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INITIATIVES UNDERTAKEN TO PROMOTE DISSEMINATION, IMPLEMENTATION AND DEVELOPMENT OF SCIENCE AND TECHNOLOGY IN EGYPT (CASE STUDY)

by

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I-Introduction

Science and technology management, policy and planning have come to play an increasing important role in economic, social and political life of every society. Both research and development (R&D) activities and technological development became crucial ingredients in building national capabilities for application of science and technology (S&T) to development. Such processes need knowledge and experience at certain levels of management, policy-making and planning for both in scientific and technological community, and the end-user sectors or general public.

Hence, the national initiatives undertaken to promote dissemination, implementation and development of S and T capabilities (NSTIs) constitute a powerful means for S and T capacity building in the country.

However, in Egypt, during the last 25 years, there has been an increasing awareness of such understanding and continuous efforts are being devoted to support the national S&T system, establishing its proper linkages with other national systems and fulfilling its proper management.

In the following, a thorough review of the range of NSTIs formulated and being implemented in Egypt is presented. This review is being designed with a view to providing concrete examples of current approaches to NSTIs formulation and implementation strategies as well as coordination and cooperation arrangements and linkages to production and services sectors and the end-users in general.

II- Development Strategy Frameworks and on-going S and T Activities

Whatever the political or economic pattern of a country might be, its main ultimate objectives are to ensure economic growth and to raise the standard of living for its people. To fulfill these objectives there is a variety of means, one of which is the utilization and harnessing of scientific and technological results; the science solution. It has been fully demonstrated that when science and technology are properly oriented, they can realize most national economic and social objectives. The history of the economic growth in the advanced countries is a strong proof of this fact. Science and technology have come to be regarded as prerequisites of good living.

However, many developing countries, while not lacking awareness of these facts, still have a long way to go in order to utilize S&T for development.

The reasons are many, some of them are:

- a- poor endogenous capabilities in S&T;
- b- misuse of existing capabilities; and
- c- bad choice of foreign technologies.

To depend on foreign science and technology might lead to negative results. S&T mean different things in different societies, at different levels of development, and having different targets to achieve. The blind importation of S&T from another country leads to the importation of some of the "values" of the society in that country. This is not beneficial in all cases.

Each society should be able to identify its needs, and express them in specific objectives for S &T to materialize, whenever possible. In this, the society should depend, in the first place, on endogenous capabilities. The first component of this self-reliance is to be able to decide on how should S&T be oriented, if they are going to contribute to development.

Here, there are two important factors that should be taken into consideration as follows:

- 1- Future Looking at the Impact of New and Emerging Areas of S&T on Developing Society.
- 2- Impact of variables on S&T activities, which includes:
 - Economic liberation and new world order;

- Features of free economy;
- Critical circumstances confronting free economy;
- Requirements of the next stage, such as:
 - Modern scientific management;
 - Training of all kind and level of workforce;
 - Interest in research aiming at cost reduction and quality improvement;
 - Establishing R&D unites in production sectors with strong linkages with the universities and research centres;
 - Building of strong linkages with similar foreign R&D centres¹.

III- S&T Policies, Strategies, Work Plans and Resources

III.1 Policies, Strategies and Work Plans

During the eighties and the nineties Egypt has become more aware of the importance of S&T for development. This has been translated by the Ministry of Higher Education and State for Scientific Research and ASRT into formulating and implementing certain policies, strategies and 5-year working plans. However, these activities have already been the subject of a previous ESCWA- Expert Group Meeting held in March 1999 and ASRT had a substantive contribution to that meeting. This could be seen in the study published by ESCWA in September 1999 and entitled : "Science and Technology Policies in the Twenty - First Century" (pp. 33 - 49).

In this respect, we could refer only to two main points. Firstly that the planning process is being carried out within the framework of a long-term view for S&T development in the country (till the year 2017 for ASRT). Also, within the range of a futurist vision announced by the Ministry of the Higher Education and Ministry of State for Scientific Research² which is summarized in the following.

