Implementation Mechanisms of the Strategy for the Science, Technology and Innovation in Islamic Countries

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1. Introduction

The Islamic world, comprising countries in various stages of development, is fully conscious of the importance of Science and Technology as an engine for economic growth and social development. Accordingly, all Islamic countries are making efforts to develop Science and Technology in order to reap the benefit for the social and economic development of their people. However, as a glance at the latest Human Development Report will show, the majority of the Islamic countries falls in the medium or low categories of human development, with only a few in the category of high human development. Similarly only a few Islamic countries can be regarded as having some significant scientific base. To assist the Islamic countries, the Islamic Educational, Scientific and Cultural Organization (ISESCO) has chalked out a Strategy for the Development of Science and Technology in Islamic Countries.

The Strategy broadly classifies the Islamic countries into the following three categories:

- Countries with a significant scientific and industrial base;
- Countries with a fair scientific and industrial base; and
- Countries with hardly any scientific and industrial base.

It also describes the present state of human development in the Islamic states vis-à-vis the advanced countries and correlates it with the low values of indicators such as the S&T expenditure, number of researchers per million population etc. It highlights the fact that despite being rich in natural resources, the Islamic countries are mostly in the low category of human and economic development, with only 10 being in the category of high human development largely on the strength of their oil revenues. It recommends a number of measures for the development of science and technology in the Islamic countries.

The Strategy correctly advocates a cooperative and collaborative approach for this purpose. While each individual country would need to continue its efforts for the development of Science and Technology, it is only as a collective entity that the Islamic countries will be able to achieve the optimum results in a reasonably short time. The Strategy therefore proposes the formation of an Islamic Economic Community on the lines of the European Economic Community for reaping the full benefits of cooperative mechanisms for the development of Science and Technology in the Islamic world.

It must be emphasized that the development of Science and Technology is not an end in itself but is rather a means to an end, namely **the social and economic development of the people**. Like all countries of the world the Islamic countries are also committed to the achievement of the Millennium Development Goals (MDG) that are intended to improve the lives of the people in terms of poverty reduction, improved education, health, nutrition etc. The achievement of these goals can be facilitated through the application of Science and Technology.

Scientific and technical capabilities of a nation determine its ability to provide clean water, good health care, adequate infrastructure and safe food to its people. It also determines the ability of a nation to develop and utilize its natural resources in an optimal and sustainable manner. Therefore any program of action for achieving the MDG should have science, technology and innovation as its centerpiece.

For achieving their long-term goals of development, all Islamic countries need to develop their own capabilities for science, technology and innovation in order to have sustainable growth and to produce indigenous solutions to their problems. In this they will be guided by their national objectives and their current level of development. However, in the short term, there is sufficient capability in the Islamic world to help the less developed Islamic countries in applying science and technology for improving the life of their citizens.

Utilizing the existing capabilities of the Islamic world in a cooperative mode would reduce the current dependence on the North and introduce a measure of self-reliance in the Islamic world through South-South cooperation. However, North-South cooperation in Science and Technology is essential, especially as a source of new technologies, and needs to be encouraged in addition to cooperation among the Islamic countries.

As the leaders of the Islamic countries are committed to the achievement of the MDG, it is taken for granted that they would be willing to invest the resources required for using science and technology to achieve these goals. Without the political will and the requisite financial support, the best-laid plans will not succeed in giving the desired output. It also goes without saying that the recommendations of the Strategy are assumed to be, in general, broadly accepted.

*For acquiring the hallmarks of **Knowledge Based Economies** – high levels of skills & education, lifelong learning and innovation – Islamic countries need to make the requisite investment in human capital, which coupled with competitive advantage based upon institutional excellence is the key driver of economic growth. A focused investment in education and training (especially technical education) providing opportunities for lifelong learning and skill development, an efficient (and affordable) national and international telecommunications network and R&D in all areas of human knowledge (focusing on emerging technologies) will eventually lead*

to the creation of a knowledge based economy, characterized by enhanced industrial and commercial competitiveness due to improved productivity generated through information-intensive and value-added businesses as well as products or services with a high component of knowledge or knowledge intensity.

2. Human Resource Development

Human Resource Development is the bedrock on which the whole infrastructure of the S&T system as well as the industrial and technological base is built. In order to build scientific and technological capability all Islamic countries need to devote sufficient resources to provide all their young men and women with the opportunity to gain higher education. The prerequisite for this is the development of a sound educational base that caters for development of human capital in science and technology as well as arts and humanities.

