducing and eventually eradicating poverty by increasing the level of income and employment opportunities for all Malaysians irrespective of race;
- (ii) accelerating the process of restructuring society to correct economic imbalances so as to reduce and eventually eliminate the identification of race with economic functions.

35. The NEP represents a new approach in dealing with the economic and social problems through emphasising the importance of achieving a better distribution of income, wealth and employment among the various ethnic groups and regions in the country within the context of an expanding economy. In 1970, about 49.3% of the households were poor. The incidence of poverty was higher in the rural areas and the problem was predominantly that of the Malays and other indigenous people. Also, there were wide imbalances in the income among the races, mainly due to differences in degree of participation in the productive sectors of the economy and in the employment and ownership of assets.

36. The thrust of development policy in Malaysia, that underlines all development plans is to narrow the socio-economic differences so that the benefits of development are shared equitably by all groups in society and through this process attain national

unity. In the attainment of the NEP, a major role is expected from the private sector, and investment by the sector, consistent with the national goals, is given encouragement through appropriate fiscal and monetary policies.

37. The NEP objectives are to be achieved within a span of two decades i.e. 1971–1990 and for this purpose an Outline Perspective Plan (OPP) was formulated. The period 1981–1990 constitute the second decade in the implementation of the NEP. The long-term target of the OPP are as follows:

- (i) a rate of growth of the economy in real terms at least by 8% per annum to enable the achievement of the various socio-economic objectives, with a growth rate of 12% per annum for the manufacturing sector;
- (ii) full employment of the labour force, through the generation of 1.9 million jobs by 1990;
- (iii) reduction in the incidence of poverty of 15% of total households by 1990;
- (iv) the employment in the various sectors of the economy and at all occupational levels should reflect composition of the country by 1990; and
- (v) pattern of ownership of share capital in the corporate sector should be restructured such that by 1990, Malaysians own and manage 70% with Malays and other indigenous people own and operate at least 30%, and foreigners 30%.

38. During the first decade of implementation of the NEP, major progress was made in the attack on poverty. Overall, the incidence of poverty declined from 49.3% of total households in 1970 to 29.2% in 1980. Progress was also made in restructuring the pattern of ownership of equity and in the development of the less developed states of the country.

39. In order to ensure that the policies and programmes for the second decade 1981–90 will be successfully carried out, planning and implementation capacities will be enhanced and further initiatives taken to organise the machinery of the Government to deal with the challenges ahead. The need for effective organisation of the development effort has become more critical in the light of the less favourable outlook of the world economic situation, the need to ensure the attainment of the targets of the NEP, the challenges posed by advances in science and technology and the need to fully harness the nation's manpower resources for full participation in the development process.

40. The machinery for the planning evaluation and coordination of development efforts is shown in the chart. The Economic Planning Unit (EPU) of the Prime Minister's Department serves as secretariat to the National Development Planning Committee (NDPC) which has the overall responsibility for planning and development matters. The NDPC consists of heads of all major Ministries dealing with development and is chaired by the Chief Secretary to the Government. The NDPC in turn reports to the National Economic Council (NEC) – a committee of senior cabinet ministers under the chairmanship of the Prime Minister. EPU coordinates the presentation of issues and policies for the consideration of the NDPC and NEC. This process, whereby fundamental issues are fully considered at the highest levels of Government, ensures that Malaysia's development policies and programmes meet the needs of the people in terms of the underlying concept

and strategy of the development plan. At the state level, the State Economic Planning Units and State Development Offices are responsible for formulating state development strategies and coordinating the preparation of state development projects and programmes. In addition planning cells have been established in Ministries and Departments to plan the departmental programmes and policies.

41. Implementation is the responsibility of executive Ministries, Departments and agencies at the Federal, State and regional levels. To ensure the effective implementation at the national and inter-departmental levels, the Implementation and Coordination Unit (ICU) was established under the Prime Minister's Department. The ICU serves as a secretariat to the National Action Council which is chaired by the Prime Minister and serves as a forum to resolve implementation bottlenecks as well as to ensure that implementation of projects meets with the national objectives.

2.2 SCIENCE AND TECHNOLOGY AND THE ROLE OF DEVELOPMENT POLICY

42. Social and economic development through the application of science and technology is one of the concepts enshrined in the National Ideology called the Rukun Negara. This Ideology is used by the Government of Malaysia as a guide for most policies relating to social and economic development. It is also within the context of the New Economic Policy that science and technology should be harnessed for the development of the country.

43. Although science and technology is important for development of the nation, socio-economic development must be consistent with scientific and technological development. During the last decade, emphasis was given to the development and transfer of appropriate technology covering the major areas of activity involving agriculture, mining, manufacturing, energy, medical and health infrastructure. In this case, appropriate technology means technology that utilise natural resources, use of local skills, in line with the current energy situation and also help to promote exports. Therefore, any application of science and technology should be geared towards the achievement of socio-economic goals set out in the national development. To this end, technology transfer is being promoted to accelerate rural development in view of the fact that this sector comprises the bulk of the poor people. However, there are several factors that must be considered when adopting foreign technology for local consumption. It is relevant to review and analyse the appropriate scale of the technology needed, the cost, the complexity of operation and maintenance and also to see that this technology does not aggravate any existing problems of unemployment or under-employment, under-utilisation of equipment or give rise to pollution of our environment.