The main forces for change for year 2010 agreed upon are:

- 1- Increasing international integration or globalization.
- 2- Increasing application for information and communication technologies.
- 3- Improving systems for sustainable development for the environment.
- 4- Increasing developments in the application of biotechnology and genetic engineering.

Secondly, the most important technologies that will govern the 21st century are:

- 1- Information and communication technologies
- 2- Energy
- 3- Transportation
- 4- Microelectronics
- 5- Genetic engineering and biotechnology
- 6- Suitable management control systems for the international economy.

III.2 S&T Resources

A- General Structure of the Present Science and Technology System:

The system includes institutions with both deliberation and implementation functions.

¹ ASRT, "Development Policies of the ASRT during the period between 1997/98 - 2011/12 and Total Estimated Costs of the 4th, 5th and 6th Five Year Plans, Initial Working Paper, ASRT, Cairo, Egypt, p.p. 2-5.

² Ministry of State for Scientific Research and Ministry of Higher Education, "Science and Technology Policy in Egypt: Futurist Vision", Cairo, Egypt, 1998.

Institutions with Deliberation Functions:

- 1- Four National Advisory Councils, affiliated to the Presidency of the Republic, with assignment to study selected topics of public interest. One of these is the council for education, scientific research and technology.
- 2- Permanent Ministerial Committee for Technology Transfer and Development.
- 3- Ministry of Scientific Research (MOSR): The Minister is responsible before the cabinet and parliament for matters related to S&T Policy and issues, which cut across various sectors and disciplines. The minister is also responsible for the institutions affiliated to MOSR.
- 4- Government Ministries: Most Government ministries administer both deliberative, as well as specialized executive functions.
- 5- The Academy of Scientific Research and Technology (ASRT): One of its major functions is to deliberate through thirteen specialized councils and a number of technical committees.

Institutions with Implementation Functions:

Institutions with implementation functions may be departments, laboratories or large multidisciplinary centers. They can be categorized into:

- 1- Governmental.
- 2- Public sector.
- 3- Private sector.
- 4- Non-governmental organizations.

B- The ASRT survey included the distribution of S&T institutions engage in scientific research and their distribution across areas of activity. Other ASRT survey indicated S&T manpower resources in Egypt. Both resources are thoroughly mentioned and analyzed in the previous mentioned study published by ESCWA in September 1999 and entitled: "Science and Technology Policies in the Twenty-First Century " (pp.33 -37).

C- Concerning financial resources, at least 95% come from the government and about 0.6% percent of the domestic GNP.

III.3 Strengths and Weaknesses of the S&T System

The study conducted in 1996 under the auspices of the Egyptian Ministry for Scientific Research and funded by the World Bank³ has identified the strengths and weaknesses of the Egyptian S&T System.

A- Strengths

- 1- Tremendous human resources with a large number of highly educated and specialized personnel.
- 2- Presence of a considerable number of R & D institutions in various specializations and disciplines.
- 3- Many shining example of success, particularly in agricultural research and in some of the well focused industrial R&D.
- 4- Long-time tradition on S&T.
- 5- Governmental commitment towards S&T institutions.

B- Weaknesses

This study sought to suggest remedies in areas of serious weakness. Despite the many shining examples of success, the Egyptian S&T system in place prior to this study was isolated from the socio-economic development of the country. It failed to become a scientific and technological power, which could induce an

³ Ministry of State for Scientific Research & World Bank, "An Overview of Study on Improving the S&T Policy and Management in Egypt", A World Bank- IDF Funded Project WB 28836, January 1997, Ministry of State for Scientific Research, Cairo, Egypt.

effective transfer of technology and know-how from advanced nations and, in turn, create a solid national technological base, both of which are necessary foundations for successful socio-economic development.

It must be noted that during the past two years, many positive changes have taken place in response to the many important recommendations that evolved from the study. Below is a summary of the common set of problems that were identified in the study.