Besides producing research scientists, engineers, doctors etc the education system should also be able to produce competent technicians and technical personnel. Barring a few exceptions, the latter aspect is not fully catered for in most Islamic countries and the situation needs to be urgently rectified. The system should cater for the development of a child according to his/her natural inclination and ability and provide education/training to enable him/her to function as a productive member of society. However, changing an education system is a long-term process – typically showing results 10 to 15 years later – that all countries need to seriously consider undertaking for the long-term benefit of their people. Needless to say Islamic countries with a largely functional education system would require only minor modifications.

2.1 Long Term Measures

Introduction to science as a study of nature needs to be introduced during the primary level of education. At present, while all countries are undertaking special measures to achieve the MDG of universal primary education by 2015 (Goal 2), appropriate measures should be taken to cater for the introduction of science at the primary level. A model curriculum should be developed for this purpose, which could be adapted to suit the requirements of individual countries. The integrated curriculum in vogue in Malaysia and Indonesia could serve as a template for such curriculum.

At the secondary level, the education system should focus on ‘doing science’ rather than ‘learning science’ through passive absorption of information. This would require well-equipped laboratories in all secondary schools and colleges as well as highly motivated science teachers specially trained to make optimum use of these laboratories. Special modules would, therefore, need to be built into the teachers’ training programs. It is also at this stage that the natural aptitude and interest of the students become evident, whether oriented toward higher education or gravitating

toward technical and vocational education. The system should, however, provide for a chance for higher education at a later stage for those who opt for technical or vocational education at the secondary stage. The 'second channel of education' of Germany is a good example of such a system.

At the tertiary level the education system should be able to produce competent doctors, engineers, architects etc, as well as scientists capable of working at the leading edge of research. The universities in the Islamic countries should function as centers for creating new knowledge **with immediate economic goals** rather than just as 'degree mills' for producing graduates for the job market. For this purpose, competent and motivated faculty, well-equipped laboratories, availability of research funds and a system of rewards and incentives for researchers as well as active collaboration with universities in the industrially advanced countries are required. *The Consultative Council for Implementation of the Strategy should be in a position to advise individual countries on this aspect.*

Vision 1441 adopted during the 10th Session of the Islamic Summit in 2003, alos emphasize a number of important long term measures which may be taken into consideration for promotion of science and technology.

2.2 Short Term Measures

The long-term measures detailed above typically require a gestation period of about 15 years to show results. However, by using a cooperative and collaborative approach, the Islamic countries can utilize the existing expertise and facilities available in the OIC member states to good advantage in improving the lives of the people.

2.2.1 Higher Education: While initiating measures for the development of their own education systems, Islamic countries with little or no S&T base can get their high-level S&T manpower trained in Islamic countries with a significant S&T base at a much lower cost than in the West. For this purpose, these countries would need to embark on targeted programmes for training a given number of scientists and engineers at the postgraduate level. To supplement their own resources, where necessary, funds for such targeted training programmes within an overall developmental strategy could be contributed from institutions such as the Islamic Development Bank, Asian Development Bank, African Development Bank etc. Some of the already existing scholarships programmes for the least developed member countries, though useful in this context, would need to be increased manifold to have some visible impact in a reasonable period of time. To supplement such programmes, the relatively advanced Islamic countries may consider offering an increased number of scholarships under their Technical Cooperation Programmes to Islamic countries requiring such assistance. Professors from the relatively advanced countries could also take up teaching assignments in the less developed Islamic countries for teaching relevant courses. Federation of the Universities of the Islamic World should be appropriately strengthened to cater for the requirements of the less developed Islamic countries.

2.2.2 Joint Research Programmes: To search for solutions to their immediate problems, countries with little or no S&T base would do well to initiate joint research programmes with Islamic countries that have a sufficient S&T base. For example, there are a number of world-class research centers for Genetic Engineering and Biotechnology in the OIC member states, where collaborative research projects could be undertaken to increase the crop yield or disease resistance of crops in the less developed Islamic countries. Similarly, world-class research centers for other fields could be identified. ISESCO should prepare a directory of leading research centers in the Islamic countries. In such collaborative programmes the following modes could be used:

- Providing place(s) for research in the Research Centre to enable the scientist(s) from the less developed countries to work on their problems with the active participation of the scientists from the Centre.

- Training in experimental techniques for scientists of the less developed countries for use in research centers in their own countries.

The programmes for exchange of scientists of ISESCO, COMSTECH, IDB and TWAS could be used to good advantage for this purpose.