44. The efforts of many years of applying science and technology for research purposes have contributed towards making Malaysia a leading producer of rubber, palm oil and pepper. Production of these commodities improved both in quality as well as quantity due to the development of a variety of seeds and clones that gave a high yield per acre. Research through the use of Science and Technology also contributed to the various breakthroughs in the processing of both rubber and palm oil. These improvements in processing led to the production of a superior grade of processed rubber known as the Standard Malaysian Rubber (SMR). Research efforts are also focussed towards the

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reutilisation of waste products from palm oil and rubber effluents. Concentrated research efforts are also geared towards rice cultivation, resulting in the near self-sufficiency in rice production. Through the application of science and technology in the agricultural sector, better and increasing production are being realised, and this leads to an increase in income thereby promoting rural development thus contributing towards the achievement of the New Economic Policy.

45. In the manufacturing sector, development in science and technology is aimed at the greater utilisation and reprocessing of natural resources to stimulate the production of manufactured and intermediate goods. Application of science and technology in the mining sector is aimed at reducing the operating costs to enable the economical exploitation of the deposits.

46. The growing trend in the Malaysian economy is the encouragement of the application of science and technology to the furtherance of establishing resource based and agro based industries in the manufacturing sector which makes extensive use of local resources. To meet with the increasing demand for energy in the expanding manufacturing sector concerted efforts are being made to exploit locally available sources of energy such as the building of hydro electric power stations and mini hydros, waterworks and natural gases. Research and development is also underway to seek out and harness cheaper alternative sources of energy such as solar energy, biogas and nuclear energy.

47. Studies are constantly being conducted in the field of medical science, health and family planning programmes contributed to the improved health standards of the people.

48. Research efforts on various fields and subjects are being carried out by both the public and the private sectors in the country. Research institutes established by the Malaysian Government such as the Malaysian Agricultural Research and Development Institute (MARDI), Rubber Research Institute Malaysia (RRIM), Palm Oil Research Institute of Malaysia (PORIM), Forest Research Institute, Mines Research Institute, Institute of Medical Research (IMR) are a few of the research institutes that contributed greatly to the implementation and achievement of the national policies and objectives on the advancement of science and technology for development.

49. Apart from these institutes, the Standards and Industrial Research Institute of Malaysia was also established to undertake research in the transfer of appropriate technology and to ensure acceptable standards of the manufactured goods are produced. The Tun Dr. Ismail Atomic Research Centre (PUSPATI) was established in 1975 and is to undertake training and research in the application of nuclear technology for agriculture, industry and medicine.

50. Besides sources of information from internal research and studies conducted, Malaysia also has close liaison with various international scientific organisations and is actively involved in international agencies, thus gaining from the exchange and dissemination of information on research projects undertaken by the developed countries.

51. The realisation of the importance of the role played by science and technology in development process has led to a review of the educational policies of the country.

Greater emphasis is being placed to educate and train capable personnel to cater for the increasing demand for scientists and technicians. Opportunities are being increased in institutions of higher learning by expanding existing facilities. Intake into science courses in the various universities and colleges are being expanded to achieve a target of 60% science graduates.

2.3 POLICY MAKING MACHINERY FOR SCIENCE AND TECHNOLOGY

52. The Ministry of Science, Technology and the Environment has been given the role for the planning, coordination and development of all activities related to science and technology. It is also entrusted with the design and development of National Science and Technology policies. It is assisted in this task by the National Council for Scientific Research and Development and the Coordinating Council for Industrial Technology Transfer. In addition the various research and development institutions have their own respective councils that provide direction on policies.

53. Essentially the objectives of the Ministry are:—

- i. To develop and to promote the expansion of science and technology with the aim of improving the quality of life.
- ii. To formulate research plans and determine that the extensive application of science and technology does not give rise to adverse effects so as to sustain a prosperous and peaceful nation.
- iii. To ensure that material development through science and technology does not pollute the environment and destroy wild life and plants.
- iv. To integrate physical development through science and technology with human and individual development in order to reduce undesirable conflicts and stress that may arise from environmental and technological changes.

54. Implementation of the national science and technological policies and objectives are carried out by various institutions and departments which are directly under the charge of the Ministry of Science, Technology and the Environment. These departments or institutions are:—

i. Environment Division

The activities of the division is governed by the Environmental Quality Act of 1974. Its main function is to ensure that the economic and industrial progress of the nation would not be pursued at the expense of the environment. Among its main activities are research and monitoring activities on discharge of waste, survey and investigation activities into the causes and remedies for air pollution, setting up of standards and criteria for the maintenance of the quality of the environment and also to enforce the provisions in the Environmental Quality Act of 1974.

ii. Tun Dr. Ismail Atomic Research Centre (PUSPATI)*

PUSPATI was established in 1972 as an atomic research centre. The main objective of this centre is to introduce and extend the application of nuclear science and