- 1- Lack of an explicit national S&T policy;
- 2- Inefficient and complex organizational structure causing conflicts rather than promoting harmony.
- 3- Seriously limited financial resources;
- 4- Deficient physical and information resources;
- 5- "Laissez Faire" funding policy and selection of research topics left to individual researchers;
- 6- Most R&D institutions function as academic units rather than as technology centers;
- 7- 75% of researchers are in universities;
- 8- Only 15.7% of S&T personnel are in Engineering and Technology;
- 9- Foreign funds are not well coordinated;
- 10- Links between R & D institutions and industry are weak;
- 11- Technology transfer follows laissez-faire policy with so significant role for the S&T institutions.

IV - Managerial Aspects

Undoubtedly, such previous S&T development and upgrading is based on three essential foundations: the first one is to benefit from the seasoned experience of the current generations of Egyptian professors in university teaching and scientific research. Secondly, this should be combined with experiences of leaders and officials responsible for implementing development plans in all sectors of workforce as well as private and public production sectors whose practical experiences are indispensable. Thirdly, there should be sustainable cooperation with such institutions and agencies concerned with S&T and development in particular regional organizations, UN agencies, OECD, EC, USAID, CIDA, etc.

All this has called for certain management initiatives out of which three aspects should be mentioned:

First: Reorganizing of the Scientific Research Sector

In November 1998, three Presidential Decrees for the restructuring of the scientific research sector were issued. They include, specifying the responsibilities of the Minister of State for Scientific Research, restructuring the Academy of Scientific Research and Technology and restructuring of the Supreme Council for Research Centres and Institutes.

Second: The Universities

The Egyptian Government has launched a new initiative to strengthen the linkage between the Egyptian R&D community in universities, research institutes, and the production and services sector. Organizational restructuring of universities' managing system has been carried out to introduce, in addition to the Vice-presidency offices of "Student Affairs" and "Graduate Studies and Research Affairs", a new Vice-presidency office for "Society Services and Environmental Affairs" was created .

Following that, Vice-Deans offices were set in each faculty. Business-based, results-oriented, self-financed autonomous units were allowed to function under the supervision of the Vice- Deans for "Society Services and Environmental Affairs". Highly flexible administration and financial procedures were formulated to control the management aspects of these units. More than 300 of these units are new in operation all over the Egyptian universities and research institutes. Results regarding the quick and positive response to end-users' requests are pronounced.

Third: Upgrading of Technology Management

Management is the implementation of objectives, plans and internal operational efficiency of an organization or an entrepreneurship. The essential management functions are: planning, organizing, activating, motivating and controlling.

In the framework of this understanding, Egypt devoted considerable efforts in the last ten years for:

- 1- Upgrading national and sectorial capabilities in technology management specially management programmes on: technology planning, technology choice, technology transfer and technology development;
- 2- R& D management;
- 3- Marketing and commercialization of research results, technology and university services.

These efforts include holding of conferences, seminars, workshops, study, training courses, and other promotion activities.

V- Recent Technology Development Initiatives:

The building of endogenous science-based technological capacity is a long-term, complex and protracted endeavor. A minimum infrastructure is a prerequisite for achieving endogenous capacity. Therefore, the basic objectives of a National Technology Policy will be initially the efficient absorption and adaptation of imported technology appropriate to national priorities and resources and subsequently the development and strengthening of indigenous technology base. This entails the formulation of "National Technology Policy", sectorial technology strategies, implementation plans, mobilization of resources, issuing of necessary legislative and legal matters, practicing of modern technology management and others.

However, in Egypt, during the past two years, very remarkable steps have been taken by the government for strengthening the national technological capabilities, which are imperative for promoting sustainable development and improving the quality of life. This is represented by the following:

V.1 Availability of Political Will and Political Support Initiatives

V.2 Formulation of National Program for Technology Progress

Higher decision makers (The President of the Republic and the Cabinet), Legislative Bodies and Political Parties have realized that the National Projects and Development plans include important S&T elements that could be covered only by specialists. They have also realized that through studies need to be performed by the S&T community before taking any decision in major development plans. This is represented by a number of important initiatives among them:

A- The President of the Republic declared on 30 September 1999 and later on 23 July 2000 the need for formulating a national program for technological progress to serve the National Program for State Modernization. Each concerned ministry is now preparing its sectorial technological program, where the total national program will be discussed and approved by the end of this year.

