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Full Length Research Paper

The role of science and technology education at network age population for sustainable development of Bangladesh through human resource advancement

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Education is supposed to play a vital role for the development of a nation. Many countries made progression through education. Nevertheless, some of them also failed to retain the development achieved since these countries failed to supply required skilled workforce for emerging economics caused by globalization and rapid change of economic pattern. This now forces policymakers to prioritize the production of skilled manpower that can contribute for sustainable development. The countries that achieved sustainable development have given a high priority to science and technology education in formulating education policy. Bangladesh has no more alternatives in order to gain development, except properly utilizing its population. Bangladesh's economy and human development could have grown faster than its actual progression in the last 25 years (that is, since independence in 1971), if it had earlier taken substantial steps in educational development. This paper has defined a 'network age population' for Bangladesh. This paper also suggests that this population is required to provide science and technology based education with some revision of education policy in order to ensure the sustainable development.

Key words: Employment market, network age, societal dependency, technological transformation, Technology Achievement Index (TAI), workforce development.

INTRODUCTION

The more seriously we examine the 'route map', the more closely the discussion on sustainable development comes to resemble a debate on the right concept for structuring national and even global society. The notion of sustainable development relies on a transparent process of debate and learning involving the whole of society, in a way, largely unknown until now. As a result, sustainable development is one of the most demanding, but also one of the most complex, concepts which political thinking can give rise to. Sustainable development as a new paradigm poses the challenge of thinking in the medium to long term, instead of the short term. It challenges societies to work in an interactive and cooperative way, instead of in categories defined by self-interest. It challenges them to reconcile conflicting rationalities in work practices in science and politics and to link efficiency, fairness and provision. Sustainable development, as a concept, allows us to appreciate better how we can optimize the process of shaping the future and that politics, aided by science and technology (S&T), can take a more active role in that process. S&T analysis and research can make the possible consequences of decisions or lack of action clear. The "learn and search" process for the most suitable pathways to sustainability can be organized more efficiently by means of such signposting. This places S&T firmly on the sustainable development agenda.

Problem statement and research questions

Population is the living wealth of the nation. Development thus centres on expanding the people's choices to lives that they value. An analysis of growth pattern and age group distribution of population including identification of the period of least dependency provides fundamental basis for planning for population and development. The workforce deployment at the micro-level presents the distribution of the workforce in two major sectors: agriculture and industry of a number of countries and explains the reasons why the developing countries require transforming their workforce from agriculture to industrial sector.

The workforce employment pattern presents mainly in the context of Bangladesh; the percentage distribution of the workforce as professional, mid-level technical person power and skilled workforce. The education system of the country suffers from very low level of external and internal efficiencies and is mostly non-responsive to the employment market demand (Alam, 2008a). Education is the key to creating, adapting and spreading knowledge for technological transformation in the network age. Basic and secondary education create ability to learn and interpret information whereas the tertiary education is responsible for producing higher level workforce, producing new knowledge and adapting knowledge produced elsewhere.

Current situation of science and technology in Bangladesh

The need for faster technological development is increasingly felt in Bangladesh. Development plans of Bangladesh have emphasized science and technological research to develop technologies through adoption of imported technology as well as development of indigenous technologies. As the country is heavily dependent on imported technologies, proper planning is required for its effective transfer through acquisition, assimilation and adoption (Alam, 2008a).

A National Science and Technology Policy has recently been formulated and adopted by the Government. It has laid down the directions for S and T activities and research, institutional and manpower development, dissemination and documentation facilities. The National Council for Science and Technology (NCST) determines S and T policies, reviews the activities of different institutions and provides direction towards S and T research and activities. These are the efforts recently taken by the government. However, education system is yet to respond with a well-timed science and technology education and facilitates for education that can cater well the network age population to bring sustainable development through the advancement of human resources.

Objectives and research questions

This paper includes an overview integrating population and development, workforce deployment at the macro-level, workforce employment pattern, non-responsiveness of education to employment market in the context of Bangladesh and technological transformation in the network age. In doing these, the paper will answer following research questions:

1. What is the present status and problem in science education?
2. What are the reasons for decline in science enrolment?
3. What is interrelationship between population and development?
4. What is the contribution of education in developing workforce focusing on science education?
5. How can education system in Bangladesh play a constructive role for creating workforce for sustainable development?

Before writing the data that are used to have the findings of research, the writing that follows explores the role of education in development focusing on science and technology education.

LITERATURE REVIEW

The role of education in development

Education is to be considered as a key agent of development, either as a way of developing human capacity, increasing the skilled workforce for modernisation, or as a matter of personal freedom, developing capability and empowerment. From the 1940s onwards, and as described in the previous section, education provision was either considered in terms of producing the requisite 'manpower', which the country needed as an investment and which would yield both social and private rates of return, or as a response to social demand (Thomson, 1981). However, due to the popularity of more humanistic theories of development in the 1990s, there was a general realisation that education was not only the key to economic development and human capacity/productivity building, but was also a basic human right and a necessity.

