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TECHNOLOGICAL CAPABILITY - BUILDING : THE CASE OF BANGLADESH

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EXECUTIVE SUMMARY

* The Country and the Economy

Bangladesh is a small country in South Asia having an area of 143,998 sq. km and with a sub-tropical monsoon climate,which is frequently affected by natural calamity.

She inherited a completely war-torn economy at the time of her independence in 1971. The economy grew at a slow pace of 2.3 percent between 1970-'80 and 4.3 percent between 1980-'91 with the dominance of agriculture sector to GDP contribution. Bangladesh GDP rose from US$ 6,664 million in 1970 to US$ 23,394 million in 1991 at purchaser's prices.

Bangladesh economy is characterised by her dependance on external aid and vagaries of nature. The growth of exports is only 7.6% during 1989-90 and the lion share of total exports is spent on import of petroleum products, cotton, food grains, capital and consumer goods. The main export items are jute, ready-made garments, frozen food, leather, tea and handicrafts.

The development prospects of the country have been largely negated by the high population growth rate of 2.3 percent during 1980-90 with a population density of 678/sq. km.

* Human Resource Development

Bangladesh has nine Universities of which one is Agricultural, one Engineering, and one Science & Technology. Out of 46,803 students enrolment in the seven functional universities in 1989-90, 42.12 percent were enrolled in scientific and technological subjects. The Polytechnic Institutes provide a two/three-year diploma course programme for the secondary school leavers. The Vocational Training facilities for trade/crafts courses and Non-formal courses are available at the various Government Institutes to build up technical and management skill. However, the existing systems of education needs to be restructured to the needs of industry and job market as well as to match the indigenous technology capability building needs.

Contractual (foreign funded project specific) industrial trainings and post-graduate studies, are externally funded. GOB has a programme for Transfer of Knowledge Through Expatriate National (TOKTEN) with the assistance of UNDP. As regards remuneration of S&T manpower, GOB does not have any seperate remuneration level.

Human resource development asssistance from bilateral or multilateral sources has been ad-hoc in nature. However, to strengthen S&T capabilities, Bangladesh is dependent on external assistance, the need for which has to be assessed and channelled more effectively.

* **Technological Development**

Technology has been recognized as the engine of economic growth. The conjoint policy of "make some-buy some"strategy is being regarded as more appropriate than concentrating on development and diffusion of all technologies alone. Capability development strategy to import, adopt and digest selected export oriented technologies as well as to foster local technology generation capability is being emphasised.

Bangladesh Seed Certification Board is responsible for standardization of seeds of agricultural crops. In the industrial sector,BSTI does the job of quality control of domestic products, and the BITAC povides the technical services for Engineering quality control and also undertakes manufacture of custom designed spare parts.

* **Information Base**

Bangladesh Bureau of Statistics (BBS) compiles and publishes statistics for all sectors, but such statistics are of limited use for R&D purposes. There are about 150 consulting houses for engineering, management and software development services and about 50 Scientific and Technological Societies for popularising Science and Technology.

Bangladesh National Scientific and Technical Documentation Centre (BANSDOC) within its limited facilities tries to provide the scientists and technologists some access to the international information network.

* **R&D Activities**

There are 58 R&D organizations in the country. In the agricultural sector, under an umbrella arrangement, Bangladesh Agriculture Research Council (BARC) coordinates research funding, long-term research planning etc. involving a number of institutions like BRRI, BARI, BJRI etc. In the industrial sector organized review mechanism has not yet been started for R&D activities. The Bangladesh Council of Scientific and Industrial Research (BCSIR) has only recently introduced research programme planning. This organization developed a good number of processes but achieved limited success in their commercial exploitation. Housing and Building Research Laboratory (HBRL) and Road Research Laboratories (RRL) have also achieved limited goal. The main reasons of limited success in R&D are considered to be low investment in R&D and sub-critical level of manpower. Shortage of competent manpower has been due to the "brain-drain" phenomenon i.e. exodus of competent S&T personnel to other countries in search of better emoluments under package deal.

In the industrial sector (both public and private), in-house R&D is almost non-existent. There are scattered evidences of sporadic initiatives for

shop level innovations. In the recent years, there has been a realization to have such facilities in the major industrial units under public sector corporations.

In Bangladesh, the triangular linkages among universities, R&D organisations and the industrial enterprises are very weak. This is partly due to lack of government patronization and partly because of lack of serious efforts on the part of the enterprises themselves. Thus, Universities and R&D organizations have the limited scope to contribute in the process of overall technology transfer and development mechanism. Bangladesh's linkage with International R&D networks has so far been very limited and that too is with the universities only.

* **Relationship Between Economic Policies and Technological Capability Building**

Bangladesh prepared her first National S&T Policy draft in 1980 and further reviewed in 1986 which is still in force. The S&T Policy recognises the need for national technological capability building and needs to be reviewed further to make it more pragmatic to cut across all other relevant policies and for providing specific directions to acquire technological capabilities in areas where Bangladesh may prove her competence.

* **Technology Transfer and Capability in Agriculture Sector.**

The technological capability in the agricultural sector in Bangladesh is considered ahead of the other sectors. The particular advancement has been made in respect of improvement of varieties of seeds and breeds, increasing yield of cereal crops.

Findings of recent studies suggest that there is an urgent need for acquiring proper knowledge in balanced and efficient use of fertilizer and pesticides to reduce its adverse effects on soil and environment. Some technological capability has been developed in manufacture of irrigation pumps, assembling of engines, motors but needs appropriate standardization policy. There has not been significant farm mechanization in Bangladesh as large majority of agricultural activities are yet done by manual draft power.

The agricultural research system in Bangladesh has attained a relatively high level of expertise in respect of scientific investigations except in 'horticulture'. The Agricultural Information Service (AIS) of the Ministry of Agriculture, and BARC having links with FAO and Commonwealth Agriculture Information System provide mechanism for collecting, processing and dissemination of technological information to agricultural support institutions in the country. But Technology Information and Development in the fisheries and livestock sector have been inadequate and leave much to be desired through technological interventions.

* **Other Policy Interventions in Agriculture Sector**

The farm land in Bangladesh is too much fragmented and land reform initiatives have failed so far. Institutional credits through banks have helped farmers to the diffusion of modern technologies but it did not benefit much the small farmers as evident from their small share to total institutional credit. However, some NGO's and Grameen Bank are quite successful in mobilizing the marginal farmer's initiative by providing small credit at low interest rate. There is no credit support for "risk capital" fund that can allow local level experimentation on technology innovation.

Agricultural farm inputs namely, fertilizer, shallow tube-well, etc. have been privatized since 1987-88 in line with government's policy of privatization/deregulation . The process of privatization of agricultural inputs has to some extent stabilized their price and supply.

Seasonal variation in prices of cereals and low crop prices during the harvesting period bring the question of price support to the growers as the traders also try to take advantage of the poor liquidity position of the farmers. In order to overcome this problem and to ensure fair prices to the growers GOB has recently introduced a system of rice procurement through open tender from the traders rather than from the mills, which is expected to benefit all the farmers and not only those who have access to a mill or a government procurement centre.

In Bangladesh, food accounts for more than 90 percent of total expenditures of rural population and more than 60 percent of it are spent on rice. Therefore, the welfare gains of consumers (rural poor) from rice policies/food subsidy are reflected in the real price of rice faced by the consumer.

* **Technology Transfer and Capability in Industry Sector**

Attainment of economic growth through industrial development has been the objective of GOB's successive Industrial Policies. But adequate policy support to facilitate the process of dynamic technology transfer has been absent and, as such in spite of liberal industrial policy, the technological capability in the industry sector has remained very poor.

In the Engineering industry, which plays a critical role in raising capability for local manufacture and fabrication of capital goods, the performance of the public sector has remained unsatisfactory. Serious effort for innovation on the part of enterprises and failure on the part of GOB to curb continued import of machinery and equipments in which there is local capability has negated the dynamic technology transfer mechanism. The local capability has been ignored by suppressing the local demand for various engineering products.

In the private sector, the effort to replicate imported small machines, spares is evident but, inadequate availability of raw materials of required

specifications, and lack of processing facilities namely, surface treatment, heat treatment, and lack of qualified manpower are hindering the process of technology transfer.

In the chemical and fertilizer sector, all the six fertilizer factories were set up under "turn-key" arrangement. Local manufacture of some parts though possible, but due to aid conditionalities all procurement including the process licence had to be based on foreign supply, without having any contractual obligation. Lack of active role on the part of technocrats to adopt and assimilate imported technology is also responsible for the failure to develop local capabilities. Mastering skill of plant operation and maintenance only does not help much in gaining local capability through technology transfer process.

Cotton textile sub-sector has been able to integrate some locally made spares in operating the age old textile machinery. But, for overall improvement, innovations and import of modern technology for local adaptation would be necessary.

Like the cotton textile, the jute sub-sector has also suffered from technological stagnation partially due to loss of markets of jute products to synthetics. Development of technologies for diversified uses of jute is being explored and encouraged by GOB for which extensive R&D effort is a pre-requisite.

Above 90% of the output of leather industry is exported in the form of wet blue leather. But GOB's present policy is to gradually switch over to export of leather goods and by 1999 to completely stop export of finished leather.

Electronic industry has made some slow progress through progressive manufacture of radio, and television receivers using imported components based on foreign design. However, some household electronic gadgets of low quality are being manufactured with locally manufactured components, based also on local design. But to enter into hi-tech export market, capability development with regard to product quality and cost competitiveness and careful selection of items of manufacture would be necessary. The selective approach should take into account the technological comparative advantage of the country.

* **Other Policy Support**

Patent Office and Trademark Registration Office of the Ministry of Industry work for industrial property protection system. Rules and Acts followed for the purpose deserve serious review.

In order to develop both import substitution and export led industries the financial and fiscal incentives provided by GOB are in line with the open market policy. However, periodical review of these incentive

mechanisms is needed to be competitive in the international market. Similarly, the exchange rate policies and policy support to augment foreign investment have also been reformed and further policy innovations in this regard should reflect the GOB's desire to enhance local technological capability.

* **Conclusion**

For accelerated economic development,the need for rapid industrialization is a precondition which in turn, calls for building national technological capability to be competitive in the international market. It is therefore, absolutely essential to have a long term national technology development plan along with effective policy instruments to encourage investment flow and to facilitate technology transfer. Considering this, the current GOB's strategy of open market policy is a positive step towards unhindered flow of technology and warrants the need for greater foreign investment. The need for foreign capital, would be, (i) to invest massively in technical education and R&D to develop indigenous technological capability and (ii) to finance transferring technology from abroad. A policy option to address the issues of technological capability building therefore, must be made taking into account the present status of the country's technological capability. For this purpose, a Technology Capability Schedule (TCS) for the country would have to be prepared in order to evolve the future course of actions.

Bangladesh cannot afford to work in isolation for her technological capability building. It would require man, manterial, management and international cooperation which calls for adequate investment in all the four components of technology(Technoware, Humanware, Inforware and Orgaware).

1.0. INTRODUCTION

In pursuance of the Work Programme (TD/B/WG.5/L.2) of the Ad-Hoc Working Group on the Interrelationship between Investment and Technology Transfer, the need for exchange of national experiences on the basis of country-case studies has emerged. As part of this objective, a country-case study with reference to Bangladesh on "Technology Capability-Building has been carried out. The scope of the study is basically to review and identify related factors responsible for the present state of technological capability of the country and to underscore the areas deserving attention for enhancing technological capability and international competitiveness through sustained technological and economic development.