* PUSPATI was transferred to the Prime Minister's Department on the 16th June 1983.

technology in a peaceful manner in the various fields such as medical, agriculture, industrial and other fields in the efforts of national development, apart from ensuring that public security and environmental cleanliness is not impeded by the use of this new technology.

iii. Standards and Industrial Research Institute of Malaysia (SIRIM)

To improve the status of local industries and to expand technological development through industrial research development standards and transfer of technology in line with the New Economic Policy.

iv. Chemistry Department

To provide analytical, investigatory and advisory services to all Government Agencies, Municipalities and Statutory Bodies.

v. Department of Wildlife and National Parks

This department is given the responsibility to safeguard and preserve the wild life of the country so that extinction due to hunting and environmental changes does not occur. This department administers the Wildlife Conservation and National Park Act of 1976/1972 and also the National Park Act of 1980. Among its main activities are the enforcement of the above acts, the management of Wildlife and National Park.

2.4 NATIONAL COUNCIL FOR SCIENTIFIC RESEARCH AND DEVELOPMENT

55. The National Council for Scientific Research and Development (NCSRD) was established in 1975 with the primary objective of monitoring, evaluating and coordinating scientific and research development in support of national development. The NCSRD will advise the Government on all scientific and technological matters.

56. The Council also has the responsibility of ensuring maximisation of utilization of resources such as manpower and physical facilities. The Council also provides linkages between research and scientific institutions within and outside the country.

57. The membership of the Council is drawn from senior scientists of various disciplines. The Chairman of the Council is the Chief Secretary to the Government of Malaysia.

58. The Council has established four main Committees to provide coverage of scientific and technological development viz:

- i. Agricultural Sciences Committee
- ii. Industrial Sciences and Technology Committee
- iii. Marine Sciences Committee
- iv. Medical Sciences Committee

In addition, the evaluation of Socio-Economic aspects of the above activities are also incorporated so as to ensure a balanced approach to contribution of science and technology in national development.

59. The Government has also established a Trust Fund to finance scientific research in areas that are not already covered by existing research programmes and that have serious implications and usefulness to the country.

2.5 NATIONAL INSTITUTIONS ESTABLISHED TO PROVIDE SERVICES RELATED TO TECHNOLOGICAL TRANSFER

60. In 1977, the Coordinating Council for Industrial Technology Transfer was formed with the main intention of accelerating industrialization and coordinating various agencies which has been entrusted to perform activities relating to technology transfer.

61. Membership in the Council includes representation from both public and private sectors. The government departments and private agencies involved are the Ministry of Trade and Industry, Ministry of Science, Technology and the Environment, Economic Planning Unit of the Prime Minister's Department, Malaysian Industrial Development Authority (MIDA), National Productivity Centre (NPC), National Council for Scientific Research and Development (NCSRD), Malaysian Industrial Development Finance (MIDF), Malaysian Industrial Development, Finance and Industrial Consultants (MIDFIC), Federation of Malaysian Manufacturers (FMM) and Standards and Industrial Research Institute of Malaysia (SIRIM).

62. The main task of this Council is to identify the priority sectors for development and to formulate technology transfer plans and policies as well as to monitor the technology developments of the country in order to ensure a more effective growth of industrial and economic development of the country. It carries out public relation activities, coordinating and harmonizing relationship between the donor and recipients involved in the transfer of technology. It also cooperates with comparable organisations in other countries in the furtherance of technology transfer.

63. In addition, a technology information centre has been established at SIRIM for storing technical information on computer.

2.6 ROLE OF NON-GOVERNMENT AND SEMI-GOVERNMENT BODIES IN POLICY MAKING

64. Non-government and semi-government establishments and organisations especially universities, research institutions and professional bodies play a very important role in the innovations of science and technology. The universities have their own research budgets apart from grants from various sources to promote and undertake research in science and technology. Research conducted by the private sector are mostly on the agricultural sciences. R & D institutions are advised by the appropriate scientific committees in the respective organisations.

65. There are at least forty two scientific societies in Malaysia for the promotion of the various professional disciplines. The recent establishment of COSTAM (Confederation of Scientific and Technological Association in Malaysia) an umbrella organisation covering the major scientific and technological associations in the country is to represent the different scientific societies. A Malaysian Professional Centre was also established

in 1973 to represent the various scientific and technological associations. Efforts to establish a National Academy of Sciences are being made to increase the participation of scientists in national scientific and technological development.

PART 3 – SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

3.1 INSTITUTIONAL NETWORK

66. In Malaysia, most of the institutions active in science and technology activities are the government agencies such as the Malaysian Agricultural Research and Development Institute (MARDI), Rubber Research Institute Malaysia (RRIM), Palm Oil Research Institute of Malaysia (PORIM), Forest Research Institute (FRI), Mines Research Institute of Malaysia, Institute of Medical Research (IMR), Tun Dr. Ismail Atomic Research Centre (PUSPATI) and institutions of higher learning. The private sector has also undertaken a considerable amount of research activities. The major institutions performing scientific and technological activities are described as follows:

Institute of Medical Research (IMR)

67. The Institute of Medical Research was established in 1900 and is primarily entrusted with the task of carrying out research on the causes, treatment and prevention of beriberi and all forms of Malaria fever.

