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THE ESCWA TECHNOLOGY CENTRE FOR DEVELOPMENT

DETAILED ASSESSMENT OF REGIONAL NEEDS AND PRIORITIES AND IDENTIFICATION OF IMPLEMENTATION MECHANISMS

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Preface

The Economic and Social Commission for Western Asia (ESCWA) and its member countries have been concerned with the issues raised by science and technology in development for a long time. They have recently come to realize the need to couple science, technology and innovation (STI) policies with practical applications in order to gain tangible benefits, particularly with the advent of globalization and knowledge dissemination. That concern was reflected by the adoption of resolution 254 (XXIII) on the proposed establishment of a regional technology centre (TC) at the twenty-third ESCWA ministerial session in May 2005. The full text of the resolution is attached in annex I.

The resolution was formalized on the basis of the *Pre-feasibility Study on Establishment of the ESCWA Technology Centre for Development*, the first draft of which was reviewed online by a virtual panel of experts in early 2006. The second draft was submitted for discussion at the third meeting of the Consultative Committee on Scientific and Technological Development and Technological Innovation (ESTIC), which took place at UN House in Beirut on 6 and 7 March 2006. The enhanced Pre-feasibility Study was accordingly issued by ESCWA on 27 March 2006 and resulted in approval for the establishment of the ESCWA TC, as indicated in resolution 274 (XXIV) adopted at the twenty-fourth ESCWA ministerial session held on 11 May 2006. The full text of the resolution is attached in annex I.

The adoption by ESCWA member countries of the concepts of regional cooperation in science and technology is deep-rooted. An early report of the then Economic Commission for Western Asia (ECWA)[1] for the establishment of a pan-Arab regional centre was approved by the member countries, as well as by the member States of the League of Arab States in 1978.[2] At that time, however, the approved plans were not implemented. Moreover, attention to such concepts and technological needs has been repeatedly drawn in several United Nations studies and recommendations.

This *Report* is a continuation of the efforts employed by ESCWA to establish a centre in the region in order to exploit the recent advances in information and other technologies, defined as Special Activity C within the aforementioned Pre-feasibility Study. The ESCWA TC also aims at strengthening national capabilities in STI policy formation and implementation in order to obtain greater benefits from current economic activities and from available human capital. Thus, the mission of the ESCWA TC is to assist ESCWA member countries and their public and private organizations to acquire the necessary capabilities to accelerate socio-economic development in order to attain technological parity with other nations.

For the ESCWA TC to be effective and relevant, it will have to address competition, transaction and networking by focusing on the following issues:

(a) Harnessing modern technologies for socio-economic development, poverty alleviation, employment and gender issues;

(b) Promoting the exchange and transfer of information and knowledge in the region;

(c) Raising awareness on the role of science and technology in socio-economic development in the region;

(d) Encouraging the use of modern tools and mechanisms for development;

(e) Promoting and developing partnerships and supporting effective interaction between ESCWA member countries and the private sector, as well as strengthening their capabilities in negotiation and resource management.

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[1] ECWA was renamed the Economic and Social Commission for Western Asia (ESCWA) in 1985.

[2] ECWA, *Second Revised Feasibility Study for the Arab Regional Centre for the Transfer and Development of Technology* (ECWA, 20 October 1978) E/ECWA/NR/CTT/2/Rev.3.

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Executive summary

In 2006, the twenty-fourth ministerial session of the Economic and Social Commission for Western Asia (ESCWA) passed a resolution to establish a regional technology centre (TC) with an aim to harness science and technology for socio-economic development. The resolution was formalized on the basis of the *Pre-feasibility Study on Establishment of the ESCWA Technology Centre*, which had undergone prior review by various expert groups.

The main reason behind the decision was the collective realization that, although major advances have been marked in fields like education and health, the ESCWA region as a whole was lagging behind other newly industrialized countries, the reason being that the industrialized world, through its knowledge-based economy, has established capabilities with which the Arab countries have been unable to compete.

The movement of some ESCWA member countries towards the Gulf Cooperation Council (GCC) Common Market and the Arab Common Market, as well as World Trade Organization (WTO) membership, should facilitate cooperation and regional use of national organizations. It should be noted that, although the technology market of individual member countries is limited, the entire ESCWA market is very large, and member countries can take over more of the benefits of their economic activities though regional cooperation.

Thus, the ESCWA TC will seek to build upon the considerable resources available to the member countries of human capital, financial tools, adequate policies and ongoing major activities in order to highlight latent technological resources that can be tapped through such established methods as outsourcing and subcontracting which, in turn, will be expected to contribute to the flourishing of small and medium enterprises (SMEs).