The study has been carried out as per suggested outlines provided by the Ad-Hoc Working Group of Trade and Development Board of UNCTAD. Various sections of the study as have been structured address the concerns of Bangladesh for technological capability building - the prime criteria for international competitiveness in the process of transition to market economy.

1.1. Social and Economic Structure : Salient Features

1.1.1. GDP and the Economy

Bangladesh covers an area of 143,998 sq.km and is located in the north eastern part of South Asia. Bangladesh generally enjoys a subtropical monsoon climate. The geographical area that now constitutes Bangladesh is an independent and sovereign country since 16th December,1971.

Bangladesh presents a classic case of mixed experiences for her economic growth and development. Since independence, the government of Bangladesh (GOB) have been pursuing economic reform programmes in order to augment the process of economic growth. It would be somewhat misleading to periodise a reform process . The point of departure in Bangladesh has however been that the reforms of the period 1972-82 were largely undertaken in response to specific problems faced by the economy at the time largely arising out of short term exogenous shocks. The reform process since 1982 has been much more holistic in its coverage, attempting to change the entire direction of the economy towards a private enterprise dominated market economy. This does not imply that prior to 1982 the Bangladesh economy was largely a command economy since the contribution of public enterprises to Gross Domestic Product(GDP) did not exceed 15%. This was not surprising in a small farmer dominated agrarian economy with a large service and informal sector. Thus even the changes initiated since 1982 are part of a continuum in the process of reforming what was and remains a mixed economy.

An objective appraisal of performance of the Bangladesh economy in last two decades would clearly reflect that its growth remained far below its potential. Bangladesh's GDP rose from US$6,664 million in 1970 to US$ 23,394 million in 1991 at purchaser prices. The average annual GDP growth

rate is 2.3 percent between 1970-80 and 4.3 percent between 1980-91. This growth performance is much below the average performance of low-income economics at 4.5 percent for 1970-80 and 6.0 percent for 1980-91. The Bangladesh agriculture grew by 1.8 percent per annum on the average between 1970-80 and 2.7 percent between 1980-91 while growth in industry sector was 5.2 percent in 1970-80 and 4.9 percent in 1980-91.The slow growth of agriculture is basically due to socio-economic constraints.

The structural composition of the country's GDP underwent some changes though not very optimistic. The share of agriculture in GDP stood at 36 percent in 1991 as against 57.9 percent during 1972. Industry contributed 16 percent of GDP in 1991, out of which manufacturing sector accounts for only around 9.5 percent. It may be noted that the contribution of the services sector is significantly increasing from 37 percent in 1970 to 48 percent in 1991.

1.1.2. Investment

One reason for disappointing performance of the Bangladesh economy in past two decades has been the declining trends in its gross domestic investments. Average annual growth rate of gross domestic investment during 1980-90 was even negative (-0.6 percent). The decline in investments has been witnessed in both private and public sectors. This accounts for a high incidence of unemployment and under employment, amounting to 30 and 40 percent of the country's total labour force. The gross domestic savings also declined from 7 percent of GDP in 1970 to 3 percent in 1991. The consequences of the declining trends in savings and investments as much as the faltering performance of two main productive sectors(agriculture and industry) are all too obvious for Bangladesh.

1.1.3. External Trade and Balance of Payments

In general, the Bangladesh economy can be characterised by two types of external dependencies-dependence on foreign aid and dependence on nature. Between 1972 and 1985, Taka(Bangladeshi Currency) depreciated by over 460% and the average annual growth rate of exports was 7.6 percent during 1980-90. Bangladesh's total merchandise exports which stood at US$ 340 million in 1972-73 increased to US$ 1674 million in 1990.

Owing to low level of development and limited natural resources Bangladesh is heavily dependent on imports, not only for petroleum products, foodgrains, capital and consumer goods but also for industrial raw materials whether for domestic or export-oriented industry. Imports recorded an average annual growth of 8.0 percent between 1980-90. It may be mentioned that imports were substantially below the projected level in the past, because of slow growth in export earning and shortfall in foreign capital.

The balance of payments position of the country remains precarious. It suffers from a major structural trade deficit which makes it heavily dependent on external aid. Structurally, the external sector's weakness is characterized by the fact that the merchandise export earnings finance less than half the import requirements.The share of traditional exports is however declining due to export success of ready-made garments and frozenfood (shrimp). The present trade structure is likely to continue until such time as the country is able to produce a much larger proportion of semi-manufactures for which the development of indigenous technological capability is a *sine qua non.*

1.1.4. Demographic Features and Literacy Rate

According to population census conducted in March 1981 by the Bangladesh Bureau of Statistics(BBS), the population of the country was 89 million in 1981, which has been estimated at 110 million in 1992. The latest population census was conducted in 1990 but official data on total population has not yet been made public.

The average annual growth of population was 2.6 percent during 1965-80 and for 1980-90 it was 2.3 percent. The projected growth rate of population during 1989-2000 is 1.8 percent. Forecasts of population growth vary but suggest a figure of between 125 and 140 million by the year 2000.

According to the 1981 census, 15.2 percent of people lived in towns. The average annual growth rate of urban population was 6.2 percent during 1980-90. The population density of 605 per sq km in 1981 had increased to 678 per sq km in 1985. The 1981 census also gave a literacy rate, for the over-fives, of 24 percent and that of the population of age fifteen years and above is 29.2 percent.

2.0. HUMAN RESOURCE DEVELOPMENT : MAIN POLICIES

2.1. Human Resources and skill Development.

Educated and skilled manpower constitute the basic requirement for technological advancement. Historically the policies related to human resources in this part of the Indian Subcontinent were directed more towards liberal arts than sciences or technical subjects. However, several initiatives have been taken to reorient the education system in the country. The efforts aimed to develop a type of education which would produce the manpower required to perform the role of forerunner to physical development in various sectors.

In addition to the formal education programs, nonformal courses are being increasingly organized by various ministries, such as the Ministry of Youth Affairs and the Ministry of Industries, who utilize the facilities available in the existing institutions.

The Bureau of Manpower, Employment and Training (BMET) administers the Vocational Training Institutes (VTIs) and Technical Training Centres (TTCs) while the Directorate of Technical Education (DTE) organizes the evening trade courses in the Polytechnic Institutes. Recently, BMET has switched to a modular training scheme using the concept of Modules of Employable Skill(MES). These are short duration (6 months) courses for specific trades. All the crafts courses may eventually be changed to the MES system. This scheme is expected to be more efficient than the two-year programmes now being run for crafts courses.

Foreign training of technical personnel is usually a built-in feature in most of the sophisticated industrial and infrastructural projects, especially in those which are externally funded. For post-graduate education and training abroad,professionals usually depend on foreign government sponsored scholarship schemes or research/teaching assistantship offered by foreign universities. Government does not have any significant scholarship schemes of foreign training programmes of its own.

Continuing education for practising engineers, technologists and technicians has become essential to keep pace with the dynamic nature of modern science and technology. Exceptionally qualified scientists and engineers play a central role in the creation of the appropriate environmentfor technology-based development. Academic institutions can impart the basic skills only. The products of formal technical education system need to be trained and retrained in the emerging and advanced topics in order to stay alive in this technological age. In this respect the Bangladesh University of Engineering and Technology(BUET) has taken the initiative in establishing academic linkages with foreign Universities of repute for exchange of teachers, researchers and post-graduate students. The Governement has also undertaken a programme of "Transfer of Knowledge Through Expatriate National (TOKTEN)" with the assistance of UNDP.

Specific policies related to the use of foreign skilled and unskilled manpower as well as repatriation of skilled manpower are absent in the country. As regards remuneration of S&T manpower, it may be mentioned that they do not have any seperate remuneration level in comparison to other professionals.

2.2. Education and Training

The formal structure of the education system in Bangladesh is five years of primary education, five years of secondary education, two years of higher secondary education followed by a diverse programme of higher education centred on the university system. There are three basic types of institutions of higher education, namely universities, constituent colleges affiliated to universities, and Institutes of Technology. In addition to the

institutions of higher education there are polytechnic and monotechnic institutes which offer diplomas. The entry requirement for these institutes is completion of secondary education. There are also Vocational Training Institutes(VTI's) and Technical Training Centres(TTC's) which offer craft courses.

In Bangladesh, the participation rates (i.e. the percentage of the population of the relevant age group enrolled) in primary, secondary and higher education in 1989-90 were, 84, 24.2 and 3.3 percent respectively.

In 1989-90, education took 12.6 percent of the national budget. This was divided as follows: primary education 46.4 percent; secondary and higher secondary education 38.8 percent; technical education 2.4 percent; university education 8.7 percent; and other educational support 3.8 percent. All the development budget and between 90 and 95 percent of the revenue budget of universities are financed by the government through the University Grants Commission.

2.2.1. Universities

The nine functional universities in the country consist of: general universities; one agriculture university; one engineering university; one Islamic University and one Science & Technology University. Amongst them S&T University and one general university have started functioning very recently. Among the nine functional universities five are mainly teaching universities and four are teaching and affiliating universities. There are 568 constituent and affiliated colleges of the universities with enrolment of 0.46 million students in 1989. The affiliated colleges include medical, dental, agricultural, textile, leather and teacher training colleges.

The total student enrolment in the seven functiolnal universities in 1989-90 was 46803 of which 42.12 percent were enrolled in scientific and technological subjects. The teacher-student ratio varies from one university to another, being lowest(1:11.63) in the technical universities and highest in the Islamic University (1:32.11). About 38 percent of the teachers in the universities have Ph.D degrees. It may be pointed out that the universities face the problem of brain drain. As the facilities for Ph.D programmes in the Universities are not well developed, most of the teachers prefer to go abroad to take Ph.Ds. Many of them settle abroad.

The R&D activities in the universities are very limited. Most of the research work relates to student theses. However, some research projects are also undertaken by the faculty members, but these are very few. The research activities of the universities are normally funded by the University Grants Commission. In addition, the universities occassionally get research projects from other organizations. The small number of research projects received from other organizations reflects a general lack of university-industry interaction, which is a common problem in Bangladesh. Table-2.1 shows the distribution of research grants by faculty of the universities by the University Grants Commission in 1986 and 1989. The amount is obviously very inadequate.

2.2.2. Technical Colleges & Schools and Vocational Training Institutions

Formal technical education is offered in three tiers: Crafts courses offered by Vocational Training Institutes (VTIs) and Technical Training Centres(TTC's), diploma level courses offered by Polytechnic and Monotechnics, and degree courses offered by the Bangladesh Institute of Technologies (BITs) in addition to Bangladesh University of Engineering and Technology. Bangladesh Textile College and Bangladesh Leather Technology College under Dhaka University offer degree courses in Textile Engineering and Leather Technology.

Table-2.1. Research Grants to Universities by the UGC in 1986 and 1989

Research Area	1986		1989	
	Amount (US$)	Share %	Amount (US$)	Share %
Arts & Humanities	2509	8.75	3576	14.66
Social Sciences	5928	20.67	3143	12.88
Physical Sciences	3245	11.31	894	3.66
Chemical Sciences	2978	10.38	4319	17.07
Biological Sciences	1874	6.54	5571	22.83
Engineering Sciences	8699	30.33	1278	5.24
Agricultural Sciences	3446	12.02	5622	23.04
Total:	28679	100.00	24405	100.00

Source : UGC Annual Report 1986,1989.