68. In a span of eighty years this institute has become the main Medical Research Institute in the country and is presently conducting research on over a hundred projects per year.

69. Its main activities involves research, training, vaccine production and referral diagnostic laboratory services. The main thrust of IMR research is directed at:

- i. Investigating rural health problems
- ii. Research into the causes and treatment of insect borne diseases especially dengue, scrub typhus, leptospirosis, parasitology chemotherapy, malaria and especially filarasis.
- iii. Community nutritional status; nutritional biochemistry and nutritional disorders.
- iv. Abnormal haemoglobinopathies, G⁶PD deficiency and genetic disorders.
- v. The newer biochemical and radiochemical methodologies in relation to hormone disorders, chemical enzymology and toxicology.

70. International collaboration has been fostered since 1960 with various organisations such as Hooper Foundation of California in the studies of parasitic diseases, study of genetic factors in blood disorders and research in social, cultural and behavioural factors affecting health. IMR is also a regional centre for research and training in Tropical Diseases being:—

- i. WHO Centre for Research – Training in Tropical Diseases and Nutrition for Western Pacific Region

- ii. WHO Secretariat for inter-regional Malaria Training Programme for Asia
- iii. South-East Asia Ministers of Education Organisation's Tropical Medicine & Public Health Project (SEAMED-TROPMED) Centre for post-graduate training for research scientists in Applied Parasitology, Entomology and Medical Microbiology.
- iv. The frequency, distribution, etiology and epidemiology of Malaysian cancers with particular reference to oral and cervical cancer.

71. Among the most recent achievements of this institute was the setting up of a snake farm in Kangar, Perlis for the production of and research into antivenom specifically for cobra, pit viper and seasnake bites.

Standard and Industrial Research Institute of Malaysia (SIRIM)

72. SIRIM was established as a Federal Statutory Body in 1975 under the SIRIM Act of 1975 which is administered by the Ministry of Science, Technology and the Environment. It is governed by a 24 member council and assisted by 3 committees namely; The Executive Committee, The Standards Committee and The Research Committee.

73. The essential role of this institute is:—

- i. To promote and conduct industrial research with the aim of improving procedures and processes, innovate procedures for new processes and techniques, promote the consumption of Malaysian products and using and adapting foreign technologies;
- ii. To promote, develop and promulgate standards for commerce and industry and for goods produced in or imported into Malaysia by:
 - (a) conducting test on products and encouraging the various industries to set up their own quality control;
 - (b) giving certifications for the control of quality;
- iii. To promote industrial efficiency and development;
- iv. To promote public and industrial welfare, health and safety;
- v. To promote industrial extension in meeting standards; and
- vi. To improve production processes and techniques.

74. The main activities of SIRIM can be classified into the following categories:—

- i. **Industrial Research:** Activities included are research and development, engineering research, scientific analysis, industrial design and fabrication.
- ii. **Standards and Establishment of Standards:** This involves development of standards, uses and implementation of standards and determination of quality and also metrology.
- iii. **Industrial Consultancy Services:** This activity involves industrial consultation and guidance, industrial relation, technical clarification and technical publication.

Greater emphasis has been given to the Metal Industry Research and Development proposed and associated activities such as Metal Technology and Foundry Technology. R & D activities has in the past been geared mainly to the development of the Small Scale Industries.

75. The annual budget for SIRIM in 1981 is M\$34.6 million of which M\$8 million is to be spent on equipment for the laboratory. New projects implemented include the setting up of Metal Industry Technology Centre and Metal Industry Research and Development Centre. These two centres are set up to improve metal technologies of the country.

76. Branches of SIRIM has been set up in Kota Kinabalu, Sarawak, Kuala Trengganu, Kota Bharu, Alor Setar, Seberang Prai and Johore Bahru to provide consultation and testing facilities. These branch laboratories will be able to provide engineering testing and chemical analysis facilities.

Malaysian Agricultural Research and Development Institute (MARDI)

77. The Malaysian Agricultural Research and Development Institute (MARDI) was established by the MARDI Act which was passed by Parliament on 14th February, 1969. This research institute which is under the Ministry of Agriculture is governed by a Governing Board and the Scientific Council. Up to date MARDI has established Research Stations located in different parts of Peninsular Malaysia covering 6,810 hectares of land.

78. The overall objective of MARDI is generally to intensify its research activities according to research priorities identified and to develop new technologies which can be easily adapted by farmers thereby increasing their income in consonance with government's New Economic Policy of eliminating poverty.

79. The activities of MARDI include the research in food production, processing and preservation, the maximum utilisation of agricultural products and the reduction of wastage in food and non-food production from processing to handling and transportation. It also acts as an information centre by publishing and distributing information on research to agencies, farmer's associations and relevant agencies.

80. Some of the achievements of MARDI are in research into high yielding varieties of rice such as SRI Malaysia I and II and shorter maturing varieties such as MR 7 and MR 10. Significant progress has also been achieved in the development of vegetative method of propagation of cocoa. Under its livestock programmes the main thrust was towards improving the supply of foodstuffs and studies on spawning and rearing techniques in the breeding and reproduction of fresh water fish.