The ESCWA TC, through a network of collaborating public and private organizations, will address the following major issues:

(a) Identifying systemic issues that obstruct national and regional economic development;

(b) Providing insight and assistance to member countries on effective mechanisms of technology acquisition and accumulation;

(c) Making available, through outsourcing, the considerable technological capabilities currently sequestered in existing national industries;

(d) Proposing mechanisms for a more effective utilization of national infrastructures and the very large human capital available to the region;

(e) Providing assistance in strengthening national science, technology and innovation (STI) policies;

(f) Facilitating access to information at low cost, and identifying and disseminating best practice in the region;

(g) Providing assistance to member countries in achieving the Millennium Development Goals (MDGs).

Those activities will filter down and provide impetus for the development of competitive consulting, engineering, design and contracting organizations, in addition to providing opportunities for numerous SMEs involved in repair and maintenance activities. In turn, they will be expected to have a considerable impact on the type, range and volume of financial services in the region and on inter-Arab trade and technological

cooperation. By effective collaboration and by reducing costs, it will then be possible to compete on the international markets.

As a result of those activities, there will be readily available technologies in the region and an adequately trained labour force to respond competitively to the existing demand for such services. There should be a substantial impact on socio-economic development, as a result of an increase in employment and the multiplier factor associated with projects undertaken in the region by highly competitive, indigenous STI-based organizations and a highly skilled workforce.

In order to accomplish those objectives in a timely and well-structured manner, the ESCWA TC will be established around operational structures, namely, a board of directors headed by an executive director and two support units, a systems and projects division and an information and data management division. The ESCWA TC will have access to a network of national centres and organizations, in addition to a pool of national and international consultants. Adequate operations call for a full-time staff of about fifty well-trained and multi-experienced professionals.

The ESCWA TC will be affiliated to ESCWA; however, it will not be part of an already existing line management system. The Centre will be governed by an independent board of governors, who will approve the periodic work plans and solicit the funds necessary for such an operation. An endowment fund is the most plausible funding mechanism in order to sustain an annual operational cost of about $10 million.

ACRONYMS AND ABBREVIATIONS

ACI	Amman Chamber of Industry
ACSAD	Arab Center for the Studies of Arid Zones and Dry Lands
AFESD	Arab Fund for Economic and Social Development
AFP	Agence France Presse
AHDR	Arab Human Development Report
ALECSO	Arab League Educational, Cultural and Scientific Organization
AMF	Arab Monetary Fund
APCTT	Asian and Pacific Centre for Transfer of Technology
API	Arab Planning Institute
APICORP	Arab Petroleum Investment Corporation
ARAMCO	Arabian American Oil Company
ASTF	Arab Science and Technology Foundation
BCSR	Bahrain Centre for Studies and Research
CERT	Centre for Excellence for Applied Research and Training
CNRS	National Council for Scientific Research
DRUID	Danish Research Unit for Industrial Dynamics
EAD/ESCWA	Economic Analysis Division, ESCWA
EC	European Commission
ECWA	Economic Commission for Western Asia; in 1985 the Economic and Social Commission for Western Asia (ESCWA)
EIB	European Investment Bank
EJADA	Euro-Jordanian Action for the Development of Enterprise
ESCAP	Economic and Social Commission for Asia and the Pacific
ESCWA	Economic and Social Commission for Western Asia
ESCWA TC	ESCWA Technology Centre
ESTIC	Consultative Committee on Scientific and Technological Development and Technological Innovation
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GCC	Gulf Cooperation Council
GDP	gross domestic product
GFCF	gross fixed capital formation
GIS	geographic information systems
GM	genetically modified
GNP	gross national product
HCST	The Higher Council for Science and Technology
HIAST	Higher Institute of Applied Sciences and Technology
HSP	highly skilled personnel
ICARDA	International Center for Agricultural Research in the Dry Areas
ICT	information and communications technology
ICTD/ESCWA	Information and Communication Technology Division, ESCWA

ACRONYMS AND ABBREVIATIONS (*continued*)