Above all, education is a human right and, as such, should receive priority in the allocation of national resources. It is very short-sighted to keep education bound and gagged to the role of manufacturing skilled manpower, or to judge one's success by the number of either children or adults who have efficiently undertaken a 'learning package' (Hallak, 1990, p. 45).

Education was previously seen as fundamental, not only to the economic development, but also to the social and political development within nations and for individuals. Hallak (1990) argues that education is also linked to human resources development and that this has an impact on more than just economic growth, but also an impact on the wider development of individuals and societies. Education, he argues, contributes to:

- Individual creativity, improved participation in the economic, social and cultural roles in society.
- Improved understanding of an individual and heir res-

pect for others, thus promoting social cohesion and material understanding.

- Improvement in health and nutrition.
- Improved chances of economic development.
- Improved technological development.
- Socio-cultural change.
- Democracy and equality.
- Ecological development/quality of life (increasing people's awareness of their environments).

Examining the list, it is clear that for Hallak, modernisation and economic development, although desirable, are not the only aspects of human development that are and should be enhanced by education provision. Participation in social, political and cultural activities and improvements in health as education goals are equally important. Woodhall (1997) notes that investment in education and training produces benefits for the individual and for society as a whole. Moreover, Tilak (2002) observes that education not only benefits those who gain it through increased income, but also helps overall social development. The return on investment for society will be a skilled workforce that will enable global competitiveness and economic growth, while the return for the individual will be an improved career path, increased earning power and a better quality of life. According to Fagerlind and Saha (1989), the concept of 'human capital' suggests that education and training raises the productivity of workers and increases their earnings over their lifetime. But this is not always true for the high percentage of learners and trainees who have gained their education leaving certificates. It is the people with a high level of education; observe Fagerlind and Saha (1989), who are most likely to benefit from human capital investment.

The role of science and technology (S&T) in development

Over the last three decades, numerous studies, reports and memoranda have made dire predictions about what is likely to happen if governments, businesses and consumers do not change their patterns of behavior (Alam, 2008b). These studies and reports have made it clear that a 'business as usual' approach will lead to significant environmental problems, economic crises and social tensions. This outlook has made sustainability a popular term in political debate. In essence, it means "sustaining the ability of a system to function in the long term. Underlying this term is the need for societies to check whether patterns of behavior and political, technological and economic decisions do not damage the prospects for future generations to enjoy a full economic and social life, without serious impairment to environmental endowments and life support systems.

The truth of Muir's famous dictum, 'Everything is connected to everything else in the universe', is becoming ever more obvious as economies merge into global interdependencies, and for the first time in human history, our technologies and the ways people use them have the capacity to transform the biosphere itself. At the Global Sustainability Summits in Rio de Janeiro in 1992 and Johannesburg in 2002, countries committed to developing along a sustainable path, and over the past decade, numerous international agreements, for example, on climate change, biodiversity and social development, have been entered into (Alam and Shahjamal 2009, Alam, 2008). Under the Kyoto Protocol and the Biodiversity Convention, for example, governments have looked beyond short-term interests and have made commitments that are intended to protect and improve the environment in the long term. In these and in many other similar cases, scientific analysis, informed by research, has been centrally involved, both in defining the problems and in developing strategies which shape policy.

Representative bodies of the international scientific community, such as the International Council of Scientific Unions (ICSU) and the World Congress on Science, have underlined, in significant policy statements, the contribution of S&T to sustainable development. The ICSU, representing hundreds of national academies and professional bodies, observed, in preparations for the 2002 World Summit on Sustainable Development in Johannesburg: "Sustainability has become a 'high table' issue in international affairs, and on many regional, natio-nal, and local agendas. Though visions of sustainability vary across regions and circumstances, a broad international agreement has emerged that its goals should be to foster a transition toward development paths that meet human needs while preserving the earth's life support systems and alleviating hunger and poverty that is, integrate the three pillars of environmental, social and economic sustainability.

Science and technology are increasingly recognized to be central to both the origins of sustainability challenges, and to the prospects for successfully dealing with them. Decision makers, at all levels, need timely, reliable access to the knowledge generated by science and engineering to introduce rational policies that reflect a better understanding of complex technical, economic, social, cultural and ethical issues concerning the society, the earth, and its environment".

The ICSU, along with government and inter-governmental agencies, subscribed to the statement of the 1999 World Congress on Science and the Use of Scientific Knowledge, which urged a more central role for science in policy formation: "Enhancing the role of science for a more equitable, prosperous and sustainable world requires the long-term commitment of all stakeholders, public and private, through greater investment, the appropriate review of investment priorities, and the sharing of scientific knowledge. Science decision-making and priority-setting should be made an integral part of overall development planning and the formulation of sustainable development strategies".