Note : 1 US$ = Taka 39.13 (1988-89 exchange rate).

1 US$ = Taka 29.89 (1985-86 exchange rate).

The number of different types of technical institutions in 1989-90 are shown in Table-2.2. Number of teachers and students enrolled in these institutions in 1989-90 are 1988 and 21246 respectively.

2.2.3. Management Training

The upgrading of faculty competence and laboratory facilities, teaching curricula and materials have not kept apace. Technical education has to be restructured and improved, in order to better respond to the demanding technical changes augmenting the productive sectors. It is felt that the Vocational and Technical Education system (VTE) needs to be reorganized to offer shorter, newer courses linked specifically to the needs of industry and job market.

Only a few Management Development Institutes and Centres are functioning in the country with the sole objective of imparting management and or skill development training. The Institute of Business Administration of Dhaka University offers degree and diploma level courses for business management. In addition, there are other a few institutions which undertake training programmes as part of continuing education on regular basis.

Table-2.2. Number of Technical Institutions in Bangladesh

Institutions	1989-90
Bangladesh Inst. of Technology *	4
Technical Teachers Training College	1
Polytechnic Institute	18
Institute of Graphic Arts	1
Leather Technology College*	1
Commercial Institute	16
Vocational Training Institute	51
Glass & Ceramic Institute	1
College of Physical Education	2

Source : Statistical Year Book of Bangladesh, 1991

* offers degree level courses.

2.3. Role of External Assistance

Attempt of funding agencies to make a lasting effect on the economy of Bangladesh mainly consists of transplanting or transferring some new technology in the existing socio-economic setting. In the absence of a long term human resource development plan with cross-sectoral considerations to meet the needs of technological changes, the contribution of funding agencies (bilateral or multilateral) has remained ad-hoc in nature for the recipient.

Various programmes carried out for education and training (as discussed in earlier paragraph) to strengthen S&T capabilities of the country seems reasonable. For improvement in the quality of education, GOB is implementing a programme under the General Education Project (GEP) which is funded by the GOB and a consortium of external donors(involving IDA and ADB). A project is underway for rehabilitation of primary schools which is being funded by IDB(for flood rehabilitation of primary schools) and EEC (the assistance is being lined up). It may be noted that ADB funded project for strengthening Higher Secondary Education: science could not be made effective as yet. Due to delay in project approval, the ADB fund for Open University could not be utilized during 1992. Apart from these national level projects,programme-specific collaborative projects are and were implemented as part of human resource development. For example,TOKTEN programme funded by UNDP, BUET-AIT link programme funded by UNDP and Ford Foundation grant for strengthening capability of Public Administration Training Centre(PATC) are noteworthy. GOB has also formal arrangement with the U.K. Government under the Technical Assistance Programme for human resource development. In the Science & Technology Sector GOB has Scientific and Technological protocol among others with China, Pakistan and India for exchange of scientific personnel and technological information. Although there is a need for further strengthening of activities, but due to shortage/lack of fund it may not be possible disturbing more important programmes like Universal Primary Education(UPE). In this context, it is desirable to develop need based higher education, training programme for which external assistance requirements need to be assessed and sought.

3.0. TECHNOLOGICAL DEVELOPMENT : MAIN POLICIES

3.1. Technology as Strategic Variable in Development

Technology is now well recognized as the engine of growth for any economy-developed or developing. To facilitate technology based development it is important to appreciate the various basic components of "technology" so that we may not consider it as a "black box". There are four basic components of technology which appear in different forms.

The components are :

(a) Production tools, machines, factories etc. which are the actual physical facilities and equipment. These may be referred to as the object embodied form of technology (Technoware);

(b) Production skills, innovativeness, creativity which are the human abilities, skills,expertise etc. This is the human embodied form of technology (Humanware);

(c) Production facts and information which are the documented knowledge in the forms of theories, designs, blue prints, manuals etc. This is the document embodied accumulated knowledge or information (Inforware);

(d) Production arrangements, linkages, organizations etc., which are the organizational frameworks within which all the above mentioned forms of technology need to operate to raise productivity (Orgaware).

All four components of technology are complementary and interdependent. Their relationship is circular and one depends on another. Development should ensure growth in all the four components at the same time.

Overall considerations of the choices available to late starters in technology development (e.g. Bangladesh) reveals two basic strategic considerations in arriving at a development policy.

(a) It is necessary to select and import some mature technologies and successfully digest these in the socio-economic milieu through an evolutionary learning absorption process in which local R&D institutions and industry work hand in hand.

(b) It is essential to attain some capability to develop a few carefully selected technologies in the local technology generation facilities (R&D institutions). Local technology generation in some specialized areas will give the country some competitive edge in the international market.

The conjoint strategy, also known commonly as the "make som- buy some" strategy, forms the basis of a working agenda for the country. It is important that parallel efforts are undertaken on both the fronts. Pursuit of either option alone results in stunted technological growth. The two strategies stand to gain from each other and are mutually reinforcing.

A. Technological Infrastructure

3.2 Standardization and Quality Control

In agriculture sector, the Seed Certification Board takes care of the standardization of the seeds of agricultural crops for introduction in the country. In addition, there was a Committee for Agricultural Mechanization under the Ministry of Agriculture which was responsible for fixing the standards of agricultural implements to be introduced in the country. However, recently the Government has abolished the Committee, and there is no standardization of agricultural implements.

In the industry sector, standardization and quality control in Bangladesh are the responsibility of the Bangladesh Standards and Testing Institution (BSTI). BSTI has so far standardized the local production of about 1275 industrial products. Standardization of imported products is not in force in the country. The number of quality standardization certificates issued by BSTI to clients by product category are shown in Table-3.1.

Apart from BSTI, Bangladesh Industrial Technical Assistance Centre (BITAC) serves the metal working and plastics industries through providing training and technical services for quality control and production. It also manufactures custom-designed spare parts.

Table-3.1 Number of Quality Standardization Certificates issued to Clients by product Category by BSTI

Product category	No.of products	Licence awarded	Licence in force
Agriculture & Food Products	45	322	225
Chemical	22	66	50
Jute & Textile	20	22	20
Electrical	19	174	120
Engineering	7	19	15
Others	31	56	31
Total	144	659	461

Source : BSTI.

3.3. Support Services

In view of the inadequacy of documentation and information facilities in the country, the Bangladesh National Scientific and Technical Documentation Centre(BANSDOC) has been established to meet the information requirements of the scientists and technologists of the country and to serve as an important part of the infrastructure needed for an effective research and development programme. Thus BANSDOC is the national documentation centre that provides the scientists and technologists of the country with access to international literature in their respective fields. In real sense, BANSDOC does not have its own library. To procure requested documents, its staff has to locate sources. In about 97 percent of the cases materials are not locally available and BANSDOC has to request foreign organizations in procuring microfilm or photocopy.

The Bangladesh Bureau of Statistics (BBS), collects and compiles statistics for all sectors, including science and technology, to meet the needs of development planning, research, policy and decision making. However, the S&T statistics published by BBS are general in nature and are of limited use to the scientific and technological community.

There is no technology transfer centre in the country. Engineering design organizations, software development specialist organizations and management consultancy organizations are not well developed in the country although there are over 150 consulting houses. A summary list of project assignments completed by local consulting firms have been presented in Appendix Table-I.

There are more than 50 non-governmental scientific and technological professional societies and associations in the country. Most of them are monodisciplinary and a few are multi-disciplinary. All these societies and associations are mainly involved in popularizing science and technology.

B. Research and Development.

3.4. R&D Organizations.

The Ministry of Science and Technology of the Government of Bangladesh has listed 58 organizations as being engaged in R&D. This list, however, includes universities, some government run routine testing laboratories, medical research cum hospital centres, and scientific support service institutions. Appendix Table-II lists major R&D organizations together with their principal areas of activity.

Research activities in agriculture sector are co-ordinated by an umbrella organization, the Bangladesh Agriculture Research Council. Its functions include medium and long term research, planning, organizing and funding co-ordinated research involving a number of institutions; and regular review of research output of the different agriculture research. Some of the component units of the Council namely, the Bangladesh Agriculture Research Institute (BARI) and the Bangladesh Rice Research Institute (BRRI) have their own programme planning and review mechanisms. Externally funded projects are usually kept under constant review.

Except for agricultural research, the major activities which could lead to viable technological outputs are more or less concentrated in the Bangladesh Council of Scientific & Industrial Research (BCSIR). The range of research activities carried out in the Road Research Laboratory, and the Housing and Building Research Laboratory has been limited. Research activity of the Bangladesh Atomic Energy Commission are primarily in theoretical physics, and many of the research establishments planned for the organization are in the process of being erected or installed.

Other than agriculture, organized review mechanisms have not yet been instituted for R&D activities. In BCSIR, for instance, research programme planning has only recently been introduced. Previously, an individual researcher used to select his research projects based on his own judgement. The decision on the approval of the project was taken by his superiors, who had specialized in the same discipline. This procedure gave rise to a large number of projects. Similar is the condition of the Bangladesh Atomic Energy Commission. Thus, subcritical levels of manpower and fund allocation are painfully evident for R&D units outside the agriculture sector.

The average percentage of the Annual Development Plan (ADP) allocation devoted to Research, Development and Design activities (including study reports, pilot schemes and basic infrastructural work) in different sectors during recent years are as follows :

Industries	1.92%
Natural Resources	1.25%
Transport	0.54%
Health	5.00%
Agriculture	10.32%
Flood Control; and Water resources	0.44%

An investment of ~~US $~~ 760 million Taka is envisaged during the Fourth Five Year Plan (1990-95) period for the Science & Technological Research (STR) sector, which is around 1.86 percent of the total public sector planned outlay. Apart from this, government also spends from its revenue budget for R&D organizations. During 1991-92 the recurring budget allocation was 97.10 million Taka.

Total manpower in R&D institutions during 1989-91 indicates that of the total 15488 manpower only 382 are with Ph.D degree, 2957 are with graduates and post-graduates and 9107 are technical personnels. Table-3.2 shows the achievements of R&D organizations and Universities during the financial year 1987-88 and 1988-89.

Shortage of competent manpower is indentified as the major constraint in R&D institutions. The so called "brain-drain" phenomenon, attraction for overseas jobs and lack of proper service conditions in the R&D institutes, have all contributed to the shortage of competent scientists, engineers and skilled technicians.

With the notable exception of the Bangladesh Rice Research Institute, the absence of organized and well-planned research management system is prominent. Consequently, the research efforts are fragmentary, uncoordinated and are not generally related to long term development objectives.

Table-3.2. Achievements of 52 Major R&D Organizations and 6 Universities during 1987-88 - 1988-89.

Sl No.	Achievements	52 R&D Organizations	6 Universities	Total
1.	Number of patents and processes developed	295	5	300
2.	Number of patents and processes leased out	149	-	149
3.	Number of R&D projects undertaken	2365	818	3183
4.	Number of R&D projects completed	386	367	753
5.	Number of processes in production	38	-	38
6.	Number of research paper published	2078	876	2954
7.	Number of regular reports	812	130	942
8.	Number of Bulletins	186	29	275

Source : Report on National Science Citation Index, 1992.

In the industrial sector, in-house R&D units are almost non-existent. R&D support in the form of fullfledged in-house facilities is also lacking in the sector corporations. There are some scattered evidences of sporadic initiatives for shop level innovations (blue collar research). However, they have lacked support and guidance from the top and have not been carried out within the framework of a planned initiative. However, some sector corporations (for example, Bangladesh Steel & Engineering Corporation, Bangladesh Chemical Industries Corporation) have recently set up R&D Divisions which are still in the infant stage.