2.2.3 Technical and Vocational Education: This is the weakest aspect of S&T manpower in the majority of Islamic countries. The Strategy has correctly identified the severe shortage of good technicians and competent sub professional manpower in the Islamic world as a major weakness. For example, Pakistan despite having 28 Polytechnics and 7 mono-technic institutes is unable to meet its requirements of technical and vocational manpower. All Islamic countries need to undertake a crash programme of Technical and Vocational training. Combined with schemes of providing micro-credit to finance small business start-ups, such programmes would contribute significantly towards reducing unemployment – and hence poverty (Goal 1) – in the Islamic countries. In this connection, the countries with hardly any scientific and industrial base would need to set up polytechnic and mono-technic training institutes to train manpower according to their requirements. In this endeavor, the relatively advanced Muslim countries could guide and assist them in terms of planning, development of curricula, training of teachers in vocational subjects etc. Such programmes can start producing visible results in a relatively short period of time.

2.2.4 Women in Science*: Providing equal opportunities of higher education to men and women, as recommended above, would eventually equalize the gender disparity in scientific and technological fields over the long term. However, special measures are required to be taken to improve the participation of women in scientific and technical professions in the short term. Educating women in the sciences, besides being an imperative of meeting international obligations related to equality, has the*

practical objective of changing social attitudes and preparing the next generation for adapting to changing world conditions. In developing Islamic countries women make a major contribution to the production of food as well as providing energy, water and health care to their families and communities. Scientific and technical training would enable them to apply their knowledge in the performance of these tasks and roles. For example, training in simple technologies such as chlorination of water in homes would enable them to improve the safety of the water and sanitation for their families. In many communities, women are the primary holders of indigenous knowledge on sustainable use and management of the environment. Training in science and technology would improve their ability to respond to new challenges in this role.

2.2.6 Youth in Science*: To generate and promote a science culture, participation of youth in scientific activities is imperative. Activities such as science fairs, exhibitions, competitions etc serve to generate sustained interest of young people in science and technology. ISESCO may organize regional science competitions in association with IDB. With the present high salaries and growth prospects in the business and service sectors, bright young men and women are not pursuing careers in science and technology. In order to attract the best minds to science and technology it is essential to make the career prospects, especially in teaching and research, as attractive as those for other fields. The prospects of a good career with a salary that would provide reasonable financial security to them and their families would contribute considerably in influencing young men and women to decide in favour of science and technology while choosing their future careers. Technical and vocational education should be complemented by courses in entrepreneurship to equip the young men and women for setting up small and medium enterprises, i.e. generating employment rather than seeking employment.*

2.2.7 Brain Gain*: The migration of highly trained professionals – doctors, engineers, scientists etc – from developing countries to the developed countries, commonly known as 'brain drain', exacerbates the shortage of trained manpower for the developing countries. Islamic countries are no exception to this global phenomenon. However, many developing countries have, through various programmes, made good use of their S&T professionals spread around the world. The TOKTEN programme of the UNDP is quite useful in obtaining the services of expatriate nationals for short-term training or advisory assignments in the home country. In Pakistan, this programme has been replaced by a similar programme that is financed entirely by the Government. During the early nineties, China was able to attract its highly qualified scientific manpower to return by giving them the opportunity to head their organizations as well as other incentives not available to Chinese citizens at that time. Similarly in Pakistan, under the Foreign Faculty Hiring Programme undertaken by the Higher Education Commission to address the shortage of university faculty, a large majority of the 'foreign faculty' consists of expatriates spending their sabbatical year at a Pakistani university. In addition to academics, expatriate nationals are a useful source of FDI, especially in high-tech start-ups, as in the case of India. Appropriate incentives such as tax breaks or soft loans are required to attract such investment.*

3. Development of the Industrial and Technological Base

All Islamic countries, notwithstanding the level of their development, need to develop their industrial and technological base. The industrial sector is the prime end user of the S&T manpower as well as of the output of the R&D organizations of the country. Without the development of the industrial and technological base, the investment in development of human resources would succeed in only contributing to increasing the 'brain drain' as the trained scientific and technical manpower would gravitate to other countries that would provide the requisite employment opportunities. In this quest each country would need to assess its present level of development vis-à-vis its development goals. Starting from its current level of technological development, each country needs to start a plan of upgrading its technological base. *A technology foresight exercise based on an objective SWOT analysis would be particularly useful for making policy decisions, especially in emerging fields such as biotechnology, new materials, nanotechnology etc. Analyzing current trends with realistic extrapolation to the future is particularly helpful in identifying niche markets where a country could use its strengths to good advantage.*