UN Secretary, General Kofi Annan, previewing the World Summit on Sustainable Development in Johannesburg in 2002, noted that "the model of development that has brought us so much has also exacted a heavy toll on the planet and its resources. It may not be sustainable even for those who have already benefited, let alone for the vast majority of our fellow human beings, many of whom live in conditions of absolute deprivation 'So far, our scientific understanding continues to run ahead of our social and political response'. The international scientific community, in its contributions to preparations for the Johannesburg Summit, recognized the need for science to make itself more policy-relevant. A 'dialogue paper', prepared by a consortium of international scientific bodies, urged problem-oriented and interdisciplinary research that addresses the social, economic and environmental pillars of sustainable development. The scientific organizations stressed the need to overcome divisions between the natural and social sciences, and proposed that research agendas must be defined through broadbased, participatory approaches involving those in need of scientific information.

Data

Research for this paper, the first of its kind in Bangladesh, has been carried out through secondary data. With in the current climate in Bangladesh, science and technology education receives less priority in policy formulation (Alam et al., 2009). Thus, it is very early to use primary data to investigate the impact of science education.

Unless science and technology education is developed to confront the challenges of 21st centaury, science education will be legging behind resulting lack of research and innovation at science education. Considering these, it is time to make aware the society and policy makers to seriously consider this issue. Thus identifying the role of science education, this research advocates the need to science education and the nature of science education required given the type of increasing network age population using following data.

The main data sources used for this paper are the United Nations Development Programmes (UNDP), United Nations Educational Scientific and Cultural Organisation (UNESCO, 2001), Human Development Reports (UNDP, 1994, 1995, 2001, 2002), The World Bank Reports (2002, Document available at: www.worldbank.org), United Nations Population Division Reports (1999; Document available at: www.un.org/popin/wdtrends.htm.), The University Grants Commission (UGC) Reports (UGC, 2001, 2002, 2003), The Bangladesh Bureau of Educational Information and Statistics (BANBEIS) (BANBEIS, 2007) Reports and a series of unpublished study reports planned and conducted by Prof. Rafique[1] from 2000 to 2004 involving employment market and education programmes of the technical and vocational graduates. By the large, from least to highest development of South East Asian countries that have been considered for analysis of situation and data include: Bangladesh, India, Indonesia, Japan, Pakistan and South Korea. Literatures also supplement where necessary.

In addition, 13 years spent researching alongside education system in Bangladesh allows for some of the arguments to reflect personal observation during that time.

FINDINGS AND DISCUSSIONS

Present status and problem in science education

The state of science teaching in schools and colleges in Bangladesh is far from satisfactory. Science once the most sought-after subject at secondary, college, and university levels in the country is losing its appeal in an alarming shift of choice. Qualified teachers and properly equipped laboratories are few and far between and could hardly be found in most of the schools. The teaching methodology and teachers cannot inspire the serious and meritorious students to take up science for their higher studies. As a result, enrollment in secondary and post-secondary science has steadily fallen over the last 10 years. This is alarming. If we cannot stop this trend, we will very soon be facing a situation where science and scientific enterprises in our country will be seriously jeopardized, leaving us as a nation of traders (Alam, 2008a).

Nowadays science education is losing its importance, quality, and priority over other areas of education. This is alarming, especially when development can only be achieved through assimilation and application of technology. In the past a science teacher in Bangladesh invariably implied a person with strong background in science and mathematics. Unfortunately, today students in Bangladesh can earn a BSc degree without mathematics.

Moreover, science students are opting for non science subjects for their higher education because of demand in the job market, indicating the poor priority that we are attaching to science education. We have been unable to impress young students with the beauty and joy of science. Our industries, including information and communication technology, do not perform anywhere near expectations. This must have resulted in the setback of science enrollment. In the name of globalization, multi-

[1] Professor Rafiqe is a distinguish scholar; the former Director General of Directorate of Technical Education, Bangladesh currently working with the UNESCO, Dhaka office

national companies are penetrating into the country with their products, for which we are acting as agents or salespersons only. This has perhaps increased students' interest in business studies. Even students with strong skills in physics, chemistry, and mathematics are opting for business studies (Alam, 2008b).

This trend of decline in science education is noticed also in the universities. There are 25 public universities and 53 private universities in Bangladesh. Most of the private universities offer bachelor's of business administration (BBA) degrees but rarely any basic science subjects (Alam, 2008b; Alam and Khalifha, 2009). The gender distribution in teaching staff and the student enrollment shows an alarming disparity in male versus female ratio in all the universities. In these institutions of higher education, women account for less than 20% the numbers of female students in science in both the public and private universities is less than 20% (Alam, 2008b).

Reason for decline in science enrolment

A national workshop to identify problems of science education in Bangladesh was organized by the Bangladesh Science Academy in August 2006. Some of the problems identified as common in both secondary and higher science education include lack of laboratory space, lack of funding, and inexperienced and fewer qualified teachers with poor salaries and lack of motivation.

There are fewer science-based jobs in the country. The IT boom seems to be over (Alam, 2008b). Most industries in the country do not have R&D facilities. Science education is regarded as difficult and only attracts top students in schools and colleges. Science education is made more difficult by poor and unattractive teaching and too much unnecessary workload with poor or no laboratory facilities, computing, or Internet facilities. Even students with strong skills in physics, chemistry, and mathematics are opting for business studies. In a typical private university, more than 50% of the students are enrolled in BBA studies because it is easier to get good grades and then good jobs.