IDB	Islamic Development Bank
ILO	International Labour Organization
IMF	International Monetary Fund
ISRO	Indian Space Research Organization
IT	information technology
JCCA	Jordan Construction Contractors Association
JEA	Jordan Engineers Association
JIC	Jordan Innovation Centre
KACST	King Abdulaziz City for Science and Technology
KISR	Kuwait Institute for Scientific Research
LACIE	Large Area Crop Inventory Experiment
MDGs	Millennium Development Goals
MENA	Middle East and North Africa
MESA	Middle East Strategy Advisors
NASA	National Aeronautics and Space Administration
NRC	National Research Centre
NGO	non-governmental organization
OAPEC	Organization of Arab Petroleum Exporting Countries
OECD	Organisation for Economic Co-operation and Development
PPP	purchasing power parity
PVC	polyvinyl chloride
RCTT	Regional Centre for Technology Transfer; in 1985 Asian and Pacific Centre for Transfer of Technology
RSS	Royal Scientific Society
SAGIA	Saudi Arabian General Investment Authority
SARC	Scientific and Applied Research Center
SEIDAM	System of Experts for Intelligent Data Management
SDPD/ESCWA	Sustainable Development and Productivity Division, ESCWA
SSRC	Scientific Studies and Research Center
STI	science, technology and innovation
SME	small and medium enterprise
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIDO	United Nations Industrial Development Organization
WTO	World Trade Organization

Introduction

More than at any other time in their history, the stability, prosperity, security and international standing of the Economic and Social Commission for Western Asia (ESCWA) member countries are contingent on the acquisition of the technologies underpinning their economies. The realization of such technological achievement is not only possible, but also extremely important. The achievements of India, the People's Republic of China, the Republic of Korea and Taiwan Province of China on that course are encouraging, and should inspire the ESCWA region to redouble its efforts and be innovative in adopting effective strategies to attain its objectives.

Since the 1950s, both Governments and the public in the ESCWA region have been increasingly committed to development. The main approaches adopted to pursue those objectives have been major investments in the socio-economic infrastructure and in education. Although Arab countries have made considerable progress during the past fifty years, they have not yet achieved their goals. Moreover, other developing countries possessing fewer resources and opportunities have been more successful in their efforts. For example, Arab countries have invested more in education on a per capita basis at home and abroad than either China or India, as illustrated in table 1; however, those two countries have become leaders in development, while the Arab countries are still lagging in their efforts.

One of the most important achievements of the past two centuries is the identification of mechanisms and favourable conditions for converting knowledge embodied in human capital into socio-economic benefits. The ability to undertake such conversion at a high rate is predominantly dependent on education and political culture.

TABLE 1. NUMBER AND RATIO OF STUDENTS PURSUING STUDIES ABROAD AND IN HOME COUNTRY

	Total population	Students studying abroad			Students studying in home country	
	1997 (millions)	1999*	1999 corrected**	Ratio (per million)	Enrolment in higher education	Ratio (per million)
Arab countries	253.4	111 854	120 602	476	3 168 445	12 474
China	1 227.0	95 899	106 036	86	7 364 000	6 002
India	962.0	48 348	52 932	55	9 834 000	10 223

Sources: Compiled from United Nations Educational, Scientific and Cultural Organization (UNESCO) statistics and others.

Notes: * Based on UNESCO data.
** Figures were obtained through the complementing of UNESCO data with European Union (EU) statistics.

The growing sophistication in science and technology requires an increasingly complex infrastructure, known as the science, technology and innovation (STI) system, which consists of laboratories, libraries, educational and training institutions and related facilities, as well as communications facilities, associations and organizations, with financial services acting as intermediaries. On the one hand, such infrastructure would facilitate the acquisition and application of technology; and on the other hand, it would promote the development of technology. The STI system is a crucial part of the mechanism needed to convert knowledge into socio-economic output. The weaknesses of the national STI systems in the ESCWA region have drastically reduced the benefits derived from the investments made during the past thirty years in economic infrastructure, which totalled an estimated $4,000 billion in gross fixed capital formation (GFCF).[3] Most of those investments were undertaken by international companies utilizing turnkey contracts, which did not do much to promote or facilitate technology transfer to national and regional organizations. As a result, the region has intensified its technological dependence without enhancing its technological infrastructure. Considerable literature on the subject of national systems of science and technology has been written about

[3] Compiled from World Bank data at constant prices for 2004.

the region by the Arab League Educational, Cultural and Scientific Organization (ALECSO), ESCWA and UNESCO; hence, the specific requirements have been defined in great detail.[4]

Most developing countries attempt to acquire the technological capabilities underpinning the services they need so as to become progressively more technologically independent. In addition, they can increase the multiplier factor associated with such activities. The two main groups of imports into Arab countries are: (a) agricultural equipment and food supplies; and (b) services to the oil, gas and phosphate sectors, the construction industry and the industrial sector, including cement, metallurgical, textile and electronics industries, as well as information and communications technology (ICT) related equipment and services.