3.5. Linkage Between R&D and Productive Sector.

Since almost all enterprises in Bangladesh are of small or medium scale, their capability to introduce technological change depends upon the support provided by the national technology infrastructure. What can be

bought and what can be locally developed depends upon the status of this infrastructure, which is supposed to promote technological innovation through strong triangular linkages among: the academic institutions engaged in S&T education and research; R&D organizations; and the engineering and industrial enterprises. Linkages here refer to the elements of the connection and flow between them. In Bangladesh the "triangular linkages" is very weak partly due to lack of government patronization and partly because of lack of serious innovation efforts on the part of enterprises themselves to absorb and adapt technologies through a dynamic technology transfer mechanism. It may be mentioned that acquiring technological competence through triangular linkages should not be only problem solving in nature rather progressive. Since the process of innovation is fraught with risk and uncertainty, there is a need on the part of the government to provide attractive incentives for R&D investment in private sector.The present R&D infrastructure at the enterprise level can at best meet the demands for maintenance, replication and to some extent adaptation.

3.6. Opportunity for International Cooperation

In order to have access to the new and emerging sciences and technology, it is essential to findout what is happening in different laboratories of the world. The dissemination of information on the front line R & D work would be possible if we can set up an information clearing house in the country with linkages to the international network of information centres. Establishing a "Technology Transfer Centre" is a felt need for which international co-operation could be useful. Also we have to build up an association with the renowned centres for emerging sciences and technologies, already existing in the West. It is worthwhile noting in this connection that Nobel Laureate Abdus Salam, President of the Third World Academy of Sciences in a recent meeting of the Academy at Caracus, Venezuela (15-19 Oct./90)has proposed the establishment of a"Net work of 20 centres of Excellence in the South dedicated to high-level training and research in areas of science, high technology and environment critical to the development of the South (training and research should be equally emphasized)"Bangladesh should house one or two of these centres of excellences and take full advantage of the collaboration between these world centres for the building of necessary expertise in at least selected areas of the emerging sciences and technologies e.g. material science and bio-technology.

4.0. RELATIONSHIP BETWEEN ECONOMIC POLICIES AND TECHNOLOGICAL CAPABILITY-BUILDING

The first attempt towards formulation of a state policy for science and technology was made in 1980. However, due to over-ambitious organizational constraints the draft could not sail through. In January 1985, the Science and Technology Division (now full fledged Ministry) circulated another draft National Science and Technology Policy (NSTP) document. The draft was subsequently approved by the National Committee for Science and Technology (later named as National Council for Science & Technology) in the beginning of 1986. The NSTP of 1986 is still in force without further revision. The NSTP recognizes the priority for the integration of scientific and technological con- siderations with overall development strategy of the country and the need for the establishment of a national capability for development of indigenous technology and attainment of a national capacity for gaining mastary over imported technology.

The rationale for Government concerns as outlined in NSTP can be summarized as follows :

(a) Inability of private sector to allocate adequate share of total profits for technological efforts;
(b) Imperfections in capital markets prevents allocation of sufficient funds for technological change;
(c) Market mechanism can not be relied upon to coordinate and direct large scale cross sectoral technology development initiatives;
(d) Society's possession of a natural mechanism for dissemination of scientific and technological information is weak.

A technology policy for a country cuts across several policy areas of economic and social development. It cannot be considered as a compartmentalized policy dealing with scientific and technological research activities only. It has to be viewed as a mode of analysis, promotion and control that affects most policies, deals with goals and programmes in many areas, make use of a variety of policy instruments for intervention in the market place.

A. The Agricultural Sector

4.1. Technological Capability in Agricultural Sector.

Four major recognizable types of agricultural production technologies are : (i) biological technology such as improved varieties of seeds and breeds; (ii) chemical technology such as fertilizers,insecticides and pesticides, (iii) land augmenting technologies in the form of irrigation and water management; and (iv) mechanical technology such as power tillers.

In case of biological technology adequate attention has been given in all steps required for seed technology growth (e.g. generation, demonstration, standardization and diffusion). Appropriate institutions have been established to carry out the functional activities(Research and Development,Standardization, Distribution, Extension, Credit support etc.)required for technology base development (see : Appendix Figure-1). Agricultural research efforts have been particularly successful in cereal crops. The land under cultivation has remained stagnant at about 22.5 million acres since 1970. Technological progress has cut the unit cost of production of rice by about one fifth and has increased gross profit per unit of land by 1.2 times along with increase in crop yields.

Although there are some fluctuations in the consumption pattern, the consumption of fertilizer has increased from 3 million metric tons during 1972-73 to 17 million metric tons during 1988-89. Transfer of knowledge about the optimum use of balanced fertilizers for crop production is an area requiring priority attention. This particular issue will help in efficient (economic) use of fertilizer and also reduce its negative effects on environment.

During early sixties modern methods of irrigation have been introduced in the country in the form of low lift pumps for surface water irrigation, tubewells for ground water exploitation and large gravity schemes involving river diversion and construction of embankments. The irrigated area by modern methods has recorded a substantial increase from 4.58 percent of total avreage during 1970-71 to 44.17 percent during 1989-90.

For mechanized irrigation system, the country has been depending on imported technology. Some capabilities have been developed for indigenous manufacturing of irrigation pumps. There are some capabilities for assembling of prime movers (e.g. engines,motors). Locally manufactured irrigation machines are finding it difficult to compete with imported machines due to tax anomalies. The current tariff structure on agricultural input machinery is shown in Table-4.1. Moreover, removal of standardization procedure(both local and imported machines) has increased importation of foreign machines indiscriminately.

Table-4.1. Current Tariff Structure on Agricultural Input Machinery

Item	Custom duty	VAT
Diesel engine (3-20hp)	7.5%	15%
Diesel engine (20.01-40hp)	15 %	15%
Spare parts	30%	15%
Agricultural machinery	15%	15%
Raw materials and accessories	15%	15%
Pumps	45%	15%

Source : S.H. Rahman, A New Tariff Structure for Agriculture Production Inputs, ADB, Dhaka, July 1992, pp. 41-46.

There has been no significant farm mechanization in Bangladesh. Land preparation is carried out almost entirely by bullock drawn plough. From the point of view of negative impact on rural employment, Government followed a restrictive policy in introducing mechanised tillage devices. After the devastating flood of 1987 and 1988, the restriction on importation (no need of standardization) and use of mechanised tillage devices has been withdrawn.

The agriculture sector is perhaps the only sector of the economy which has some organized mechanism for collection, processing and dissemination of technological information in the country. There is an "Agriculture Information Service (AIS)" under the Ministry of Agriculture with branches all over the country. The Bangladesh Agriculture Research Council (BARC) has links with international information system like AGRIS of FAO and the Commonwealth Agriculture Information System.

The agricultural research system in Bangladesh has attained a reasonably high level of expertise in almost all the fields of scientific investigation. It is now possible to adopt, develop and field-test new varieties of cereal crops. However, research and development capability in horticulture has not yet achieved the same degree of sophistication.

Technology transfer and development in the fisheries and livestock subsectors have been very slow and inadequate in the country. Both the subsectors offer wide ranging opportunities for technological upgradation. As shown in the case of food grain production, technological upgradation in this sector is bound to have positive effects with respect to income generation for the rural poor. Additionally increased productivity in these subsectors will open up possibilities of linkage industries and export possibilities.

4.2. Land Reform

Land is perhaps the most important and potentially powerful asset that a person, community or state controls. Land is not only valued in an economic and productive sense, but also as a symbol of social status and identity. The control of land is therefore a fundamental issue that dictates the very structure of a society.

Land reform is the redistribution and rearrangement of existing patterns of land ownership. Poverty, inequality and fertility are closely linked to the issue of land reform that have a direct impact on social development. In Bangladesh,the cause of failure of land reform is assumed to be the state interventions-that is the top down policies of giving equity and power to the peasants. This approach has rarely benefitted the poor. Present land tenure pattern in Bangladesh is as follows :

Percent Rural Households	Holding size	percent of land
4.9	>3 hactre	28.0
24.7	1-3 hactre	24.7
70.3	Nil or < 1 hactre	50.0 (approx.)

As regards farm size and productivity; there is a need for consolidation of fragmented land holding. To maintain the land ownership *status quo*, there is a need to improve the economic condition of the marginal farmers wherein the role of off-farm technologies is crucial.

4.3. Agricultural Credit

Acievement of self-sufficiency in respect of food grains has been an important objective of agricultural credit policy. Institutional credit in the agricultural sector is now channelised through a multiagency system which consists of (a) Bangladesh Krishi Bank(BKB) and Krishi Unnayan Bank, Rajshahi, (b) Nationalised Commercial Banks, (c) Bangladesh Samabaya Bank Ltd., (d) Bangledesh Rural Development Board and (e) Grameen Bank.

In Bangladesh, both the number of borrowers from the institutional sources of credit and the amounts by these have gone up. The amounts lent went up from Tk.500 million in the mid-seventies to over Tk.1100 million by mid-eighties. The percentage of rural households which received institutional

credit is around eighteen. It is reported that very few small farmers of the country have benefited from the credit facilities. None of the credit packages has any definite incentive that can generate and mobilize resources, and encourage the use of local technology.

Further, some of these credit lines are tied which excludes the local bidders and products. It is interesting to note that in most cases interest rates are same for all types of technology acquired through an agricultural credit scheme. There is also no credit support that can allow local level experimentation on agricultural technology. There is specially no low rate of interest for loan if that is used for technology transfer and development in the agricultural sector. However, some NGOs provide supervised credit to the farmers at a low interest rate which seem to be very effective, nevertheless, initiatives and policy support from the government in this matter are still half-hearted. At present, there is no financial mechanism to provide for risk capital funds for technology development in agriculture.

4.4. Privatization of Agricultural Inputs.

Full privatization including imports of irrigation equipment has been in effect from 1987-88. As regards fertilizer, there are occational reports of localised shortages, but certainly many fewer than in the days when Bangladesh Agriculture Development Corporation (BADC) had a monopoly of the retail or wholesale trade. Presently, the fertilizer market is very competitive, marketing costs are low compared to what they used to be under public sector distributions, and profit margins are modest. Shallow tubewell sales have also shown a healthy rate of growth (from 183 during 1987-88 to 276 during 1990-91). A priori one would expect a multitude of suppliers, whose livelihoods depend on providing the right input at the right times, would on balance serve the interest of users better than salaried employees who have no such incentives, and the Bangladesh experience to date has not belied this expectation.

4.5. Price Support

With the withdrawal of input subsidy, the need for output price support to the farmers comes to the forefront. In Bangladesh seasonal variation exists in the farm level prices of cereals; their prices remain low during harvest period and relatively high during off-harvest period affecting the small farmers mostly. The government procurement prices were not effective to achieve the objectives of price support. Recent government initiative for procurement of rice through open tendering represents one of the most daring policy innovations. Under the system, the government will buy rice from traders and not directly from millers, or for that matter from growers. Even though, the traders will buy at market prices rather than at an administered support price, the market price will itself be affected by the addition to aggregate demand represented by traders purchases for the government. Benefit per grower may be lower, but the beneficiaries will be all growers who sell a part of their produce, not just the tiny minority who have access to a mill or a government procurement centre.