With the introduction of grading systems, students are more interested in ensuring the highest grades. This is discouraging students from attaining skill in mathematics and other science subjects. We need to write good science books. Salary and other benefits of teachers should be given due consideration. Commitment of the government to create a science and technology-driven economy to face challenges of the 21st century is important.

We can organize competitive events to popularize science among children. Olympiad-type events do not require huge funds. One important way for students to find joy in science is through commonplace scientific experiments. By directly observing cause and effect students internalize knowledge. However, experiments are not emphasized in schools and colleges, partially due to insufficient funds for purchase of scientific instruments and constructing laboratories. It is true that equipping every school laboratory with imported scientific instruments and consumables is a significant investment; scientific instruments from indigenous materials may be used as an alternative.

Population and development

Linkage between population and development is important to maintain a positive balance between the socio-economic development and population growth. Rapid and unplanned population growth is likely to create untenable strain on social, economic and natural carrying capacity of the land. According to the Fifth Five Year Plan (FFYP) document the population of Bangladesh was only 42 million in 1950 with density of 290 persons per square kilo metre, in 2010 population is projected to be 218 million - a five fold increase (The Ministry of Planning, 1996). As per the United Nations Population Divisions 1999 document projection during this 100 years population of India will increase 4.5 times, Indonesia 4 times, South Korea 2.6 times and Japan 1.3 times. The density of population in 2050 will be 1515 persons per square kilo metre in Bangladesh, 466 in India, 167 in Indonesia, 527 in South Korea and 290 in Japan (United Nations Population Division, 1999).

The percentage of population in the age group 5-14 years in Bangladesh in 1950 was 23.1, in 1990 the percentage was 28.4, in 1995 it was 30.1, and the prospective percentages will be 20.2 in 2010; 15.0 in 2030 and 13.8 in 2050. The number of school-going population of 5-14 years was 9.7 million in 1950, 31.0 million in 1990, 31.0 million in 2000, and the number will be 31.0 million in 2010, 28.35 million in 2030 and 30.0 million in 2050 (The Ministry of Planning, 1996).It should be noted that the absolute number of school-going children in the age group of 5-14 years after 2000 will remain steady and rather decrease during the next 50 years.

The combined old and young dependency ration that is societal dependency in Bangladesh was 0.78 in 1950, 1.07 in 1980, 0.69 in 2000, and it is assumed that in 2020 the societal dependency will be 0.54 in 2030 0.49, 2050 0.68 (Bangladesh Bureau of Statistics, 2005; Document available at: www.bbs.gov.bd.). The least dependency ration for Bangladesh may happen in 2030. This happened for Japan in 1970, for South Korea and Sri-Lanka in 2000 and will happen for both India and Indonesia in 2020. The dependency ratio was 1.07, the highest in Bangladesh was in 1980 and then gradually started declining and the lowest will occur in 2030. Even counting from 2000 it will take 30 years to acquire a status of highest proportion of active working population. Heavy investment on education and health services during this period will help to build human capital to spur accelerated economic and social development. The East Asian countries took this opportunity of demographic bonus in their development planning. South Korea increased secondary enrolment from 34 to 84% between 1970 while tripling the expenditure per secondary pupil.

Workforce deployment

The Fifth Five Year Plan (FFYP), 1997-2002, document projected the total employment to increase from about 50 million in 1996-97 to 56.53 million in 2002 in six major sectors: agriculture, industry, power-gas, construction, transport, and trade and services of the economy (The Ministry of Planning, 1996). The overall projected increase of employment was 12.7%. The sector wise percentage increase of employment projected was: agriculture 6, industry 58, power-gas 105, construction 15, transport 17, and trade and services 14. The percentage distribution of workforce in 1996-1997 and projected for 2001-2002 in these six sectors were: agriculture 63 to 59, industry 7.4 to 10.4, power-gas 0.21 to 0.43, construction 2 to 2.11, transport 4.4 to 4.6, and trade and services 23 to 23.4. The actual projected employment of the workforce in 2001-2002 for six sectors will be: agriculture 33.382 million, industry 5.847 million, power-gas 0.215 million, construction 1.196 million, transport 2.626 million, and trade and services 13.079 million. The Bangladesh Economic Review 1999, published by the Ministry of Finance (1999), presented on the basis of 1995-96 workforce survey the overall percentage distribution of workforce is: family work 40.1, day labourers 17.8, on the job 12.4 and self-employment and employing others 29.6 (The Ministry of Planning, 1996).