Countries with a basically agrarian economy should focus on upgrading their agricultural base through technological innovation and introduction of new technologies. Their research institutions should also be mainly geared to agricultural research focusing on new crop varieties, increase of crop yield, optimum use of available water resources, stress-tolerant crops for utilizing marginal agricultural land, reducing the use of chemical pesticides for protecting the environment etc. In the current scenario of high food prices, their focus should not only be to provide food security for their citizens, but also to produce exportable surplus for earning foreign exchange. Their industrial-technological base would also, by necessity, be geared to service of the agriculture sector – production of farm implements and agricultural machinery, provision of agricultural inputs such as quality seeds, fertilizers, pesticides as well as agro-based industries for utilization of the agricultural output etc. A flourishing agricultural economy should lead to increase in disposable incomes leading to a demand for consumer goods, which would then generate its own requirements of technological advancement.

Similarly, countries whose economy depends on mineral resources should upgrade their technical know-how and expertise for the extraction and processing of these resources. Their research institutions should be engaged in research on improving the extraction methods and subsequent processing of the minerals in order to be able to export finished products instead of raw minerals. In the current scenario of high oil prices, which is likely to continue in the future, the oil producing Islamic countries would do well to invest the additional income in the education of their young men and women and creating a sound scientific, technological and industrial base. The industrial-technological base could be in the downstream oil-

processing activities, as well as in other appropriate technologies. The Islamic Republic of Iran, which is already treading this path, is a good example to be emulated.

Islamic countries with a relatively developed industrial and technological base would need to focus on acquisition of new technologies through joint ventures with the technologically advanced countries as well as development of technology in their own R&D setup. In this they can try to attract investment in the downstream activities of production, gradually moving up the value chain and eventually leading to acquisition of technology. It must be emphasized that, other factors being equal, FDI is attracted by the availability of an adequate supply of well-trained and technically competent manpower, which underscores the importance of developing the human capital. *Special attention should be paid to technologies such as biotechnology, nanotechnology, information technology etc.*

3.1 Linkage with Industry

Member States should also endeavour to improve their industrial products through focused R&D effort in their research institutions. Measures should be introduced to ensure that the R&D system of the country is fulfilling the requirements of the industrial sector and to provide incentives to the industrial sector to establish their own R&D setups. Without the involvement of the industry in the choice of R&D projects, the research efforts of the scientists would not converge with the requirements of the industrial sector.

To provide incentive to the scientists for actively seeking collaboration with the industry, a part of the income generated through research contracts from the industry may be given to the scientist/research group involved in the R&D effort. Similarly, the royalty accruing from the commercialization of a patent may be shared according to an approved ratio among the Government, the R&D organization and the scientist(s) who developed the patent.

3.2 Increase in Research Expenditure

It is necessary that all Islamic countries increase their expenditure on Research and Development (GERD) from its current low levels to at least 1% of their GDP over a given, self-determined time period. However, an increase in GERD is a necessary, but not sufficient, condition to ensure technological development. An increase in GERD by the government alone to support and/or upgrade the existing research infrastructure might result in an increased number of international publications, but it is not likely to result in indigenous development of new technologies or products, which are the prerequisites for technological and economic development. It is imperative to increase the ratio of research expenditure by business enterprises to that by the government in the Gross Expenditure on R&D in

all Islamic countries. Without the participation of the business sector in this expenditure the R&D effort of the nation will remain divorced from the needs of its industrial sector.

3.3 Incentives for Development of Technology

To promote the indigenous development of technology, governments of the Islamic countries would also need to improve their incentive structures, which could range from taxation regimes and market-based instruments to consumption policies and changes within the national system of innovation. Preferential government procurement of locally produced goods can also be used to promote technological innovation and generate markets for new locally produced products. These measures would foster the creation of small and medium enterprises, which would play a leading role in the development of new opportunities and the use of technology. *Special additional incentives might be necessary to encourage new high-tech start-ups in fields such as biotechnology, information technology, nanotechnology etc. It needs, however, to be ensured that the incentives are not misused in acquiring obsolete or obsolescent technology.*

3.4 Facilitation of Small and Medium Enterprises – Technology and Business Incubators

The important role of the small and medium enterprises in poverty reduction and fostering sustainable social and economic development cannot be overemphasized. To assist them, governments need to set up and/or support the setting up of business and technology incubators in the vicinity of universities and research organizations. These incubators should provide affordable factory space as well as necessary support for business development, marketing, financing and legal services. The knowledge capital of the universities and research organizations should provide the requisite input in the development of new technologies and industrial products. Setting up of production networks helps small and medium-size enterprises to access skills, find highly educated labor, and pool business services. The rapidly changing technological and global environment makes networking particularly important in fostering incubation activities.