4.6. Terms of Trade for the Agricultural Sector.

The rural purchasing power of the agricultural sector is better indicated by the movements in terms of trade (internal terms of trade) which is measured by the ratio of prices received by agricultural sector to the price paid to the industrial products. The level of increases of relative prices of agricultural products may affect the consumption basket of the rural poor. From 1978/79 to 1987/88, while the general price index of wholesale prices increased by about 15 percent, the prices of agricultural products grew by 16.03 percent per annum and that of manufactured products, by 12.69 percent.

It may be noted that the terms of trade deteriorated for agricultural products till 1982/83 from 1978/79 and then recovered slightly in 1983/84 and improving over the years since 1984/85.The relative decline in market prices of agricultural products had a negative impact on farmers and but a positive effect on the rural poor's real income.The real income of the rural poor is affected mainly by the consumer price indices of the rural people and by the prices of rice. Food accounts for more than 90 percent of total expenditures of rural population in the labour abundant country of Bangladesh. More than 60 percent of the expenses of the rural people on all food items are spent on rice. The rate of inflation relevant for the poor is therefore, determined by the price of food and particularly the price of rice. The price, in turn, is highly dependent on domestic production and imports of food, food aid, food grants, government expenditure on food subsidies. The price of wholesale coarse rice during 1975/76 and 1986/87 grew by 16 percent per annum at current prices. Welfare gains of consumer (rural poor) from rice policies/food subsidies is reflected in the real price of rice faced by the consumer. If the price of rice goes up, the consumer is worse off and better off if it goes down.

B. The Industrial Sector

The industrial sector has received 12.70 percent of total Fourth Five Year Plan(1990-95) allocation of Tk.672300 million. This sector employs about 11% of labour force in the country.In most industries, processing of raw and intermediate materials involves only simple and less sophisticated operation (assembling and packaging). As a result, cost of raw materials generally accounts for a large proportion of production cost; and value added to raw material is low. Some of the exceptions to this pattern are fertilizer, paper and cement industries. Large scale enterprises have mostly been set up under "package deals" or "turn key" contracts.

It may be mentioned that in Bangladesh most neglected area of productivity and technological research is in Industrial Sector (see:Appendix Figure-2). Poor performance of Industrial Sector may be attributed to poor investment in industrial research. There is no research organisation involved with research on absorption of imported technology (identification and evaluation of technological alternatives, regulation of technology importation, engineering design, technology adaptation, experimentation in plants etc.). In the manufacturing sector information collection, processing and dissemination systems are not so well developed as in the agriculture sector.

4.7. Technology Transfer in Industry Sector

The following sections attempt to briefly outline the extent of technology transfer attained and draw lessons from past experience in some of the major industrial sub-sectors.

4.7.1. Engineering Industries

Engineering industries play a critical role in raising domestic capability for local manufacture and fabrication of capital goods. These industries taken together can be considered as the driving mechanism for continual upliftment of the material base and technology in the country. There are four broad levels of engineering enterprises in Bangladesh, viz,

(a) Large integrated enterprises, e.g. BMTF, GEM, Dockyards, Shipyards etc.
(b) Medium size foundry and workshops
(c) Light engineering workshops
(d) Cottage level blacksmith shops and other artisans

The performance of the large scale public sector engineering plants has generally remained highly unsatisfactory, the level of capacity utilization remaining as low as 25 percent in Bangladesh Machine Tools Factory(BMTF) and 30 to 40 percent in most other plants. The unsatisfactory performance may have been partly due to lack of proper guidance from the government and partly because of lack of serious innovation efforts on the part of enterprises themselves to absorb and adapt foreign technologies through a dynamic technology transfer mechanism.

A question which obviously arises is the cost competitiveness of the local engineering sector. From several industrial case studies it has come out again and again that the local engineering sector is often able to compete effectively with imported items.

Lack of understanding on the part of the government to demonstrate its commitment to public sector engineering plants is apparent from the continued import of machinery and equipment which can be locally produced, using the huge installed capacity existing in the country. The 'self reliance' objective repeatedly put forward in the various plan and other policy documents appears hollow as the local capability has been ignored by suppressing the local demand for the various engineering products. Table-4.2 has been presented to get an idea of the impact on the engineering plants, following higher demand from five projects for their products which could be locally produced. In this table, only a small part of investment demand during the Fourth Plan have been considered. It is felt that in many other investment projects the picture will be the same.

Table-4.2. Impact on the structural engineering sector based on supply to selected scale projects during the Fourth Five Year plan(1990-95)

(Value in Tk.million: current prices)

Name of plants	Total capital investment planned during FFYP Tk. Mil.	Local supply structural engineering as envisaged in FFYP.	%of supply possible by using local structural engineering capacity(in design manufacture, fabrication)	impact on domestic structural engineering sector
Kafco	15,625	Nil	37.0 (5,781)	Significant
Jamuna	12,232	Nil	37.0 (4,526)	Significant
Power stations	30,640	Nil	10.0 (3,064)	Significant
Transmission line	19,760	Nil	34.4 (6,495)	Significant
Distribution	30,640	Nil	35.5 (10,899)	Significant

Note: Figures in brackets show investment demand in Taka Million which can be satisfied with local production.

Source: Bangladesh Planning Commission, The Fourth Five Year Plan; Bangladesh Power Development Board; and Rural Electrification Board.

Another issue relates to quality of output from the local engineering sector. Here also the performance of the public sector engineering plants is mostly satisfactory. BMTF and Bangladesh Diesel Plant(BDP), are manufacturing various items under licence from respectable foreign firms. In other plants like Chittagong Dry Dock and Renwick, where local production does not involve manufacture under licence, the quality of local manufacture has been found satisfactory,at times even better than similar imported items, by the users.

The issue of quality of output is equally relevant in the private sector. There is often inadequate availability of raw materials with required quality specifications. They also suffer from heat treatment and other facilities including surface treatment. Adequate availability of the required raw materials is obviously an important policy implication. There is also an urgent need to provide common support facilities, e.g. for heat and surface treatment, which all the relevant plants can use.

Most of the light engineering units are located in rural areas, and provides infrastructure for other Small and Cottage Industries (SCI's). The role played by these industries in overall rural technology development initiative is important due to two basic reasons; (i) provide the necessary tools and implements both for traditional farm and non-farm activities and (ii) they provide the rural based infrastructure for technology development, particularly in the engineering sub-sector.

Rural producers and in some cases users/consumers come out with good ideas (knowledge) which either pertain to entirely new design of marketable products or manufacturing processes or more appropriate introduction of the existing technologies. Such cases are very common in the case of rural engineering units, but as they take place informally they do not usually come within the purview of the formal recognition process nor do they adequately receive formal institutional support.

4.7.2. Chemical and Fertilizer Industries

Production of fertilizer- which started in 1962 with the production from the first plant of its kind at Fenchuganj - has made remarkable progress, the industry having now been firmly established with four large and two small plants for the manufacture of urea. The fertilizer industry is largely geared towards the manufacure of urea, using locally available natural gas.

The growth of the industry is based entirely on foreign supply of processes of production and also of machinery and equipment. There seems to be a dependence of the aid receiving countries on the preferential source of foreign suppliers of plant machinery. Such a relation is probably understandable because of the aid-dependent nature of Bangladesh's economic development and conditionality that most often goes with such aid.

The technology of fertilizer manufacturing is found to be controlled by a handful of suppliers. Furthermore, only a handful of general contractors mainly from developed countries have established themselves in this field. For a developing country to acquire some form of indigenous technological capability, a conscious and systematic government policy, has not been forthcoming. There should have been emphasis on in house R&D. There is also the need for an active decision-making role of the technocrats with respect to utilization and development of local capabilities. Unfortunately, Bangladesh is found to be lacking in most of these areas.

While drawing up contract for the installation of these modern fertilizer plants in the country the technology transfer arrangements included training in the skills and know-how required to operate and maintain the plant. In real terms such training does not provide the skill and experience to design and implement technical changes either by altering the particular production system or incorporating some new additional (possibly improved) equipment. Neither does it provide the necessary skill to design on our own a new similar facility. Thus, it is apparent that skills and knowledge required to manage the technology for new plants and those required to supply the technology intensive goods and services are difficult to transfer through the presently practiced contractual agreements in vogue in Bangladesh.

The lacuna in the technology transfer arrangement as mentioned in preceding section has cast its shadow in the capital goods sub-sector which had the potential capacity to meet some of the equipment needs of chemical industry. The large engineering industry built in the public sector over a period of nearly 25 years has remained grossly underutilized while some of the equipment and facilities which could have been fabricated locally have been imported time and again in the country. For instance, the following equipment facility can be built/fabricated within the country, viz,

(a) All storage tanks-including pressurized ones (upto 10-12 kg/cm^2)
- made of either mild steel or stainless steel
(b) All pipe racks, hangers, ladders, platforms etc.
(c) Several heat exchangers, all stacks etc.
(d) Electrical transmission and distribution work
(e) Water treatment plants, water intake stations etc.

It has been estimated that nearly 25% of the goods and services (inc. advisory and consultants fees) now being bought at the cost of foreign exchange could be provided locally. One has to examine the detailed itemwise Project Cost Estimate to locate areas where local contribution in the form of goods and services can be made. While drawing up the contract, the technical specification, scope of work and involvement of the client are to be clearly spelled out to identify the local inputs. Such efforts will start a dynamic technology transfer process through which local capability will grow not only to digest imported technology, but also to make innovations for application in local industries.

4.7.3. Cotton Textile and Jute Industries

Cotton Textile

Cotton textile industry has the longest history in the country. It is the second largest (jute being the largest) large-scale industry in Bangladesh. When Bangladesh was liberated the spindle capacity was 836 thousand and loomage 9000. The present figures are 1120 thousand and 6000 respectively. During the pre-liberation period the import substitution policy with respect to textile product resulted in high tariff protection. As a result the private sector dominated textile industry gave more emphasis to capacity building rather than technological efficiency or accumulation of capabilities.

During the post liberation period the cotton textile industry was nationalized and placed under the Bangladesh Textile Mills Corporation (BTMC). Immediately after nationalization and for a considerable period afterwards poor management of the mills resulted in technological stagnation. However, it needs to be pointed out that even during pre-liberation days these mills had suffered from slow balancing, modernization, replacement and expansion (BMRE). These problems were compounded by disruptions caused by frequent power failures. Thus, overall productivity of the units have declined steadily over time.

For some of the components and spare parts for textile industry, the country has acquired a degree of manufacturing capability. Nearly a quarter of the reeling machines, bundling and baling presses in present use has been locally produced. Thus, local technological capability is gradually (albeit slowly)

being built up and those mills with elaborate in house workshop facilities have fared better than others with respect to lowering of down time. Share of locally made textile machinery have fluctuated over time due to inconsistent policy with regard to in-country technological capability building. However, private manufacturers have started manufacturing power looms. This, indeed, is a welcome sign.

The BTMC need to concentrate in the encouragement and promotion of :

(a) Local machine building for the textile industry
(b) In-house quality control and standardization
(c) Productivity movement with relevant to the help of a central design and development services for the entire sub-sector (inc. publicly and privately owned enterprises)
(d) Marketing research and advisory services
(e) Information services with regard to technological changes taking place around the world.