The UNDP Human Development Report (1994) presented that the agricultural workforce deployment for Bangladesh is 60% of the total workforce and contribution to the economy from this sector is 30% and that for India is 60 and 29%, while Pakistan is 56 and 26%. The rates of deployed workforce in agriculture and contribution to the economy in Sri-Lanka are respectively 49 and 23%, in Australia 5 and 5% and in Japan 7 and 2% (Food and Agriculture Organization, 1997). It is observed that as the economy moves higher the dependency on agriculture decreases so also the deployment of workforce in agriculture decreases. A cross comparison of agriculture workforce productivity among seven least to most developed countries of the world shows that the per capita contribution of Bangladesh agriculture workforce was US$ 226, the lowest among these countries. The per capita contribution of the agriculture workforce in US$ was for Pakistan 404, India 466, Malaysia 4,052, South Korea 5,032, Japan 16,712 and Australia 22,256. The per capita contribution of agriculture workforce of India and Pakistan was about 2 times that of Bangladesh, and for Malaysia 18 times, South Korea 22 times, Japan 74 times and Australia 98 times.

The deployment of Bangladesh workforce in the industrial sector (manufacturing and others) was reported as 16% and contribution to the economy 18% and these figures for India was 16 and 29%, Pakistan 20 and 24%, Sri-Lanka 21 and 25%, Japan 34 and 38% and Australia 26 and 28% (The Ministry of Planning, 1996). For all these countries it is observed that as the economy moves higher contribution of industrial sector increases so also the deployment of industrial workforce increases proportionately. Both Bangladesh and India deployed 16% workforce in industrial sector but the contribution of Indian industrial workforce was 11 points percentage higher than Bangladesh workforce in the sector (Pritchett, 1996). There might be a number of reason for the low level productivity of the Bangladesh workforce but the most important one attributed to this was the low level performance competence of the workforce in turn their poor quality of education and training for the job they were occupying. As a result, Bangladesh's industrial goods and services and agriculture products cannot compete even with Indian industrial goods and services and agriculture products. The only reedy to this situation is to improve the performance competence of the Bangladesh employed workforce through appropriate education and training. A sound basic education of the workforce is an essential pre-condition for improvement of their performance competence. Unfortunately, as per UNESCO's Dakar Education Forum 2000 Declaration, there were 880 million illiterates in the world in 2000 of which the share of Bangladesh was about 55 million (UNESCO, 2001). The question of education and training background in turn the performance of the industrial workforce has been briefly examined and presented under the next section of workforce employment pattern.

The percentage contribution of agriculture sector for all these countries was less than the percentage of workforce deployed in agriculture. But the percentage contribution of industrial workforce to the economy for all these countries was more than the percentage workforce deployed. This shows that Bangladesh needs to transform gradually in a planned way a large percentage of the employed 33.382 million workforces from agriculture to industrial workforce for rapid economic development. The task is gigantic. The only means for this is the appropriate education and training.

Workforce employment pattern

The employment pattern shows the distribution of the employed skilled workforce as professional, supervisor/ technician and skilled worker. It may also contain unskilled workers depending on the level and type of economy. A study on job market for Vocational and Technical Institutions (VTI) graduates initiated by Directorate of Technical Education (DTE) and conducted by the Bangladesh Technical Education Board (BTEB) in 1994 covering 300 industries/ establishments with 92% response rate emerged with the percentage distribution of 192,251 employed workforce as: profess-sional 5.2, mid-level technician 1.8, skilled worker 73 and unskilled worker 20 (BTEB, 1994). The employment distribution of the 139,248 skilled workers under this study in the National Skill Standard (NSS) in percentage stood as: Master 1.4, I 8, II 52.4, III 27.2 and Basic 11. In reality, only 1.2% of these skilled workers received some form of training and 98.8% of them were occupying skilled job without any training. Of the 1.2% trained workers only 0.4% received standard training from teacher training college (TTC) and vocational and technical institutes (VTI) and 0.8% received non-formal training (BTEB, 1994).

A Tracer Study on the Polytechnic Graduates initiated by UNDP and UNESCO on a project of the DTE. The study was conducted by the BTEB in 1990 covering 182 industries employing 63,106 workforce emerged with percentage distribution of employed workforce as; professional 11.5, mid-level technician 14.4 skilled worker 41 and unskilled worker 33. Among the mid-level technician only 36% were polytechnic graduates and 64% of the posts were occupied by workers without having required background and qualification. A Tracer Study of Polytechnic Graduates jointly initiated and conducted by DTE, BTEB and the Institute of Diploma Engineers Bangladesh in 1997 covering 200 industries with response rate of 97 percent and employing 119,777 workforce, found the percentage distribution of employed workforce as: professional 6, mid-level technician 9, skilled workers 51, and unskilled workers 34.

A study of exportability of skilled person power from Bangladesh initiated and conducted by the BTEB in 1993 made a detailed analysis of person power export for five years from 1988 to 1992 based on data available with the Bureau of Manpower Employment and Training (BMET). The BMET does not follow a recognized classification of person power but the percentage distribution of the exported person power for 1992 was as: professional 6, skilled worker 27, semi-skilled worker 16 and unskilled worker 51. From 1988 to 1992 the person power export increased by about 4 (four) ties whereas the remittance increased only by 1.4 times, as a result of exporting large scale unskilled workers. As many as 8 (eight) causes were identified for low remittances but the most critical one was the large-scale export of unskilled workers.