3.5 Development of Infrastructure

Member states would also need to develop or improve the basic infrastructure of the country – transport and communication, utilities etc – in ways that promote the development necessary for sustained economic growth. The presence of an adequate infrastructure is one of the major factors in attracting foreign direct investment necessary for technology acquisition. Projects for development of infrastructure can also serve as a technological learning process, as they involve the use of a host of technological solutions and complex institutional arrangements. *In*

the current global scenario, an efficient and affordable national/international telecommunications system is a pre-requisite for attracting foreign direct investment. Projects for the establishment of such information and communications highways would yield dual benefits – providing ease of access to information as well as the acquisition of the requisite technology to set up and maintain the system. The Multimedia Super Corridor of Malaysia, comprising a high throughput fiber-optic backbone complemented by new motorways and a new international airport, which was instrumental in attracting high-tech multinational corporations ranging from small and medium-sized firms to large corporations, such as Microsoft and Oracle, highlights the importance of the development of infrastructure.

3.6 Venture Capital

Government policies should facilitate the creation of venture capital, which plays a critical role in the creation and development of small and medium enterprises, especially new products and technologies. Besides providing the requisite capital, venture capitalists can help groom small and medium-size start-ups into multinational concerns. Therefore, attracting venture capital through appropriate fiscal incentives would help in creating new businesses and improve their sustainability.

3.7 Participation in International Trade – MSTQ and IPR

Islamic countries also need to participate more actively in international trade to acquire technological and other capabilities. To participate more fully in international trade, these countries need to develop their standards-related facilities and capabilities, including those for metrology, product testing, quality assessment, and certification. This is essential in order to meet the requirements of international trade, particularly the increasingly stringent technical requirements of the industrialized countries.

Protecting intellectual property rights is a critical aspect of technological innovation. This is essential for protecting the rights of the inventors and promoting indigenous development of technology. In order to benefit from international trade, Islamic countries need to identify and utilize provisions in international intellectual property agreements that promote technology cooperation between developed and developing countries on relatively favorable terms to developing countries.

To promote the innovation process and development of indigenous technology, Islamic countries need to put policy measures in place for supporting the filing of patents by their researchers. This could be in the form of financial support for filing the patent locally as well as internationally, after an objective assessment of the commercialization potential of the invention/innovation. Similarly, a supportive policy environment for encouraging domestic commercialization of local patents/inventions,

particularly those that are in the greater public interest (e.g. vaccines), through soft loans or tax breaks for public-private partnerships would be instrumental in generating development of indigenous technology.

3.8 Innovation Fund

Encouraging the inherent innovative capabilities of the people is a low-cost and effective way of developing indigenous technology. Many developing countries such as Malaysia, Argentina and India have reaped good benefits from this approach by establishing funds to finance such activities. The governments of Islamic countries may also consider establishing such funds for financing innovative capabilities of individuals, groups, organizations and firms in the private as well as the public sector. The size of the grant would be according to the categories defined while setting up the fund and the government could, if desired, have a share (say 20%) in the income generated from any product or process developed under a grant from the innovation fund.

3.9 Role of Universities

The universities in Islamic countries have to change their role to that of "agents of development". They should gear themselves up for carrying out industrial R&D for helping the industry to improve their products; establish technology parks; introduce entrepreneurial training in their curricula and involve themselves in community development by addressing the social needs of the community through R&D.

For keeping abreast with the global developments, universities in Islamic countries should seek linkages with the universities in the technologically advanced countries. While this is possible in general, there may be some reluctance on the part of the advanced countries to share their knowledge in some sensitive technologies. In such cases, which would increase with the passage of time, universities in the Islamic countries would need to collaborate among themselves for producing the requisite knowledge denied to them by the advanced countries. *The universities should make special efforts for gaining expertise and establishing requisite facilities for research in emerging fields such as genetic engineering, bio-informatics, nanotechnology etc to reduce dependence on the advanced countries as far as possible.*

3.10 Development of the S&T Infrastructure

The scientific and technological infrastructure of all Islamic countries needs to be constantly upgraded to keep pace with the developments in the industrialized

countries. However, this will have different implications for countries at different levels of development. Countries with underdeveloped S&T infrastructures should in the initial stages focus on upgrading their S&T *infrastructure through innovation taking into consideration all important component of the system to provide a strong base* rather than going in for an elaborate research infrastructure. The basic pillars of the S&T infrastructure of any country, namely the universities and the research organizations, should be able to fulfill the requirements of the country in terms of production of adequately trained academic, professional and sub-professional S&T manpower and its utilization to generate new knowledge and to use it to develop new technologies and products for the generation of wealth.