In the post liberation era, the share of mill-made cloth to total domestic production was mostly between 13 & 16 percent-the share came down to 11% during the mid-eighties. The survival capacity of the traditional handloom sector is due to several reasons. Firstly, there is pronounced customer preference for handloom products. Secondly, handloom sector has lower labour cost. Thirdly, the large scale "modern" sector has suffered from inefficiency for a considerable length of time. Technological improvements in the handloom sector has been restricted to introduction of some semi-automatic power looms and availability of improved dyes. It is obvious that preference for certain handloom products will remain. Improvement in overall productivity, quality and diversity of products will call for innovations and import of technology referred to earlier. However, at the same time the growing garment industry should provide the necessary momentum for the technological upgrading of the large "formal" textile sector. Import of technology of more recent vintage (as opposed to the present trend) will soon become a necessity in this sector.

Jute Industry

Like the cotton textile industry, this subsector has also suffered from technological stagnation. Excessive government patronage during pre-liberation period provided no incentive to the industry to raise productivity or efficiency through technological upgradation. The local capability for spare parts production is slightly inferior to that of cotton textile industry. (This is indeed surprising because one would have thought that the "golden fibre" would attract more attention from innovative engineering manufacturers). After liberation of Bangladesh the industry underwent wholesale nationalization. Departure of skilled non-Bengali workers and management, worker discontent, excessive employment (including socalled shadow workers) have thwarted any move toward productivity movement through technology upgradation during the post liberation period.

There are, however, some positive things to report about technological development in the jute industry. Broad looms have been introduced for making carpet backing material, production of jute carpets are being manufactured using related sophisticated technology and jute yarn is being produced in some cases using state of the art technology. However, these innovations have so far failed to effectively counter the world wide decline for jute products-the new carpet mills and pite spinning mills are operating at low capacity utilization. Marketing and managerial weaknesses still persist (like in the cotton textile industry). Loss of markets to synthetics have aggravated the situation. However, concerted efforts to diversify the domestic (as well as foreign) use of jute in all probable ways have not been forthcoming. Additionally, the local capability in machine building (e.g. in Galfra-Habib) have not been utilized or encouraged.

4.7.4. Leather Industry

In Bangladesh leather processing industry occupies a very important place in terms of value added, employment and contributes nearly 12% of the total export earnings of the country. In terms of raw materials it enjoys a natural comparative advantage in having a raw material base of perhaps the finest kid leather ('Black Bengal Nanny Goat') in the world. Only jute/jute goods, garments and frozen food are ahead of leather in export earnings. About 90% of the output of leather industry is exported.

The government policy intends to move from low value added wet-blue leather to crust/finished leather and then to leather goods exports. That is, there is to be no export of finished leather after 1999. Local leather manufacturers are capable of making a positive move in this direction and success depends on government policy on technology transfer. Indeed, it is apparent that, given proper encouragement, the required expertise for moving into finished leather goods can be found among the present leather manufacturers. The manufacture of leather goods (shoes being the main item) has been found to be less demanding in terms of production expertise, but more demanding in export management. Technical collaboration with foreign established businesses in the field and also with machinery suppliers can prove helpful.

The leather manufacturers at the medium-and large-scale level are found to be reasonably well-acquainted with the technology. This is due to a number of factors. Firstly, some of them are closely in touch with foreign customers and emerging technologies. Secondly, about a dozen of the entrepreneurs have been in business for over 20 years. Thirdly, the size of the industry is reasonably big with over 200 establishments, including three dozen or so large-or medium-scale plants. Fourthly, the College of Leather Technology, being centrally located, has turned out to be very handy for obtaining some information as well as for providing reasonable expertise through regular supply of trained leather technologists. Finally, a number of simple types of machinery have been locally made for forty years,often by the leather manufacturers themselves, and some form of technological capability, though at a low level, has already been achieved.

The non-availability of long-term credit in foreign exchange and the absence of any protection for the local machinery industry can be singled out as the two main factors for the present state of affairs. Given that the industry has a high rate of return, one would expect that it should be able to continue to develop perhaps without subsidized loans. Rather, there should be restrictions on the import of machinery which is alredy locally produced or can be produced effectively.

4.7.5. Electronics Industry

Electronics industry in the country is mostly limited to labour intensive assembly operations. Most radio receivers and all television receivers are being manufactured using imported components and based on foreign design. On the other hand, automatic traffic control, voltage stabilizers, public address amplifier, intercom and various household electronic gadgets are fabricated based on indigenous design and some locally manufactured components. The ownership of the latter group of manufacturing units is characterized by persons with technical background with university degrees in physics or engineering.

The market for electronics within the country is still considered small for extensive vertical integration in the manufacture of electronics equipment. On the other hand, electronic finished goods become competitive only if most of the components are manufactured locally and in large scale. For successful development of export of electronics finished goods, it is necessary for Bangladesh to fulfill the value added requirement of the Generalised Scheme of Preference of the UN General Agreement on Tariff and Trade (GATT), that the sum of cost or value of materials in the beneficiary country plus the direct cost of processing must equal at least 35 percent of the appraised value of the article for duty free entry to USA and EEC countries. Therefore, the electronic industry in Bangladesh cannot depend on imported components for ever and must make a solid foundation by manufacturing components. It is estimated that the components in total would account for nearly 30 to 40 percent of the cost of equipments. However, electronics components industry is a vast area. Any decision to enter into this high technology industry must be preceded by careful selection of components to be manufactured.

Before the introduction of liberalization policies with respect to establishment of manufacturing units, sanctions for eletronics industries manufacturing radio and television receivers were given subject to progressive manufacturing of components (about 40 percent within the first year). It is seen that even after a lapse of more than quarter century since the establishment of the first electronics assembly industry, no electronics component for radio, not even "non-standard" components like plastic cabinet, knob, dial, pcb,transformer, etc. are being manufactured locally. The reason behind such stagnation are broadly two, namely;

(a) Component production is capital intensive and is more sensitive to scale of production . It is not possible for individual appliance manufacturer to go for such a venture. However,component industries may be encouraged as separate specialities and arrangements need to be worked out with assemblers through sub-contracting linkage.

(b) Generally a large number of parts/components are required for assembly of electronic appliances. Source of such parts are quite diverse and the local manufacturers normally procure all of them for a particular brand as a complete package from large manufacturers from overseas. To have the advantage of separate sourcing of parts and components, R&D in electronic products technology and tooling technology have to be initiated in order to provide technological support tothe growing firms.

4.8. Industrial Property Protection System

The responsibility of issuing patents and registering trade-marks in the country are vested with the Patent Office and Trade-mark Registration Office respectively. The Patent Office is under the Ministry of Industries and administers the Patents and Design Act 1911, Patent and Design Rules 1933 and grants patent for an invention and registers industrial designs according to the provision of the said Act and Rules inspite of the fact that much progress in the field of technology development has taken place since then. The terms of a patent is generally sixteen years from the date of application and can be extended for a period of additional ten years before the expiry of the term.

The number of applications for Patents and Designs (both local and foreign) received by the Patent Office in different years; and the number of cases accepted are shown in Table-4.3.

The Trade Marks Registry is under Ministry of Industries and administers Trade-marks Act. 1940, Trade-marks Rules, 1963 as revised in 1976, 1978 and 1985; and registers Trade-marks and Trade-names under the said Act and Rules. Registration of Trade-marks is not compulsory under the existing law.

4.9. Economic and Other Policy Initiatives

4.9.1. Industrial Policy

Just after liberation of the country the Government followed the nationalization policy. As a result, the private sector were left to operate in

Table-4.3. Status of Patents and Designs in Bangladesh (1972-1991)

Year	Patent Applied			Patent Accepted			Design Applied			Design Accepted		
	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total	Local	Foreign	Total
1972	51	158	209	9	3	12	14	-	14	-	-	-
1973	75	227	253	6	30	36	12	-	12	9	-	9
1974	74	171	245	10	265	275	12	-	12	3	-	3
1975	35	110	145	25	312	337	17	-	17	5	-	5
1976	35	119	154	10	119	129	34	-	34	9	-	9
1977	33	86	119	11	93	104	17	-	17	10	-	10
1978	36	113	149	13	108	121	34	-	34	18	-	18
1979	31	109	131	20	83	103	38	-	38	23	-	23
1980	34	102	136	19	82	101	91	2	93	44	-	44
1981	39	133	172	17	85	102	81	5	86	22	-	22
1982	40	104	144	13	105	118	66	5	71	26	5	31
1983	40	123	163	41	115	126	59	15	74	39	5	44
1984	62	108	170	17	94	111	154	6	160	32	8	40
1985	40	96	136	13	105	118	147	-	147	85	6	91
1986	16	77	93	26	81	107	175	2	177	161	1	162
1987	23	98	121	10	79	89	166	4	170	87	4	91
1988	24	189	133	8	67	75	176	3	179	43	3	46
1989	32	76	108	3	88	91	232	10	242	81	4	85
1990	32	76	108	9	85	94	110	3	113	77	3	86
1991	36	77	113	10	68	78	211	2	213	87	-	87
Total	789	2313	3102	260	2067	2327	1846	57	1903	861	39	900
Percen	25.4	74.6	100.0	11.2	88.8	100.0	97.0	3.0	100.0	95.7	4.3	100.0

N.B. In addition to above mentioned patents, right for 780 patents accepted during Pakistan period has been accepted. Number of patents accepted in a particular year includes patents applied in the same year and in previous years.

Source : Patent Office (Adapted from : Islam M.N; 1992).

small and cottage industries. Governments in power since 1975 have evinced disenchantment with the policy of nationalization and during 1975-1981 piecemeal reforms involving primarily the privatization of small scale enterprises were undertaken. This was followed by fundamental changes when the Government introduced New Industrial Policy (NIP) in 1982, the Industrial Policy: 1986 (IP-'86), the Industrial Policies 1991-93. Trade liberalization measures, and Investment Board Ordinance:1988 are also intended to expand the role of the private sector.

A major draw back of the Industrial Policy document is the non-mention of the mechanism and adequate policy tools through which the task of technology development is to be carried out. This task is demanding and has become more urgent in view of IP-91's greater orientation to development through the private sector.

It may be mentioned that the successful industrializing countries in Asia have utilized a judicious mix of policy instruments to achieve high rates of industrial and economic growth. The policy instruments fall into the following broad categories, viz

(a) Infant industry protection measures
(b) Credit and input subsidies
(c) Encouragement to mature industries to participate in global competition
(d) Technology investment led productivity policy.

Of the four stated categories of policy strategies/instruments, Bangladesh has experimented with first two. The other two policies have not yet been pursued with any degree of seriousness.

4.9.2. Industrial Investment

The GOB exercises general control over industrial investment through the public sector corporations and by imposing limits on both size and area of activity for private investment. Obviously, the Government does not have the same degree of control over the allocation of private sector investments in manufacturing as over public sector investments. Flows of private resources are determined largely by opportunities for profits, and it is the nature and scope of these opportunities that Government policy seeks to influence. The major instruments available at present for influencing the allocation of private investment are the sanctioning of investment, import controls, the tariff system, and other procedures for allocating foreign exchange. The sanctioning of investment is important particularly because it entitles the private industrialists to the allocation of foreign exchange for the initial capital goods imports and also allows them access to imports of raw materials and spare parts for their continuing operation. Crucial in this regard is the Industrial Investment Schedule(IIS) which lists the sectors and the permissible quantitative limits for investment, and thus serves as a guide to the investors as well as to the sanctioning authorities for approving industrial investment projects.