All these and a number of other studies (not mentioned here) were designed and conducted for generation projected future 5-10 years skilled person power requirements along with their types of vocational and the technological areas of specialization.

As in 1995, the employment pattern of employed workforce in South Korea, the percentage distribution was as: professional 4.5, technician 16.7, skilled worker 65.8 and unskilled worker 13 and that for Germany and Japan the distribution was as: professional 6, technician 58 and skilled worker 36. In the VTI graduate study conducted in 1993 the mid-level workforce was found to be only 1.8% whereas the mid-level workforce in South Korea was 16.7%, Singapore 40 percent and Japan and Germany 58%. It is observed that as the economy moves higher the need for mid-level technician increases. This finding provides a very significant clue for deciding the type and level of human resources the country needs to plan and develop for accelerated economic and social development.

Non-responsive of education to employment market demand

Scanning the employment pattern of these studies and experiences of other countries it becomes evident that the employed professional workforce ranges by and large between 4.5 to 6% in most of the countries and even the average professional person power export from Bangladesh is limited to about 6%. But the mid-level technician that is the mid-level workforce in the employment pattern increases with the growth of the economy. It was observed in a particular study that mid-level technician employment in Bangladesh was about 1.8% whereas this percentage in South Korea was 16.7, Singapore 42 and Japan and Germany 58 in 1994.

The Universities and tertiary education institutions are responsible for the education and training of the profess-sional workforce. Logically, the secondary and post-secondary education institutions are required to cater the needs of education of mid-level technician that and skilled worker. Analyses of the syllabus contents of the general secondary, higher secondary and Madrasha (Dakhil and Alim)[2] courses show very clearly that these programs are neither intended nor designed in any way to produce graduates with employable skills. Rather, forces the graduates to seek admission to next higher stage of education where in most cases there is no provision for admission and to produce graduates with employable skills. As a result the external efficiency of the education system is seriously questionable. The second-dary data collected from EFA 2000 Assessment of Primary and Mass Education Division (PMED) of the Government of Bangladesh, Bangladesh Bureau of Educational Information and Statistics (BANBEIS) Report of 1997 and UGC Report 1997 show that in 1997, the combined enrolment in primary schools and in Ebtadyee Madrasha was 19.19 million, secondary school and dakhil madrasha 6.96 million, higher secondary and alim madrasha 0.74 million and tertiary 0.55 million.

The internal efficiency of the education system is also in a very deplorable status. In the combined results of all

[2] Dakhil and Alim are the same-level degrees as SSC (Secondary School Certificate) and HSC (Higher Secondary Certificate) respectively, provided through religious education system, called Madrasha Education System in Bangladesh.

the public examination system of 1996 the pass rate was about 36 percent; at Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) 42.61, HSC 24.77 and tertiary 49 percent. For 1997, the average combined pass rate in percentage in public examinations was 47.78 and that was in Dakhil and SSC 54.2, Alim and HSC 37.36 and tertiary 55.24. This demonstrates a system loss of 64 percent in 1996 and 52.22 in 1997 in education. The nationally-accepted system loss of electricity is 32 percent though in most of the developing and developed countries this is limited to 6 to 10%. The system loss of electricity is economic loss but education system loss contributes to both economic and social loss leading to social unrest and disruption. The education resource allocation and utilization pose a more critical threat to the achievement of the goal of quality education for all. As per, World Development Report 1994, 10% of the top class people consume 72% of allocated education resources in Bangladesh (World Bank, 1995).

The allocation or resources to education supports this finding of the World Bank. The ratio of per capita recurrent expenditure of Gross National Product (GNP) per capita (US$ 220) in 1996 was for: primary school 0.06, non-government secondary schools (with government subvention) 0.07, government secondary schools 0.28, cadet colleges 4.7, polytechnic 1.45, VTI 1.2, tertiary (average) 2.47, Bangladesh University of Engineering and Technology (BUET) 3.3 and Bangladesh Agricultural University (BAU) 5.56. The students from the non-government secondary schools, government second-dary schools and cadet colleges are required to study the same curriculum, sit for the same SSC examination with so much differentiated financial input in these three types of the secondary education institutions. In the primary level the student teacher ration in Bangladesh was 76:1 in the public schools in 1998 whereas this ration in China was 22, Thailand 22, Indonesia 22 and Malaysia 18.4. Primary, being the first unfurling stage of intellectual capability of the children, it is important to realise what kind of society; we are aiming at with this level of input to primary education and how we are going to compete with other competitors in the global market.

Turning to the findings of the studies conducted on the job market and on the secondary and pos-secondary vocational and technical education it appears that this sub-system could not also produce quality graduates as per the need and demands of the job market. Surprisingly, a study conducted on the four parameters: education, occupation, income and housing value the socio-economic status (SES) mobility of employed VTI graduates was negative. About 90% of the employed graduates ended up with annual income less than the 56% of the parents. The teachers of the VTI were found to possess only 28% of the required competency derived from their background in terms of industrial experience and training, teacher experience and training and management training. The SES mobility of employed polytechnic graduates followed a well-set rising ladder in the job market. But the teachers of different categories were found to possess only 14-28% of the required competencies. Allocation of fund for instructional materials was only from 11-19% of the requirement of different technologies.