Tables 2 and 3 clearly illustrate the extent of import services in Egypt, Saudi Arabia and the Arab world as a whole, in the United States of America and Japan, and in European Union (EU) member countries. The import of services in Arab countries is considerable and equals that of capital goods. As illustrated in table 2, in such industrial countries as the United States of America, Japan and EU member countries, the share of the import of services as a proportion of gross domestic product (GDP) is lower than that of Arab countries, where the ratio of imports of services to capital goods is over 143 per cent, as illustrated in table 3.[5] The reason for the disparity is that Arab countries are not utilizing national organizations and national labour for a substantial proportion of those services.

Given an enabling environment, Arab human resources could contribute to the reduction of the import of services. Such a process would promote the employment of skilled labour and professional manpower, thus reducing the brain drain. National participation would result in the increase of the multiplier factor and the acquisition of technology.

TABLE 2. TRADE IN SERVICES AND RATIOS TO GDP, 1987
(*Millions of US dollars*)

	Import of services	Gross domestic product (GDP)	Import of services/GDP (percentage)
Egypt	2 742.6	29 337.3	9.3
Saudi Arabia	19 314.6	73 463.2	16.3
Arab world	35 769.4	338 442.1	10.6
United States of America	72 153.0	4 497 200.0	1.6
Japan	52 835.0	2 373 600.0	2.2
EU	236 635.0	5 456 000.0	4.3

Source: United Nations Industrial Development Organization (UNIDO), 1992.

The situation has not significantly changed since 1987. For example, trade between the United Kingdom of Great Britain and Northern Ireland and Saudi Arabia in 2003 amounted to over £1.8 billion worth in British visible exports and £1.8 billion in British services exports.[6] The development of a national

[4] See, for example, Abdallah Wassek Chahid and others, *A Strategy for the Development of Arab Science and Technology: The General Report and the Sectoral Strategies*, ALECSO Committee for the Development of Science and Technology in the Arab Nation (Centre for Arab Unity Studies, Beirut, 1989) (in Arabic).

[5] Statistics on the proportion of imports of construction materials in the Arab world is limited; however, the estimated proportion of major materials for the entire Arab world for 1980 was 80 per cent, according to A. B. Zahlan in *The Arab Construction Industry* (Croom Helm, London and Canberra, 1984), p. 209. During the period 1982-2000, only 12 per cent of the construction material used in Saudi Arabia was locally produced, the remainder imported, according to the article "The Saudi construction sector and future opportunities: implications of economic reforms" in *The NCB Economist* (vol. 10, No. 3, p. 6.), published by the Economics Department of the National Commercial Bank, Jeddah, Saudi Arabia, in 2000. Investments in plants for the manufacturing of construction materials are being made; nevertheless, there will still be a considerable shortage in local production, with media figures indicating that overall imports remain very high.

[6] *Opportunity Middle East*, (Middle East Association, London, June 2004).

infrastructure comparable to that of the countries of the Organisation for Economic Co-operation and Development (OECD) would contribute to the elimination of some of the internal barriers to development.

TABLE 3. IMPORTS AND RATIOS OF SERVICES TO CAPITAL GOODS, 1987
(*Millions of US dollars*)

	Imports of services (1)	Imports of capital goods (2)	Ratio (3)=(1)/(2) (percentage)
Egypt	2 742.6	2 863.0	99.8
Saudi Arabia	19 314.6	7 689.6	251.2
Arab world	35 769.4	24 917.6	143.6

Source: UNIDO, 1992.

Since 2002, the region has benefited from an increased demand for its resources. Thus, greater income has been generated; however, national technological capabilities have not been forcefully pursued. The contributions of the proposed ESCWA technology centre (TC) should enable ESCWA member countries to establish their own "engines" for accelerating economic growth. Though every Arab country has set up national science and technology organizations, they could be made more effective and utilized more efficiently through the assistance and cooperation of a regional centre. Hence, two important measures to be employed by the ESCWA TC are the following:

(a) To assist in complementing ESCWA member country resources by supplying missing components to carry out an activity;

(b) To develop appropriate methods for facilitating technology acquisition in collaboration with interested parties.

The ESCWA TC staff would need to be capable of working with a wide variety of users and assisting them with identifying and obtaining answers to the problems confronting them. To do so, the staff would be collaborating with networks of national and pan-ESCWA organizations, and cooperating with other regional and international experts. The ESCWA TC would develop rapid, low-cost, Internet-based methods to speedily connect appropriate entities and persons.

This *Report* aims at describing and discussing the major design features of the proposed ESCWA TC. An essential design feature is to maintain a high level of flexibility, which would enable the Centre to respond to the diversity of users and the rapid changes in science and technology. The world is evolving at great speed, with knowledge doubling every five to six years. It is essential that the ESCWA TC and its staff function within the constraints imposed by those global processes. The staff should constantly interact with international and regional economic, social, scientific and technological advances to provide users with up-to-date, relevant and effective services.