Rubber Research Institute Malaysia (RRIM)

81. The RRIM was established on 29th of June, 1925. It is primarily concerned with research into all aspects of natural rubber cultivation and latex production, the development of new forms of rubber and consumption as well as technological and end-uses research in the processing and manufacture of natural rubber products. It also extends its advisory and information services to all sectors of the industry.

82. In 1972, several natural rubber bills were passed to streamline the activities of various natural rubber bodies in the country. These bills enable the RRIM to encompass natural rubber research for the whole of Malaysia inclusive of Sabah and Sarawak. It also enables the institute to conduct end-use research and development of new rubber to complement its main focus on production research. Apart from these research, RRIM also carries on adaptive research on strategic and selected smallholders problems.

83. In anticipation of higher demand for natural rubber in the next decade, RRIM will emphasize the implementation of the Dynamic Production Policy of Natural Rubber. Efforts will be aimed towards increasing productivity through agronomic practices and labour utilization, optimum use of fertilizers and effective disease control. It will intensify the use of natural rubber through development of new forms of rubber and promote the growth of the rubber-based manufacturing industry.

Chemistry Department

84. The Chemistry Department and its seven branches throughout the country is directly under the administration of the Ministry of Science, Technology and the Environment. Its functions include providing analytical, investigatory and advisory services to several government agencies. Among the major agencies to which these services are provided are the Ministries of Health, Defence, Trade and Industry and departments like the Royal Malaysian Police and Royal Malaysian Customs and Excise, National Narcotics Bureau, National Bureau of Investigation, Stores and Contracts Division of the Treasury, Public Works Department and the Environment Division of the Ministry of Science, Technology and the Environment. Most of the services provided are to enable the due enforcement of legislation such as the Sale of Food and Drugs Ordinance 1952, Poisons Ordinance 1952, Customs Ordinance 1967, Excise Act 1961, Criminal Procedure Code, Explosives Ordinance 1957, Dangerous Drugs Act 1952, Environmental Quality Act 1974, Trade Description Act 1977 and Petroleum Ordinance 1949.

85. This department also provides services to ensure that the supply of materials is in accordance with specifications such as food and uniform materials for the army, police, prisons, hospitals etc.

86. It also ensures that the country's public water supplies are adequately treated as to be potable and do not contain microorganisms capable of transmitting water borne diseases such as dysentery, cholera and typhoid.

Forest Research Institute

87. The Forest Research Institute which is an agency of the Ministry of Primary Industries was established to be solely responsible for the planning and implementing forest conservation and utilisation schemes. This institute undertakes research into the feasibility of implementing reforestation schemes in areas where natural resource is depleted. It also conducts research into the viability of large scale agro-forestry farming in those areas with new species of trees that will ensure a continuous supply of raw materials for pulp and paper processing.

88. This institute is also closely monitoring the effects of forest utilisation on the stability and quality of the surrounding environment.

89. Forest Research is mainly focused on the development of forest regeneration techniques and timber utilization. Considerable efforts are being made towards silviculture of regenerated forest and forest hydrology. Progress has been made in determining preservation and seasoning schedules of various local timber species, pulping properties of certain species, wider utilization of quick growing species and rubber wood and working properties of locally grown teak wood.

Mines Research Institute

90. The Mines Research Institute which is placed under the Ministry of Primary Industries was established with the objective to carry out research and investigations into the various aspects of mining and mineral processing such as looking into the problems of mining capacity, mining technology and mineral processing. This institute has the facility of a geotechnic laboratory which carries out research on problems relating to mine safety. It will also establish a Mining Technology Testing Centre to undertake various tests on modern techniques of tin mining to ensure high productivity. A programme for manpower training in mineral resource industries will also be initiated by this institute.

Other Research Institutions

Palm Oil Research Institute of Malaysia (PORIM)

91. PORIM was established as a Statutory Body on 15th May 1979. The activities of PORIM are research into the expanding uses of palm oil, formulating new uses, improving agronomic practices and minimizing cost of operation. Priority will be accorded to biological as well as technical research aimed at increasing the proportion and performance of palm oil in edible and non-edible use. In addition, techno-economic studies will be carried out on palm oil and other oils and fats. Research on effluent treatment and disposal will also be undertaken.

92. Other major government research agencies includes the Veterinary Research Institute, the Fisheries Research Institute, Tun Dr. Ismail Atomic Research Institute and Defence Research Institute.

93. The main activities of the Veterinary Research Institute are diagnostic activities and the production of vaccines for specific animal diseases. From 1971–80 the Institute has established six regional diagnostic laboratories which provide a much improved veterinary health coverage to farmers in the prevention of disease outbreaks.

94. The Fisheries Research Institute under the Ministry of Agriculture is responsible for carrying out surveys on demersal and pelagic fish resources and conducting research to improve the techniques of fishing. Several studies were carried out on biological aspects of marine fishes. More financial allocations of research funds were given to this institute to develop aquaculture in brackish water and also inland aquaculture and cage of pen culture to supplement sources of protein and create employment opportunities for the rural people.