B- There is currently a Permanent Ministerial Committee for Technology Transfer and Development headed by the Prime Minister and composed of 14 concerned ministers. This is followed by the approval of the Council of Ministers for establishing the Executive Centre for Technology Transfer and Development, to be affiliated to the Cabinet. Such center is considered a mechanism for realizing technology transfer and development. It consists of basic units related to the technologies of food and drugs, microelectronics, computer, software, new materials, chemicals and renewable energy. It is expected that this committee will be restructured and headed by the President of the Republic.

C- According to a directive from the President of the Republic issued last month, necessary steps are being taken for the establishment of a Higher Council For Coordination Between Research Organisms in different ministries. This proposed council will be headed by the Minister of Higher Education and Minister of State for Scientific Research, and would meet once a month to discuss a defined issue and decisions to be submitted to the cabinet and concerned authorities for implementation.

D- The Legislative Authority is devoting continuous efforts to deliberate her position and initiatives in the needed national strategy for S&T building capacity and capability. A number of documents have been issued by both the specialized committees associated with the People's Assembly and Al-Shura (Consultative) Council, among them are:

- "Technology Development and Electronics Industry", Cairo, 1998;
- "Technology and the Future of Industrial Development in Egypt", Cairo, 1998;
- "Technology and Development in the 21st Century", Cairo, February, 1999.

V-3- New Technologies Strategies and Plans

One of the key questions that have emerged in the development discussion of the last 10-15 years is the question of the impact of new and emerging technologies on the development of developing countries. Whereas the main focus in the mid-eighties was on microelectronics and related areas, the incredible progress in biotechnology and genetic engineering, in materials sciences (super-conductors), in information and automation technologies and other "frontier" technologies pose new - and largely unanswered - questions. These questions have not played the same role in "traditional" technologies because the new and emerging technologies have specific characteristics such as:

- A continuous and rapid development (and they become rapidly obsolete).
- A high research input.
- An interdisciplinary research approach.
- A high capital input for production and research equipment.

Today, more attention and support is being given by the government to five main new technologies and plans. The aim here is to reach a national vision for the dimensions of both scientific and executive activities to introduce and apply new technologies. This may be achieved through:

- Identifying the quality and dimensions of the new and novel technologies;
- Coordinating with concerned production agencies;
- Selecting new technological fields;

Five new technologies have been identified, namely:

- Information Technology Strategy .
- Biotechnology and Genetic Engineering .
- New Materials Strategy .
- Pharmaceuticals Strategy
- Strategy of Egypt in the Field of Space.

The first of these technologies is being managed by the Ministry of Communication and Information, while the other four are being managed by the Ministry of State of Scientific Research.

V-4 - Science Parks and Technology Valleys

These are new initiatives in S&T building capacity in the country and they are represented by four institutions:

- Mubarek City For Scientific Research and Technological Application;
- The New Egyptian Technological University;
- Eastern Suez Canal Technology Valley;
- Northern Coast Technology Valley.

There are also other old institutions that are now in the process of restructuring and revitalization, these are the following:

- Innovation and Invention Development Agency;
- Egyptian Patents Office;
- The Technical and Technological Consulting Studies, and Research Fund (TTCSR).

V-5- Technology Incubation and Incubators in Egypt

Technology acquisition, if not self-developed, is usually concluded through licensing, joint venture arrangements or purchase of know how. This proved to be reasonably good and effective means to enter business and stay in market. With the current change from isolated markets into a global market, this method of technology transfer became of no help to remain competitive .

The most effective means to address this situation is through technology incubation in association with universities, research institutes, organizations or bodies. New technologies will be transferred through these bodies to markets after passing incubation period. During this period, the production units will become familiar with all aspects of the new technology, demonstrate their capabilities to produce and sell their products prior to the stage of going through full-fledged production .