Credit to industrial investment projects is channelled mainly through Nationalized Commercial Banks(NCB's) and the Development Financing Institutions (DFI's). The DFI's/NCB's may give final sanction for industries worth upto Tk.300 million. For approval of industries beyond the financial limit of these institutions, the applications are referred to the Board of Investment (BOI).

4.9.3. Import and Export Policies

Investment in manufacturing enterprise involves import of capital machinery and equipment, spares, raw materials and consumables and arranging adequate fund to pay for their import under various sources of foreign exchange. The entire process is subject to import control policy and implementation procedures which have important effects on overall investment in the country.

Import Policy should be consistent and in conformity with the industrial as well as technology development policy of the country. For this purpose frequent changes of the import policy is not desirable. However, the last import policy of 1991 of the country has been made for two years instead of previously practised one year. The import policy of 1993-95 has just been announced and the basic feature of which is towards more liberalization in the context of pursuing open market economy.

As part of Government's effort to develop technology, one area of vital importance deserving close, priority attention is the export sector. To encourage export development is critical to enhancing the overall technological capabilities of the nation. However, the basic development approach which Bangladesh has tenaciously pursued since independence is mostly encouragement of the growth along the lines of import substitution. The basic strategy of the export policy 1993-95 is to simplify export procedures in order to expand the export base of the country.

4.9.4. Financial and Fiscal Incentives

A few financial and fiscal incentives as outlined in Industrial Policy 1991 are presented below :

(1) A tax holiday for five, seven, nine and twelve years for industries set up in the developed, less developed, least developed and special economic zones respectively is in effect until the year 1995. The period of such tax holidays is calculated from the month of commencement of commercial production.

(2) No discrimination in case of duties and taxes for the same type of industries set up in the public and private sectors is made.

(3) Duties and taxes on import of goods which are produced locally are higher than those applicable to import of raw materials to be used to produce such goods.

(4) In cases where credits/loans obtained from foreign institutions or Government through private initiative for private industrial investments, the government relend above mentioned credits/loans through commercial banks/DFIs.

(5) Provisions are made upto 80-100 percent accelerated depreciation allowance.

(6) Special financial incentive is provided for industries located in the least-developed areas and for development of small and cottage industries. In such cases the import duty on machinery and equipments varies in between 2.5 to 5.0 percent.

(7) As long as natural gas cannot be supplied to the non-gas-lined least-developed areas and the price of natural gas remains lower than that of fuel oil, a subsidy to the extent of 40% is provided on fuel oil use in industries in these areas.

To make investment in export-oriented industries most profitable and attractive, the following incentives and facilities provided by GOB are noteworthy :

(1) Concessionery duty is allowed on the import of capital equipment and spare parts upto 10 percent of the value of capital equipment for setting up export-oriented industries, and BMRE of existing industries.

(2) In case of export-oriented industries, facilities such as special Bonded Warehouse against back-to-back Letter of Credit or notional import duty and Value Added Tax (VAT) payment facilities are in force. The exporter can also get back the duty draw back directly from the relevant commercial bank.

(3) The arrangement for providing loans up to 90 percent of the value against irrevocable and confirmed Letters of Credit/Sales Agreement is in force.

(4) The export-oriented industries are allocated increased foreign exchange for publicity campaign and for opening offices abroad.

(5) The entire export earning from handicrafts and cottage industries are exempted from income tax. In case of all other industries, proportional income tax rebate on export earnings are given between 30 and 100 percent. Those industries exporting 100 percent of their products will have tax exemption up to 100 percent.

(6) The local products supplied to local projects against foreign exchange under international tender are treated as indirect exports and entitled to all export facilities.

(7) Export-oriented industries which are identified by the Government as crash/thrust sector are provided special facilities in the form of cash incentives, venture capital as well as are exempted from paying local taxes (such as municipal tax).

4.9.5. Exchange Rate Policies

Reform efforts undertaken by the government in improving the import policy regime in recent years have also been accompanied by some positive steps in the realm of exchange rate policies and mangement of the foreign exchange market. A flexible exchange rate policy has been in operation since mid-1979, when the government started a policy of steadily depreciating the Taka with a view to improving the international competitiveness of exports, promoting export diversification and encouraging efficient import substitution.

An important innovation in Bangladesh's import policy over the recent years has been the considerable expansion of the scope for financing imports through the secondary foreign exchange market (WES market), where supply and demand determine the price of foreign exchange and hence its allocation among competing users. The relative importance of the WES market has increased considerably in the recent years. The share of exports entering the secondary market has steadily risen, for example,from 8% in 1978/79 to 27% in 1984/85, and to 71% in 1986/87. Similarly, the share of imports coming through the secondary market has increased significantly. In 1985/86, all imports, except those financed by foreign aid or through barter arrangement, were assigned to the secondary market.

As a result of these measures, imports financed at the official exchange rate through cash licences were gradually reduced from 39% of total imports in 1979/80 to 16% in 1989/90. Imports through cash licences are now limited largely to essentials such as foodgrains, fertilizer, raw materials and capital machinery for export industries. The proportion of total imports financed through the WES market increased from about 8% in 1979/80 to 48% in 1989/90. These policies, by providing easier access to imported raw materials and intermediate goods through the WES market, did away with the cumbersome and time-consuming process of import licencing and increased the ability of manufacturers to plan and adhere to production schedules. Shifting of imports from the controlled official market to the secondary market where the exchange rate better reflects the opportunity cost of foreign exchange has also resulted in a narrowing of the gap between the official and the secondary exchange rates (only 1.8% during 1990-91)and facilitated the process of eventual unification of the dual exchange rate system.

Very recently Government has declared convertibility of Taka for current account transactions except for defraying educational expenses upto S.S.C. level including unapproved courses and remittance of family maintenance expenses for the Bangladesh nationals abroad. However, for the time being Government has deferred Taka convertibility on capital account until July, 1994.

4.9.6. Policy Support to Augment Foreign Investment

The Government is encouraging foreign investment with special importance. Such investments may be established either independently or through joint venture on mutually beneficial terms and conditions. The Foreign Private Investment (Promotion and Protection) Act, 1980 continues to be the legal frame-work for foreign investments. The main provisions that exist in this Act to protect foreign investment include:

- Ensuring equal treatment in all respects for local and foreign investments;

- Industries may be established in Export Processing Zones(EPZ entirely through foreign investment or through joint ventures

- Protection of foreign investment from nationalisation;

- Ensuring repatriation of proceeds from sale of share and profits. In addition, the Government is also aware of undertaking adequatemeasures for protecting the intellectual property rights such as,patents, designs and trade-marks and copyrights. The exemption royalties, technical know-how and technical assistance fees and the facilities for their repatriation are enclosed.

- In case of foreign investments, there is no limitations pertaining to equity participation, i.e. up to 100 percent foreign private investment allowed.

- In case of joint ventures of industries set up independently by foreign investors, there is no obligation to sell shares through public issues irrespective of the amount of paid-up capital.

- If the foreign investors reinvest their repatriable dividents, those are treated as new investments.

- Foreign investors or companies with foreign investments may obtain working capital loans equivalent to their equity amount. The amount and terms of loan are determined in accordance with the Bank-Client relationships and the bank's rules and procedures.

- Exemption of income tax up to three years for the foreign technicians employed under the approved industries.

5.0. CONCLUSIONS

Government's recent efforts for accelerated economic development, hightens the need for rapid industrialization but a programme of action for sector specific reforms is essential for private sector development which calls for building national technological capability to be competitive in the international market. The commitment of the Government for accelerated privatization, decontrol and rapid growth of private sector brings to the foreground the issue of deregulation and acquiring investment induced technological capability.

For Bangladesh economy, foreign direct investment may be considered as the most potent instrument of technological development and therefore an equalizer of the quality of life. It is therefore absolutely essential to have a long-term national technology development plan along with effective policy instruments on a continuing basis to encourage investment flow and to facilitate technology transfer.It may however be noted that technology may be transferred as part of a foreign investment package or the other way in which government need to invest massively in technical education and R&D for encouraging the inflow of foreign technical expertise. The latter process is intended to develop indigenous technological capacity through the process of evolving "follower strategy" initially and subsequently leading to innovative capability. A policy option to address the issues of technological capability

building therefore must take into account the above mentioned aspects and accordingly strategies need to be redirected considering the present technological base of the country and willingness to invest progressively in R&D activities. This is because, in order to exploit the technological advances there is no alternative to building national technological capability i.e. the ability to scan, assess, select, use, assimilate, improve and develop technology appropriate to socio-economic needs of the country. With this aim it is felt that there is a need to prepare a Technology Capability Schedule (TCS) for the country, on the basis of which future programme of actions would have to be evolved.

It may be noted that technological capability is by its nature embodied in people and institutions not machinery *per se* and requires interactions and networks as the technology is constantly changing. Therefore, increased investment (domestic and foreign) in various technological areas as mentioned in the study is urgently called for to acquire national technological capability.

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APPENDICES

Appendix-1

Pattern of Project Assignments carried out by the Consulting Firms[1] based on past activities.

		Projects No.	Completed %
1.	Pre-Feasibility/Feasibility Studies/ Pre-Investment Studies		
	- Techno-Economic (New Projects)	54	23.89
	- Balancing Modernization,Replacement etc.	3	1.33
2.	Works Improvement Study	7	3.10
3.	Market Survey	16	7.00
4.	Project Evaluation/Project Report Preparation/Technical Evaluation Reports	15	6.64
5.	Valuation of Assets	4	1.77
6.	Bid Evaluation	3	0.88
7.	Appraisal of Gas Field/Analysis of Gas Distribution Net Work/Other Gas Related Studies	3	1.33
8.	Seismological Studies on Site Selection	1	0.44
9.	Design and Fabrication of Parts and Simple Equipments	13	5.75
10.	Erection and Commission of Machines and Small Plants	14[2]	6.19
11.	Design and Installation of Gas/System Pipelines	3	1.33
12.	Design, Installation and Commissioning of Electric System	20	8.85
13.	Design, Installation and Commissioning of Air Conditioning System	60[3]	26.55
14.	Miscellaneous	11	4.87
	Total	226	100.00

1. Does not include Civil/Architectural Firms.
2. Includes erection of three small plants (Sulphuric Acid,Ground Nut Oil and Cheese Manufacturing Plants)
3. Includes five industrial system.

Source : Haque, Mainul. M (1990).