95. The Pusat Penyelidikan Atom Tun Dr. Ismail (PUSPATI) or the Tun Dr. Ismail Atomic Research Centre was established in 1975 with the main aim of providing training and research and also to produce isotopes to supply to hospitals, research institutions and industrial organisations.

96. The Defence Research Centre is responsible for carrying out research activities on defence requirements of the country such as the supply, storage and usage of defence equipment.

97. Apart from government research institutions and departments, academic institutions also have their own research capabilities. There are five universities in Malaysia. The University of Malaya established in 1949 in Singapore but later was transferred to Kuala Lumpur in 1959, the University of Science Malaysia, University of Agriculture, University of Technology and the National University. The University of Malaya provides courses in economics, engineering, dentistry, medicine, arts, social science and law. The university of Science, on the other hand, emphasizes on pure science, applied science, pharmacy, housing, building and planning and other related areas. University of Agriculture provides courses in agriculture, forestry technology, social science and human studies. University of Technology offers courses in engineering and technology and the National University provides courses in business, management, economics, medicine and others. Universities in Malaysia are entirely financed by government funds and are administered by the Ministry of Education.

98. Private organisations as well as multinational companies also make contributions to the research efforts in science and technology though they are motivated by profit. Some of the active agencies are Harrisons and Crosfield Research and Advisory Services, Dunlop Research Centre, and ICI (Malaysia) Limited Company. These centres deal mainly in agriculture research.

3.2 HUMAN RESOURCES

99. In response to employment creation and demand trends over the past decade, emphasis has been placed on the expansion of the supply of manpower in the science and technical fields in Malaysia. Such a trend is expected to be intensified in the present decade with expected accelerated growth of the industrial sectors and the trend towards modernization of the primary sectors.

Enrolment Trends

100. The proportion of students enrolled in the arts courses at the University level has declined from 63.5% in 1970 to 47.8% in 1980, while science and technical courses has increased from 36.5% to 52.2% between 1979 to 1980. This has resulted in the increase of output of science and technological qualified personnel from 35% in 1970 to 39% in 1980. Early in the decade of 70's saw the rapid development of a Science University in Pulau Pinang which now has total enrolment of 7,500 students, distributed among pharmacy, science, social science, humanities and computer science courses. The College of Agriculture was upgraded to an Agriculture University and the Technical College was upgraded to the University of Technology.

3.3 FINANCIAL RESOURCES

101. Without the benefit of a careful research on the subject, it is difficult to assess Malaysia's current and annual commitment of R & D. However it is estimated that the total expenditure for R & D in 1982 is approximately 0.64% of the GNP. The current

R & D expenditures are mainly financed by the government, by way of annual budgetary grants to the various research bodies. The various R & D projects undertaken by the private sector institutions, especially in the plantation sector and also products research undertaken by large industrial and commercial firms constitute a small proportion of the total R & D. One other important area in which the government indirectly finances research is in the form of contribution to organizations linked to primary commodity research for example, tin.

3.4 SURVEYING OF THE SCIENTIFIC AND TECHNOLOGICAL POTENTIAL

102. The National Council for Scientific Research and Development (NCSRD) in the Ministry of Science, Technology and the Environment is responsible for the collection and dissemination of data and information on national science and technological development. The Council has presently embarked on the compilation and registration of all past and current research efforts, a manual of scientific equipment valued at M\$50,000 and above, and also a directory of scientific research organisations established in the country. Apart from this, the Council is conducting a nationwide survey on the current and future scientific and technological manpower. With such information and data the Council will be able to determine the present and future manpower potential of this country for the development of science and technological policies and plans.

PART 4 – POLICY ISSUES ON SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT

4.1 MAJOR DEVELOPMENTS

103. Major developments that had occurred in Malaysia in the last decade was the increasing emphasis placed by the Government on the application of science and technology for the achievement of the socio-economic objectives of the national plan. Policies on science and technology are directed towards encouraging research in the various types of innovations that will suit the local environment and requirements of the country. There is continuing effort made by the government to formulate policies that will coordinate and harmonize all scientific research and technological innovations into a single unified plan of action. To this end, the National Council for Scientific Research and Development was established in 1975. It is essentially an advisory body to the Government ensuring that all policy formulation relating to the application of science and technology are geared towards the achievement of the national objectives. It also functions as a central coordinating body for all scientific research activities.

105. The task of promoting the development and transfer of technology and assisting the nation in its efforts towards industrial development is entrusted to SIRIM. Its diverse activities include research into alternative sources of energy, reutilisation of industrial waste, design and fabrication of industrial technologies and testing of local products to ensure that Malaysian products remain competitive in the world market.

105. Malaysia's dependency in the primary commodities has led her to strengthen agricultural research. Such development is seen in the palm oil and cocoa production

sectors. Recent developments in the palm oil industry and the increasingly important role that palm oil is playing towards the contributions of the country's export earning led to the establishment of the Palm Oil Research Institute of Malaysia (PORIM) on the 15th May 1979. It is given the task of conducting research on production, extraction, processing, storage, transportation, marketing, consumption and end-uses of palm oil products. The establishment of a Cocoa Research Board has also been announced by the Government in order to spur the development of cocoa production and cocoa processing technology.