3.11 Sustainable Development and Protection of the Environment

In the quest for industrial development the environment very often is a major casualty. It is therefore advisable that measures for protection of the environment are undertaken simultaneously with those for industrial development. Sustainable development involves the use of natural resources to fulfill the needs of the present generation without compromising the needs of future generations. Special programmes are, therefore, necessary for the preservation of woodlands, wetlands, biodiversity, fisheries and aquatic resources etc. While measuring development it is advisable to use the Index of Sustainable Economic Welfare (ISEW), which gives a "balance sheet" between development and environment rather than the more common indicators such as GDP per capita.

4. Achieving the Millennium Development Goals (MDG)

All Islamic countries should make concerted efforts to achieve the Millennium Development Goals by the target date of 2015 *as well as recommendations of the Vision 1441*. However as they are at different levels of human development, some countries will have to do a lot more than others to do so. *In order to reap the maximum benefits for the people, governments of the Islamic countries need to focus on the WEHAB priority areas – water, energy, health, agriculture and biodiversity – all of which have critical and cross-cutting linkages with the MDG. In this context special attention needs to be paid to marginalized segments of the population, which very often tend to be neglected in the allocation of development funds, as the planners need to use the available resources in the most 'efficient' manner. It must, however, be borne in mind that relatively minor interventions can very often bring about a big change in the lives of the marginalized or remote communities. Further, no country can be considered to be truly developed if a segment of its population – no matter how small – is deprived of the fruits of development and progress.*

4.1 Water Resources Management

Water, which is becoming an increasingly scarce resource, needs to be treated with the respect it deserves. The importance of water for drinking, irrigation and industry is evident and does not need to be further emphasized. Provision of safe drinking water for the entire population – due to its obvious benefits for health – should be the topmost priority of all Islamic countries. Very often simple techniques such as filtration and/or chlorination are sufficient for this purpose. A decrease in the burden of water-borne diseases would reduce some pressure from the health systems freeing-up some resources for other urgent requirements.

For industry as well as irrigation, especially in the water-deficient countries, improved and efficient techniques need to be utilized for improving the water productivity. For example, successful experiments in growing rice with sprinkler irrigation have proved that older methods of flooding the fields are unnecessarily wasteful. Depletion of groundwater aquifers through over pumping needs to be addressed through groundwater recharge systems. Similarly, sewage treatment plants need to be installed, wherever raw sewage is being discharged directly into streams or rivers. All Islamic countries need to devise integrated water resource management systems to make optimum use of their available water resources.

4.2 Energy

To provide energy security to their citizens, Islamic countries need to focus not only on meeting the current requirements but also on the future requirements based on an acceptable minimum of energy consumption per capita. While the current high oil prices are providing huge additional incomes to the oil producing Islamic countries, they are a big drain on the relatively weaker economies of the non-oil producing Islamic countries, jeopardizing their growth and development. It would, therefore, be advisable to create a fund from a part (say 10%) of the additional income of the oil producing countries to assist the weaker economies, especially the Islamic countries falling in the category of Least Developed Countries (LDC) to meet their energy needs. This fund could be administered by the IDB as a soft loan facility.

High oil prices have also generated renewed interest in alternate energy sources such as solar, wind, hydro, biomass, bio-diesel etc. The major oil companies have been investing in R&D in alternate energy sources over the last 10-15 years and are now poised to reap the benefits in the current scenario of increasing oil prices. The governments of the Islamic countries need to encourage their citizens to change from conventional to alternate energy sources through subsidies such as a one-time tax exemption on the amount spent on converting to alternate energy sources. This could be easily offset by the sale of extra carbon credits accruing from the changeover. While pursuing the option of bio-diesel, special care needs to be exercised that it is not at the cost of jeopardizing the food security of the people in

the lower income brackets. It would be advisable to use non-food crops that can flourish on marginal lands.