Appendix-II

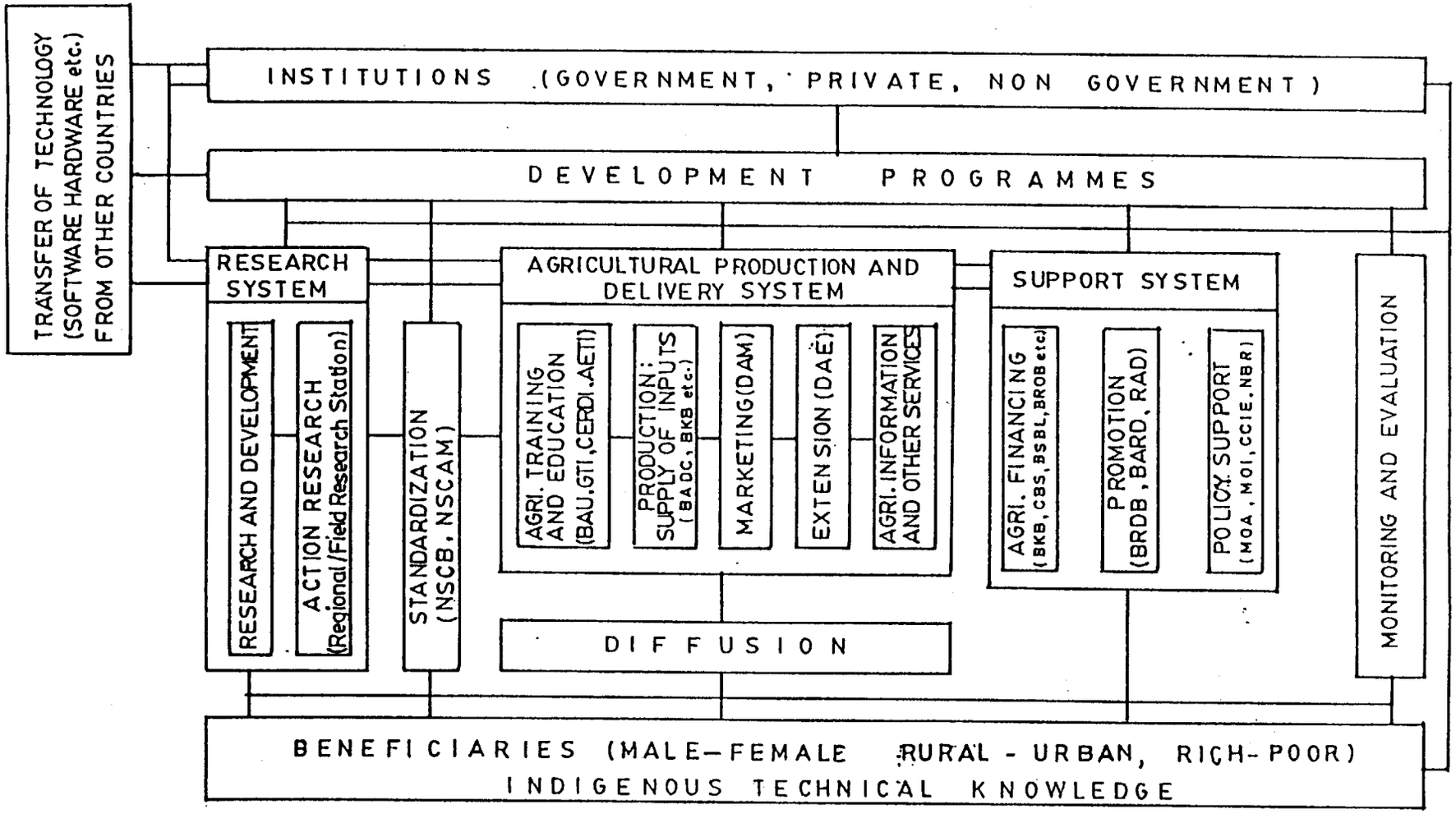
Major research organizations with their missions

Organization	Mission
Agricultural and Water Resources	
Animal Husbandry Research Institute	Animal husbandry development
Bangladesh Agricultural Research Institute	Multicrop development
Bangladesh Agriculture Research Council	Research coordination and multi-disciplinary research in agriculture & water resources
Bangladesh Jute Research Institute	Improvement of varieties of jute & multiple uses of the fibre
Bangladesh Cotton Development Board	Development of cotton varieties under local conditions
Bangladesh Rice Research Institute	Research on varietal improvement & cropping systems
Fisheries Technological Research Station	Fish breeding
Fisheries Research Institute	Fish breeding
Forest Research Institute	Silviculture, forest products utilization
Fresh Water Fisheries Research Station	Fresh water fisheries development
Livestock Research Institute	Livestock development
Hydraulic Research Institute	River hydraulics & morphology
River Research Institute	River hydraulics & morphology
Marine Fisheries Exploration and Research Centre	Marine fisheries development
Marine Biological Research Station	Marine fisheries development
National Herbarium	Collection of plant varieties

(continued) : Major research organizations with their missions

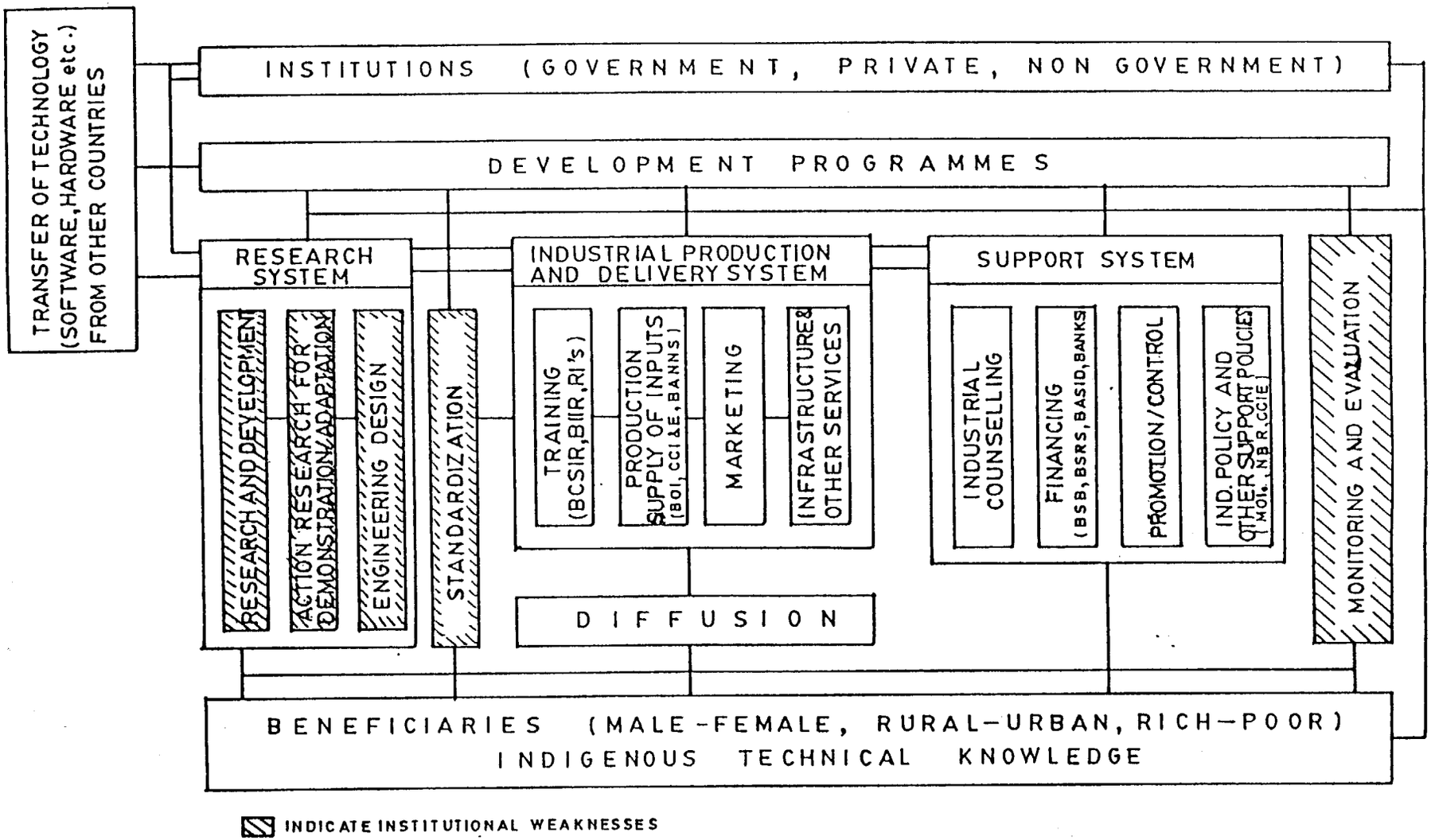
Organization	Mission
Institute of Nuclear Agriculture	Varietal improvement through application of radiation techniques
Sugar-cane Research and Training Institute	Improvement of sugar-cane varieties
Soil Research Laboratory	Determination of nutrient requirement of soils
Tobacco Research Station	Varietal improvement of tobacco
Bangladesh Tea Research Institute	Varietal improvement, tea processing & management of tea gardens
Industrial and general	
Bangladesh Council of Scientific & Industrial Research	Multidisciplinary research, pilot plant investigation, product development.
Bangladesh Atomic Energy Commission	Use of atomic energy and radiation techniques in various fields.
Bangladesh Space Research & Remote Sensing Organization	Space research and remote sensing.
Road Research Laboratory	Development of road building materials.
Housing & Building Research Institute	Low-cost housing & building materials development
Geological Survey of Bangladesh	Survey & research on geological resources
Sericulture Research and Training Institute	Sericulture development

Source : Islam M. Nazrul and Haque Mainul M (1993)



APPENDIX FIGURE 1. FUNCTIONAL DIAGRAM FOR DEVELOPMENT, ADAPTATION AND DIFFUSION OF AGRICULTURE TECHNOLOGY IN BANGLADESH : STATE OF THE ART.

SOURCE: HAQUE, MAINUL M (1987)



APPENDIX. FIGURE 2. FUNCTIONAL DIAGRAM FOR DEVELOPMENT, ADAPTATION AND DIFFUSION OF INDUSTRIAL TECHNOLOGY IN BANGLADESH : STATE OF THE ART

SOURCE : HAQUE MAINUL M (1987)

ABBREVIATIONS

ADP	Annual Development Plan
AIS	Agriculture Information Service
BADC	Bangladesh Agriculture Development Corporation
BANSDOC	Bangladesh National Scientific & Technical Documentation Centre
BARC	Bangladesh Agriculture Research Council
BARI	Bangladesh Agriculture Research Institute
BBS	Bangladesh Bureau of Statistics
BCSIR	Bangladesh Council of Scientific & Industrial Research
BDP	Bangladesh Diesel Plant
BIT	Bangladesh Institute of Technology
BITAC	Bangladesh Industrial and Technical Assistance Centre
BKB	Bangladesh Krishi Bank
BMET	Bureau of Manpower Employment and Training
BMRE	Balancing Modernization, Replacement & Expansion
BMTF	Bangladesh Machine Tools Factory
BOI	Board of Investment
BRRI	Bangladesh Rice Research Institute
BSTI	Bangladesh Standards and Testing Institution
BTMC	Bangladesh Textile Mills Corporation
BUET	Bangladesh University of Engineering & Technology
DFI	Development Financing Institution
DTE	Directorate of Technical Education
EEC	European Economic Community
EPZ	Export Processing Zones
FAO	Food and Agriculture Organization
FFYP	Fourth Five Year Plan
GATT	General Agreement on Tariff and Trade

GDP	Gross Domestic Product
GEM	General Electric Manufacturing
GOB	Government of Bangladesh
IDA	International Development Agency
IDB	Islamic Development Bank
IP	Industrial Policy
IIS	Industrial Investment Schedule
MES	Modules of Employable Skill
NCB	Nationalized Commercial Bank
NGO	Non-Governmental Organization
NIP	New Industrial Policy
NSTP	National Science & Technology Policy
PATC	Public Administration Training Centre
Ph.D.	Doctor of Philosophy
R&D	Research and Development
SCI	Small and Cottage Industries
S&T	Science & Technology
TCS	Technology Capability Schedule
TTC	Technical Training Centre
UGC	University Grants Commission
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UPE	Universal Primary Education
USA	United States of America
US$	United States Dollar
VAT	Value Added Tax
VTI	Vocational Training Institute
WES	Wage Earner Scheme