106. The Tun Dr. Ismail Atomic Research Centre (PUSPATI) is Malaysia's first venture into the research and development of nuclear science and technology. When fully operational, this centre is expected to produce and supply short life radioisotopes to hospital, research institutions and industrial organisations. It is also entrusted with the primary function of training and improving the expertise of local scientists in nuclear science and technology.

4.2 ACHIEVEMENTS AND PROBLEMS

107. Malaysia has made significant progress during the last decade in building up the scientific and technological infrastructure such as the establishment and strengthening of more higher education and research institutions as well as technical services organisations.

108. The main problem that hinders the expansion of science and technology capacity in the country is the shortage of skilled manpower especially in scientific and technical fields. However, efforts are being made to expand educational opportunities especially at college and university levels.

109. To overcome the shortage of skilled technical workers, new vocational institutions are rapidly being set up and it is expected this measure will ensure an increased enrolment of pupils in vocational schools from 4.6% of the total enrolment at upper secondary levels in 1980 to 6.3% in 1985.

110. However, such problems as developing improved methods of teaching science and technology exists and solutions for it is as well as to other problems, such as staff development, improving the teaching cum research capacity and development of appropriate scientific and technological programmes have to be found.

111. Malaysia's economic growth has been predominantly dependent on the growth of export oriented primary industries which involve major agricultural commodities such as rubber, palm oil, coconut, timber, pepper, cocoa and coffee and to an increasing extent mineral resources such as tin, copper, oil and gas. The future growth of the Malaysian economy will depend heavily on the expansion of research capacities to improve the quality and quantity of commodities production. The expansion of research capacity of post-harvest technology and utilization is therefore of extreme importance. Emphasis is also placed on research efforts in areas of processing of these commodities leading to the establishment of more resource based industries.

112. The Fourth Malaysia Plan outlines two areas for research and development and these are:—

- i. Agricultural research for which \$93 million Malaysian dollars has been earmarked for supporting activities at MARDI, PORIM and Department of Agriculture in the states of Sabah and Sarawak.
- ii. Energy and industrial research for \$77 million Malaysian dollars.

113. In addition, there are provisions for investment into research activities of forestry mineral resources, fisheries and livestock and other sectors.

114. The problem that arises in the lack of R & D activities in private sector and hence the government investment in R & D assumes greater importance.

115. The information service for science and technology is one of the missing links in the scientific and technological infrastructure in Malaysia. The need for such a mechanism is acute in Malaysia. What is needed more urgently is the industrial information service which can reach and support the industrial development in Malaysia. A Patent Information Development Centre is being established in support of the Recent Patents Act passed by Parliament this year.

4.3 OBJECTIVES AND PRIORITIES

116. The government of Malaysia recognises that science and technology is an important instrument of economic and social development. The objective of the New Economic Policy (NEP) is to achieve a socio-economic environment in which individual Malaysians can achieve self-fulfilment within a system which provides for proportional participation and control in the economic life of the nation.

117. It is within the context of NEP that science and technology is harnessed for the development of the country. Any application of science should have a bearing on the attainment of the objectives set for national development.

118. Though the country, at present moment does not possess any explicit science and technological policies and plans, it is however, implicitly integrated into the National Development Plan. However, efforts are being made to formulate an explicit National Science and Technology Policy to overcome problems of planning and implementation. This is the main priority of the Ministry of Science, Technology and the Environment.

119. Of major concern to the government is the formulation of policies and guidelines towards the transfer of technology especially technology transfer promoted to accelerate rural developments in view of the fact that this sector comprises the bulk of the poorer people. Even with rapid advances in science and technology their beneficial impact on the poorer sections of the population is at best marginal.

120. With the emphasis on the diversification of the economy, industrialisation of the country especially through the development of resource based industry leads to an increasing attention of policy makers to come out with a technological plan that will

maximise the use of our natural resources through the application, adaptation of foreign technologies and the improvement of indigenous technologies.

121. To this end, several priority areas are identified such as quality control on products, alternative sources of energy, uses of radioisotopes, conservation of resources and technical education.

122. There is great potential for improving the scientific and technological capacities of the country but obstacles and constraints such as the lack of coordination among research institutions, financial constraints and the lack of skilled manpower must first be solved. Progress have been made through the efforts of the National Council for Scientific Research and Development on coordination aspects and studies are being carried out to determine the financial and manpower requirements in the future with a view of coming out with a National Science and Technological Plan.

123. The main concern of such a plan will be the achievement of the national development objectives through the application of science and technology. However, safeguards must be incorporated into the plan to ensure that the quality of life, health and the environment will not be adversely affected through material progress.

4.4 SCIENTIFIC AND TECHNOLOGICAL COOPERATION

124. Malaysia is a developing country and its advancement of science and technology depends largely on the extent of international cooperation it carries out with the other countries of the world. This cooperation which is mainly on the exchange of scientific and technological information and expertise is carried out in three main areas:—

- i. Scientific and Technical or Cultural Cooperation between Malaysia and individual countries through bilateral agreement.
- ii. Scientific and Technological Cooperation between ASEAN Countries.
- iii. Scientific and Technological Cooperation in International Scientific or Technological Organisations e.g. through participation in United Nations bodies or agencies.