The study findings in the context of policy decision raise a very serious question and extract of which is given below:

"The type of decision model the country is following is mostly the root of evils. As an example, the model starts working in the Directorate from the Head Assistance who puts the proposal in the file with noting, and then it passes through Assistant Director, Deputy Director, Director and to the Director General. In initiating the noting and passing it through the route up to the Director General is very hazardous. File may not start or stay at any stage without any "*tatbir*"[3] in different stages. A similar ladder of the movement of the file exists in the Ministry. The proposal from the Director General is first scrutinized by the Assistant Secretary when the Administrative Officer of the section very kindly puts it up in the file. Assistant Secretary, usually being a generalist in the administration has very little to understand the underlying technical aspects of the proposal of the Directorate. The file from the Assistant Secretary routes to follow the Minister for consideration usually with very little to add or change. Normally, if the Minister has any query on the file it then follows the same route to come back to the Assistant Secretary to meet up the query and again routed the same way through the stages to the Minister. The decision-making process is hinged virtually between the Minister and the Assistant Secretary's capability.

The route between the Administrate Officer and the Minister is more hazardous than the route of the Directorate's file movement. With these steps in the decision model it breeds corruption, inefficiency, persists incompetence, causes unusual delay in decision-making, and makes the decision makers unaccountable (usually cannot be singled out an individual).

The basic issue for the country is to discard the existing model of decision making and switchover to a model which makes the decision maker accountable for the decision. Why not the Minister gives decision on the proposal of the Director General and makes the Director General responsible for policy proposal and implementation of the approved policy and accountable for consequences, instead of making him a person in the present situation as a provider of the clerical services to the Assistant Secretary of the Ministry. It is not so easy to change the decision model. Enhancement of the capability of the Directorate is essential pre-condition for any

[3] To make a high level illegal jack and channel to gain personal benefit.

Table 1. Four dimensions of TAI and selected indicators.

Dimension		TAI Indicators
1. Creation of Technology	1.1	Patent Granted per million people (1998)
	1.2	Receipt of royalties and licence fee per thousand people (US $ 1999)
2. Diffusion of recent innovation	2.1	Internet hosts per 1000 per 1000 People (2000)
	2.2	High and medium technology exports as percentage of total exports (1999)
3. Diffusion of old innovation	3.1	Telephone including cellular per 1000 people (1999)
	3.2	Electricity consumption kwh per capita (1998)
.4.Human skills	4.1	Mean year of schooling age 15 and above
	4.2	Gross tertiary science enrolment ratio (1995-97 percentage)

for any change, which is difficult. Once a bad system is in operation it can be very difficult to dislodge. Strong interests develop to continue the bad system, however inefficient, corrupt and unfair."

Information communication technology

The Information communication technology (ICT) is a very fast growing new technological area. The ICT is entering fast in Bangladesh both in education and in the job market but still in its infancy. The ICT has opened global job market where people with competence can do jobs sitting in own house anywhere in the world without going to or attending the work place. Two examples are presented to explain how ICT works instead of saying what it is.

Example one: The UNDP Human Development Report 2001 (UNDP, 2001) Making New Technologies Work for Human Development presents that more information can be sent over a single cable in a second than in 1997 was sent over the entire internet in a month. The cost of transmitting a trillion bits of information from Boston to Los Angeles has fallen from US$150,000 in 1970 to only 12 cents today.

Example two: The World Bank World Development Report 1988/89, Knowledge for Development presents that in Singapore the traders transmit their import and export declaration from their office computer to the Trade Development Board for customs clearance which issues the necessary approval within 15 minutes after routing as many as 20 government departments and agencies. After receiving the approval, the trader prints and signs the document to obtain the release of the cargo. This has resulted in ship turnarounds time less than 10 hours and the Singapore port stands as the most efficient in the world. Trader receives cargo direct from the ship that reduces the cost of warehousing the cargo. Singapore government has valued these efficiencies to more 1 percent of GDP.

Where Bangladesh stands with ICT education will be of interest to know as well. The UNDP Human Development Report 2001 introduces the technology achievement index (TAI) which aims to capture how a country is creating and diffusing technology and a human skill base, reflecting capacity to participate in the technological innovations of the network age.

The TA is a new measure of countries' ability to participate in the network age. The TAI focuses on four dimensions and selected indicators. The dimensions and indicators are shown in the Table 1.