4.3 Health

Health dividends accruing through supply of safe drinking water (Section 4.1) can be built upon by raising the awareness level, especially of the poorer sections of the population, about hygienic practices and a clean living environment. Improvement in sanitation and hygiene behaviours can reduce the incidence of many diseases. Combined with a national programme of immunization of all children under the age of 5 against childhood diseases, these simple measures will go a long way towards reducing the relatively high incidence of child mortality in many developing Islamic countries. Simple measures for reduction of toxic elements such as lead in the home environment through a ban on lead-based paints and use of iodized salt to prevent iodine deficiency will contribute tremendously to normal growth and mental development of the children.

While special focus on children is essential to break the vicious circle of poverty – disease – poverty for the future generations, measures to combat the prevalent disease burden and provide adequate health care to the people are also required. National health systems should be in a position to provide health care to the whole population. In this connection ICT could be used very effectively to provide tele-health services to remote areas and isolated communities. Measures outside the health sector, including environment (water and air pollution), raising public awareness through education and targeted information campaigns, proper solid waste management systems etc are quite effective in disease prevention, thereby reducing the disease burden and promoting the general health of the population.

4.4 Agriculture

Agriculture, which is the backbone of the economy of a large number of Islamic countries, needs special attention not only for providing food security for the people but also for its potential for poverty reduction (Section 3). The current scenario of increasing food prices should provide additional income to the farmers. However, care needs to taken that it does not lead to the shortsighted measure of bringing additional land under cultivation at the cost of biodiversity through clearing of forest areas. R&D should focus on increasing crop yields, developing hybrids for cultivation on marginal lands, ameliorating land degradation, reducing the ecological footprint of agriculture, development of technologies for more efficient use of irrigation water etc.

The research effort should be combined with dissemination of knowledge about new as well as existing technologies and best practices to the farmers, especially those with small land holdings. The use of ICT in disseminating the information to the rural areas – including remote villages – would ensure that the

benefit is not limited to the big farmers. Provision of loans to small farmers for purchase of quality seeds, fertilizers, pesticides needs to be combined with provision of crop insurance to protect the farmer against crop failures through natural disasters, extreme weather conditions etc. Providing micro credit to small farmers for undertaking small agro-based enterprises would contribute considerably towards increasing the income-generating potential of the small land holdings.

4.5 Biodiversity

Biodiversity – the living basis of sustainable development – needs to be protected and preserved (Goal 7) i.e. the loss of biodiversity needs to be halted and, where possible, reversed by restoring biodiversity in degraded areas. The importance of conserving biodiversity and the impact that it has on sustainable development and poverty reduction needs to be highlighted through awareness raising campaigns as well as building it into the school curricula for the primary and secondary classes.

Any development activity, which reduces biodiversity, threatens economic development and human health through loss of useful genetic material. All Islamic countries need to build biodiversity costs and benefits into development projects as well as integrating biodiversity concerns into agricultural practices. Care also needs to be taken that the bio-prospecting activities of the multinational pharmaceutical companies do not result in bio-piracy and that fair and equal sharing of benefits among providers, producers and users of genetic resources is ensured. A national strategy, prepared in consultation with all stakeholders and containing incentives for the conservation and sustainable use of bio-resources, would be instrumental in conservation of biodiversity.

4.6 Dealing with Climate Change

Climate change due to global warming is virtually inevitable, as some degree of climate change will occur due to the present levels of greenhouse gas emissions. The resulting increase in the frequency and intensity of severe weather causing droughts, floods, higher temperatures and rising sea levels is expected to affect the poor disproportionately. It will increase their vulnerability to natural disasters; threaten their access to food and safe water; adversely affect their health and jeopardize their livelihoods. Measures to assist the poor in adapting to the effects of climate change will therefore be necessary in addition to efforts to reduce the effects of global warming through reduction in fossil fuel consumption; promoting alternate energy sources; reducing the carbon footprint by adopting a more carbon-neutral lifestyle etc.

All Islamic countries need to monitor the changes being produced by global warming, study its effect on their territories and populations, and devise strategies for ameliorating the effects of the changes and adapting to them. While special task

forces, supported by the requisite GIS-based systems, may be set up for this purpose by each country, regional cooperation in dealing with the effects of climate change would be advisable.