125. Scientific and technical or cultural cooperation between Malaysia and individual countries through bilateral agreement can be viewed in terms of bilateral agreement for scientific and technological cooperation and bilateral economic, technical and cultural agreements containing provisions for scientific and technological cooperation. Countries with which Malaysia has established agreements with are the Kingdom of Belgium in 1966, Federal Republic of Germany in 1968, Republic of France in 1972, Socialist Republic of Romania in 1970, People's Republic of Bulgaria in 1971, Polish People's Republic in 1972, the USSR in 1972, Socialist Republic of Yugoslavia in 1972, Republic of Indonesia in 1973, India in 1979, People's Republic of Bangladesh in 1979, United Arab Emirates in 1975, The Socialist People's Libyan Jamahiriya in 1977, Republic of Iraq in 1977, The Republic of Turkey in 1977, The Kingdom of Saudi Arabia in 1975, The State of Kuwait in 1975 and the Arab Republic of Egypt in 1977. (In 1982 a memorandum of understanding was signed to promote cooperation between the Republic of Korea and Malaysia which will be strengthened by a Science and Technology Agreement.)

126. Of these agreements signed cooperation with the Kingdom of Belgium and The Socialist People's Libyan Arab Jamahiriya are specific agreements on scientific and technical cooperation. The other agreements are on economic, technical and cultural cooperation containing provisions for scientific and technological cooperation.

127. At the ASEAN level, efforts towards a development of scientific and technological cooperation have been intensified. Various programmes on science research and technology are being carried out and these programmes address themselves to science and technology problems such as the need for cheap but nutritious food formulations from indigenous materials, management and utilisation of food wastes, development of non-conventional sources of energy and management of marine resources.

128. At present, Malaysia is involved in a number of scientific and technological programmes at the ASEAN level. The cooperation programme includes:—

i. ASEAN Protein Project

The project has the basic objective of developing low-cost high protein food and to undertake related activities in research development and training.

ii. Project on the management and utilisation of Food Waste Materials

This project is carried out to meet the dual objectives of decreasing or eliminating sources of pollution and to convert these pollutants, using appropriate technology, into useful products.

iii. Project on Non-Conventional Energy Research

The project is carried out in order to enhance the capabilities of ASEAN on non-conventional energy and development and to develop and apply non-conventional energy technologies in efforts to reduce its dependency on fossil fuel.

iv. Project on Climatology

The Project has successfully completed the publication of an ASEAN Climatic Atlas and Compendium of Climatic Statistics which provide climatic data of the five countries. The scope of the project has been expanded to include other related areas such as weather modification and solar/wind energy.

v. Project on Environment

The Working Group on Environment has been charged with responsibility of:—

- a. formulation, adoption and implementation of an ASEAN environment programme.
- b. intensifying the exchange of environmental information.

129. In order to keep abreast with the advancement of science and technology, Malaysia maintains close liaison with various international scientific organisations and is actively involved in international agencies such as the International Council of Scientific Unions (ICSU), Commonwealth Science Council (CSC), International Atomic Energy Agency (IAEA), Pacific Science Association (PSA), International Foundation of Science (IFS), Inter-Governmental Oceanic Commission (IOC) and the Association for Science Co-operation in Asia (ASCA).

130. International cooperation in science and technology reflects the growing importance of science and technology in both developed and developing countries and the recognition that in future science and technology shall be the main basis of international relations. Presently, Malaysia is looking into training, collaborative research and exchange of information and experts programmes with other friendly nations with the hope that through this concerted effort mutual benefits will arise which will facilitate the achievement of the national objectives and bring about an improvement in the socio-economic development of the country.

MALAYSIA: SCIENTIFIC AND TECHNOLOGICAL MANPOWER

Year	Population (Thousands)	Total Stock (Thousands)	Total Number (in units)	Scientists and Engineers					Technicians
				Breakdown by field of educational training (in units)					
				Natural Sciences	Engineering & Tech.	Agricultural Sciences	Medical Sciences	Social Sciences	
1973	11,454.7	217.0	217,041	8,214	25,156	1,429	24,945	157,297	501.1
1980	14,261.2	340.5	340,520	13,980	40,720	2,530	40,390	242,900	935.5
1985	16,179.5	413.1	419,130	18,150	53,570	3,050	49,120	295,240	1227.1
1990	18,143.0	522.8	522,774	23,656	70,989	3,680	66,049	358,400	1582.4

1. The 1973 population figure was estimated as at December, 1973. Its source is from the 'Vital Statistics' — Peninsular Malaysia, Sabah and Sarawak, 1976. The source for the 1980, 1985 and 1990 population figures is the Fourth Malaysia Plan, 1981 — 85, P. 218.

Seksyen Sumber Tenaga Manusia,
Unit Perancang Ekonomi,
Jabatan Perdana Menteri.

29hb. Julai, 1981.

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