There are two integrated efforts in this respect, which could be summarized as follows:

A- Egypt incubator program

The Social Fund for Development in Egypt (SFD) through its Enterprise Development Program is promoting the business incubators as one of the means for fostering an entrepreneur supportive environment for business creation. This in turn will generate employment, income and economic growth as well as other economic benefits and cultural transformation in the community within the framework of the nation's overall development program.

The incubator program in Egypt has for objective to develop a network of incubation related facilities that have sustainability and impact. The business incubator's program was launched in 1995. One incubator has started operation and 8 others are in early stage of establishment. Other incubators that are being implemented are: the business incubator at Mansoura and the technology incubator at Tebbin metallurgical institute, Helwan.

Nine locations have been selected to set up incubators in non- exploited areas where technical infrastructure could be found in addition to a good business environment and an academic or industrial basis to service projects. The funding preparation and equipment of the incubators will be undertaken by the SFD.

Other locations are under study especially those of Upper Egypt, the Canal Region and Sinai⁴.

An Egyptian Incubator Association (EIA) has been established and its overall strategy reflects its dual role:

First, to serve as the implementing agency on behalf of SFD for planning. This will involve development of different types of incubators suited to local culture and condition, such as open incubators, rural hub and satellite incubators, and single sector (e.g. biotechnology) incubators, as well as other forms of managed workspaces, such as technology parks.

⁴ Social Fund for Development A.R.E, "Role of SFD in supporting and Developing Small Enterprises" Department of International cooperation and Information, SFD, Cairo, Egypt, 1998, p.p 27- 28.

Second, to serve as the association representing and servicing the Egyptian incubation industry, nationally and abroad.

B- S&T Cooperation program (STC) at ASRT

A practical experience in technology incubation has being gained by STC- ASRT during the last few years.

The following represent individual cases of different nature on projects sponsored by STC; setting problems, actions, and lessons.

- Production of Thermoplast Paints for Road Marking Using Local Raw Materials.
- Design and Application of Computer-based Technology for the Development of Food Processing in Edfina Company together with a Computerized Production Management System.
- Design, Development and Implementation of Computer Based Process Control System for Egyptalum Calcliner and D.C. Casters.
- Productivity and Quality Improvement of Edible Gelatin and Production of Pharmaceutical Grades.
- Local Substitutes of Asbestos and Copolymer in Vinyl Tiles Formulations.
- Design and Fabrication of Small - Scale Units for Production of High Quality Cheese.
- Enzyme Production for Diagnostic Kits.

V-6 Incentives and Prizes

In Egypt, there are a number of central organs, for initiating and mobilizing incentives for S&T on national level. Incentives are in three categories⁵:

1. Incentives to building institutions:

- a. Support of centres for excellence serving S&T.
- b. Support of S&T units with specific nature for areas of R&D and new technologies serving environment and development.
- c. Support of S&T units in marketing R&D results abroad.

2. Incentives for R&D projects:

The importance of spreading scientific and technological awareness among all users stresses the necessity to link closely scientific institutes to executive bodies and media to address issues that directly affect productivity and development and effect the desired social change, in order to cope with scientific and technological progress. This can be achieved through a number of valid actions and regulations by ASRT.

3. Incentives for S&T workers on the personal level:

- Formation of cadres working in S&T at home and abroad.
- Holding training programs and directing cooperation programs to new or needed areas such as biotechnology, genetic engineering, renewable energies, management of scientific research projects, technological development, data banks, information and documentation, and maintenance of scientific instruments.

A number of organizations in the S&T system regulate the award of material and moral incentives to those working in the fields of scientific and technological research. ASRT and the supreme council of culture also award Mubarak prizes for S&T, the encouragement state prizes and the state prizes of merit. It is also their responsibility to suggest any new statutes and legislations to activate scientific and technological research, study the different ways and means of preparing inventories of scientific research workers, and recommend the establishment of new awards in various scientific and technological fields as well as nomination for international awards.

⁵ UNECA, "Incentives for the Development and Application of S&T- Proceedings of a Training Seminar", Accra, Ghana, 26th - 30th June, 1995, p.p. 160 -165.

The above-mentioned organizations also take credit for awarding prizes on behalf of national organizations, local and foreign agencies as well as individuals.