4.7 Assistance to Countries in Achieving MDG

A number of Islamic countries would not be able to achieve the MDG without external assistance in terms of funds as well as expertise. The relatively advanced Islamic countries would be in a position to help them in achieving these goals through applications of simple technologies. In terms of goal 8 of the MDG – developing a global partnership for development – Islamic countries should consider forming an Islamic partnership for development for providing assistance to Islamic countries in need of such help. *This would be in addition to any global programmes of assistance to developing countries in achieving the MDG.*

Jeffrey Sachs, the head of the UN Millennium Project, has identified 7 simple measures that would help improve the lives of villagers in African countries at a relatively low cost – US$ 250 per person over 5 years. These are: fertilizer and seed to improve food yield; anti-malarial bed nets; improved water sources; diversification from staple into cash crops; a school feeding programme; de-worming for all; and the introduction of new technologies, such as energy-saving stoves and mobile phones. These measures were implemented in 12 villages on an experimental basis and brought a significant improvement in the lives of the villagers within two years (The magnificent seven, The Economist, April 27, 2006). ISESCO, in collaboration with COMSTECH and IDB, could take the lead in setting up a Task Force, which would identify similar simple measures to help the poorest people in the less developed Islamic countries and oversee their implementation with soft funding from IDB.

4.8 Use of Information and Communication Technologies (ICT)

Information and Communication Technologies can be used to good advantage by the Governments of the Member States in providing education, health and other facilities to the people. In education they can be used to provide wide coverage including remote areas to mitigate the shortage of teachers. Wireless technologies (WLL, Wimax etc) provide the possibility of wide coverage, even if a good optical fiber backbone is not available in the country. The people can be facilitated by the provision of online information as well as through the provision of other online facilities such as filing of income tax returns, payment of utility bills, applying for passports etc. Broadband (cable or wireless) can be used to provide good tele-health facilities to the population especially in the remote areas, where such facilities are otherwise difficult to provide. Such facilities proved to be of immense value in the aftermath of the 2005 earthquake in the remote northern areas of Pakistan.

5. Policy and Governance

5.1 Science, Technology and Innovation Policy

All Islamic countries that as yet do not have a Science and Technology Policy should formulate a clearly defined policy stating the national objectives for the development of science and technology and its use for the social and economic development of the people. The considerable expertise available with ISESCO in S&T Policy could be well utilized by the Islamic countries, in addition to the support provided by UNESCO for formulation of such policies.

5.2 National S&T Commissions

It is advisable to set up National S&T Commissions with representation of all stakeholders namely the Government, Academia, Industry and Civil Society to oversee the implementation of the ST&I Policy of the country and its review from time to time. The level of the National Commission should be sufficiently high to ensure that its decisions are implemented without problems.

6. Institutional Arrangements

6.1 Strengthening of ISESCO

To enable ISESCO to play their catalytic role for the development of Science and Technology in the Islamic countries more effectively, both organizations need to be strengthened and supported in terms of manpower and finances. *Similarly the programmes of COMSTECH and IDB should be strengthen in achievements of aims of the strategy for development of science and technology*

6.2 Establishment of Expert Panels

ISESCO should set up Expert Panels to oversee the long-term development and coordination of the recommendations of the Strategy in their fields of specializations. *The existing Networks in various area should also be strengthened in order to allow them to play their roles effectively. These Expert panels and Networks* should address the problems being faced by the Islamic countries in their fields and should come up with plan and recommendations. The Expert panels should have members

from all three categories of Islamic countries as classified in the strategy. The Expert panels should provide advice to any Member States on request advisory services for promotion of their relevant fields and its application for socio-economic development of their people. ISESCO should maintain a roster of experts from Islamic countries in various fields to use their expertise for providing solutions to the problems faced by any member state in any field of science and technology.

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List of Acronyms

COMSTECH	OIC Standing Committee on Scientific and Technological Cooperation
FDI	Foreign Direct Investment
GERD	Gross Expenditure on Research and Development
GDP	Gross Domestic Product
GIS	Geographical Information System
ICT	Information and Communication Technologies
IDB	Islamic Development Bank
IPR	Intellectual Property Rights
ISESCO	Islamic Educational, Scientific and Cultural Organization

ISEW	Index of Sustainable Economic Welfare
LDC	Least Developed Countries
MDG	Millennium Development Goals
MSTQ	Metrology, Standards, Testing and Quality
OIC	Organization of Islamic Conference
R&D	Research and Development
S&T	Science and Technology
ST&I	Science, Technology and Innovation
SWOT	Strengths, Weaknesses, Opportunities and Threats
TOKTEN	Transfer of Know-how Through Expatriate Nationals
TWAS	The Academy of Sciences for the Developing World
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WEHAB	Water, Energy, Health, Agriculture and Biodiversity