Out of the four dimensions of TAI measures the Bangladesh's achievement value for creation of technology and diffusion of recent innovations is negligible in comparison to 72 countries included for TAI computation and not accounted for. For two other dimensions: diffusion of old innovations and human skills the values are very low. The value of two indicators of diffusion of old innovations: telephone including cellular per 1,000 people (1999) and electricity consumption kwh per capita (1998) for Bangladesh were 5 and 81 that for Pakistan 24 and 337, India 28 and 384, Indonesia 40 and 320, South Korea 938 and 4497 and Japan 1007 and 7322. The value of two indicators of human skills: mean year of schooling age 15 and above and gross science tertiary enrolment ratio (1995-96 percentage) were 2.6 and that for Pakistan 3.4 and 1.9, India 5.1 and 1.7, Indonesia 5 and 3.1, South Korea 10.8 and 23.2 and Japan 9.5 and 10.

The achievement level of TAI of the countries is higher with higher level of human skills in turn the two indicators: mean year of schooling and gross tertiary science enrolment ratio. These two indicators are dependent on the level, type and quality of education of the country. Developing countries require developing professional researchers and mid-level technicians to acquire, absorb and use ICT in order to enter and grow in the technology-based global chain of economy.

Policy preferences

The technology achievement index focuses on four dimensions and eight indicators at the country level. The TAI values calculated for 72 countries on the basis of the available data on the indicators show three trends: a map of great disparities among countries, diversity and dynamism in technological progress among developing countries and a map of technology hubs superimposed on countries at different levels of economic development. The four criteria that were used while consulting Government sources, industry and media to rate and identify the technological hubs were: ability of the local universities and research facilities to train highly skilled workforce or develop new technologies, the presence of established companies and multinational corporations to provide expertise and economic stability, population's entrepreneurial drive to start new ventures and the availability of venture capital to ensure that the ideas make it market (Alam, 2008b).

Technological achievements are important for human development but the TAI measures only technological achievements. TAI does not indicate how well these achievements have been translated into human development. The TAI shows high correlation with the human development index (HDI), and it correlates better with HDI than with income. As the World Bank World Development Report 2002 states that poor countries and poor people differ from rich ones not only because they have less capital but because they have less knowledge. The balance between knowledge and resources has shifted so far toward the former that knowledge has become perhaps the most important factor determining the standard of living; more than the land, the tools and the workforce. Today's most technologically advanced countries are truly knowledge-based. There are many types of knowledge but two types that are critical for development: knowledge about technology and knowledge about attributes. Knowledge about technology is technical knowledge such as software technology, aerodynamics. Unequal distribution of technical knowledge across and within countries creates knowledge gaps. Knowledge about attributes is the knowledge of the specification of the quality of product and services. Incomplete knowledge about attributes is information problem.

Education is the key to creation, adoption and spreading knowledge. Basic education increases people's capacity to learn and interpret information. But higher and technological education is critical for enhancing skills of workforce, producing new knowledge and adapting knowledge produced elsewhere. The challenge for the developing countries is to gear up their capabilities, both human and institutional, so that all sectors including firms and individual can acquire, adapt and use knowledge effectively (Alam and Khalifa, 2009). An extract from the write up of the South Korean President printed in the UNDP Human Development Report 2001 as special contribution on Human Resource Development in the 21st Century: Enhancing Knowledge and Information Capabilities reads as "We are living in an age of knowledge and information, fraught with opportunities and dangers. There are opportunities for the underprivileged and poor to become rich and strong. But at the same time there is a danger that gap between rich and poor could widen. The message is clear. We must continue to develop our human resources. The success or failure of individuals and nations as well as the prosperity of mankind depends on whether we can wisely develop our human resources."

Concluding remark

The macro-level agriculture workforce per capita contribution to economy in India and Pakistan is about 2 times that of Bangladesh and in Malaysia 18 times, South Korea 22 times, Japan 74 times and Australia 98 times. The per capita contribution of Bangladesh industrial workforce is 11 points percentage lower than the Indian industrial workforce.

The employment pattern of the employed workforce reflects an uneven distribution of the different levels of working person power with 97% skilled jobs occupied by workers without having any appropriate education and training. These untrained workers are occupying 64% of the mid-level technician jobs. The secondary general education is totally non-responsive to the needs of the job market. The technological achievement index (TAI), as a new measurement of Bangladesh's ability to participate in the technology-based global network economy, is very low. The secondary and post-secondary vocational and technical education faced with different problems failed to produce graduates with employable skills. The bad resource allocation forces the 96% of the boys and girls in the non-government secondary schools with government subvention to end up with a poor quality of education whereas 10% of the top class population enjoy 72% of education resources. The education system is breeding inequality and inequity in the society. The shining prospect of demographic transition of least dependency with highest proportion of active working population in 100 years is lying ahead. There is acute shortage of researchers and mid-level technical person power to \absorb and use ICT in education and in production and services. Any attempt to resolve arbitrarily these issues, problems and barriers of the education system of the country is facing will be suicidal. There are a lot other issues that could not be raised due to the limited scope of the write up and at the same time it would be unwise to think of identifying all problems and barriers without entering into that world and understanding the causes from where and how they stem. In order to identify and resolve the problems and barriers the education system is facing the most important preconditions are to ensure very strong political commitment, willingness, under-standing, and tolerance for building sound institutional and professional capability.

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