V-7 Legislative and Legal Facilities

The report issued by State Ministry of Scientific Research and World Bank in 1997 stated that the government, guided by signals of global economic change and by the necessity to conform with the new global environment, realized that the whole gamut of legislative instruments which govern or influence the economic policies (in particular, those related to competitiveness, export, and macroeconomic policies), as well as those which govern and influence R&D establishments, need to be reviewed and amended as appropriate. The present S&T Policy Framework will concentrate on the urgently needed legislative forms directly affecting the performance of S&T in Egypt such as :

- The laws, presidential decrees, and by-laws governing the function and performance of R&D institutes.
- The existing legislative instruments for the protection of intellectual property rights (patents, trademarks and copyrights) affect the behavior of technology suppliers and technology developers. The existence of strong patents, trademarks, and copyright protection systems, as well as the prompt enforcement of the relevant laws, will improve Egypt's access to the best available foreign technology and will encourage innovation within the country as well as provide an important attraction for foreign investment and joint ventures⁶.

VI- Cooperative Arrangements at the Bilateral, Regional and International Levels

In this time of globalization there is a great need for scientific and technological cooperation between different countries at its bilateral, regional and international levels. Here, high priority is being given by Egypt to this kind of cooperation, especially with the international governmental and non-governmental organizations, with the regional agencies and the cooperation among developing countries.

In this context, large efforts are being exerted to promote scientific and technological cooperation at bilateral, regional and international levels with strenuous efforts focusing on the following:

- Maximizing the benefits resulting from collaboration with the UN, its specialized agencies, and their regional committees and offices such as ESCWA and ECA.
- Cooperating with developing countries.
- Cooperating with the Commission of European Communities.
- Cooperating with the Organization of the Islamic Conference.
- Cooperating with the Organization of African Unity.
- Cooperating with the Arab League.
- Maintaining bilateral agreements including those with USAID, CIDA, JICA and IFS.

However, a new commitment is needed in this respect, by the fora of the United Nations and its specialized agencies, those of NGOs and regional Entities and Agencies which are involved in science and knowledge sharing to improve public perception of the role of science and technology for development and encourage women's ability to engage in science and research activities⁷. Indeed, ESCWA and other concerned regional organizations could act here as a clearinghouse providing services for the welfare of all mankind regardless of race, creed or sex.

⁶ State Ministry of Scientific Research & World Bank, op. cit, No.(5), p.p.25.

⁷ Dr. Moufeed Shehab, "Science in Egypt", a working paper presented in the 26th General Assembly of ICSU, held in Cairo during 25-30 Sept., State Ministry of Scientific Research, Cairo, Egypt, 1999, p.p. 6-7.

VII - Conclusion

From the previous pages, it could be concluded that, in the last few years, very remarkable NSTIs have been taken by the Egyptian government for strengthening the national S&T capabilities, which are imperative for promoting sustainable development and improving the quality of life. This is represented by the strong and continuous political will and support for a suitable reorganization of the national S&T system. Thus, the range of NSTIs is widening in terms of policy, management, resources, operations and performance considerations. Now, there are also efforts to overcome the problems facing the overall performance and impact of the Egyptian S&T system as a whole.

However, upgrading the effectiveness of the national S&T system in national sustainable development needs more NSTIs to deal with two major changes: First, to realize respond to external changes specially those of globalization, world business and economic environment: Second, respond to internal changes to the national S&T system to create the favorable context needed to achieve stronger linkages with society and the productive sector.

Lastly, Egypt, being aware of the advantages of international and regional cooperation in S&T has done its best to tap all available international and regional resources in this respect. Towards this end, it has established and assigned several governmental structures to undertake this responsibility.

However, on the Arab regional and subregional levels there are similar or common problems, which could be more easily solved through regional cooperation. Here, a new commitment is needed in this respect, by the fora of the United Nations system and in particular its regional Entities and Agencies which are involved in S &T activities and programmes. Indeed ESCWA and Arab League could act here as a clearinghouse providing services for the welfare of all people in the region.