Box 1. Mission of the ESCWA Technology Centre

To assist member countries and their public and private organizations to acquire the necessary tools and capabilities to accelerate socio-economic development in order to attain technological parity with other nations and regions.

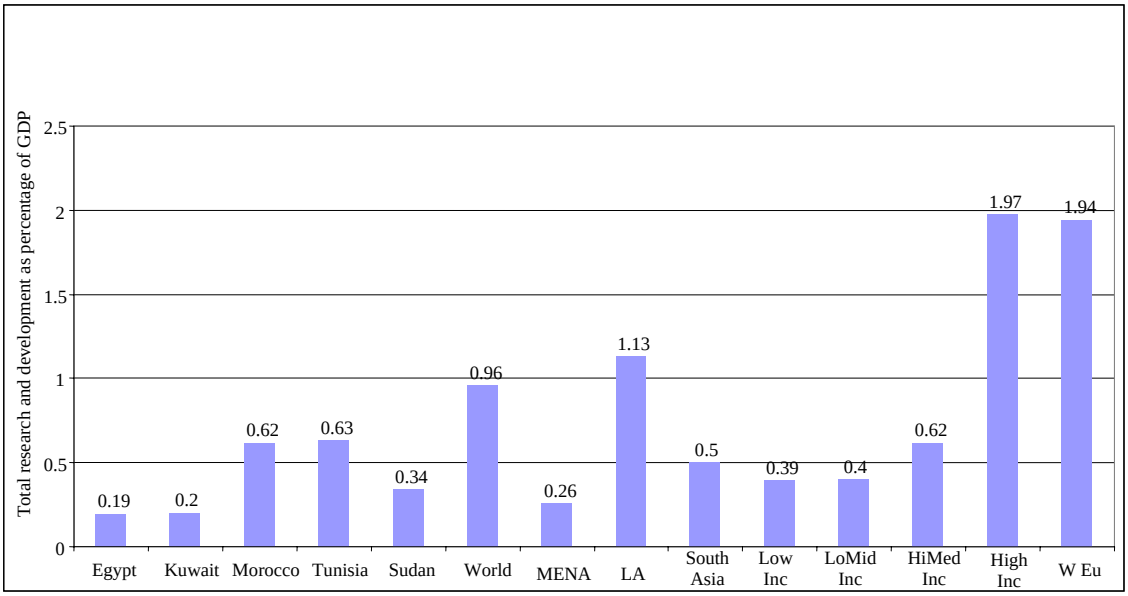
A. THE WORLD WE LIVE IN: KNOWLEDGE-BASED, GLOBAL AND COMPETITIVE

The industrial world, through its knowledge-based economy, has established capabilities with which the Arab countries, ESCWA member countries being an integral part, have been unable to compete. Figure 1 indicates the lag in the support for research and development in the Arab countries by comparison with other countries which, in turn, has contributed to the reduction of the ability of those countries to compete.

Such inability to join knowledge societies has meant that ESCWA member countries have lagged in their development, resulting in a massive brain drain, a considerable labour migration, large capital outflows and low returns on national investments.

The total number of highly skilled personnel (HSP) leaving Arab countries to the OECD countries was 967,548 in 1999. That size of migration represents roughly 300,000 more than the number of Indian migrants, and only slightly fewer than the number of Chinese migrants to OECD countries, as illustrated in table 4. On a per capita basis, the Arab brain drain is four times greater than that of China, and five times that of India. Overall emigration from China and India is 3.6 million, compared with 4.5 million from the Arab world. Thus, China and the Arab world export an equal number of HSP; however, in terms of total emigration, including skilled and semi-skilled migrants and their dependents, the Arab world surpasses China and India combined.

Figure 1. Total research and development expenditure, 2004



Source: World Bank.

Abbreviations: MENA, Middle East and North Africa; LA, Latin America; Low Inc, low income; LoMid, low-medium income; HiMid, high-medium income; W Eu, Western Europe.

TABLE 4. NUMBER OF HIGHLY SKILLED PERSONNEL IN OECD COUNTRIES, 1999

	Expatriates	Highly skilled personnel (percentage)	Highly skilled personnel (number)
Arab world	4 462 391	22.0	967 548
China	1 928 199	51.9	1 000 735
India	1 649 711	39.6	653 286

Source: OECD, *Trends in International Migration: SOPEMI-2004 Edition* (OECD, 2004).

Arab exports are mostly raw materials with little value added, with no Arab country exporting high technology products. By comparison, a small country like Singapore exports a considerable range of high technology products. The export of phosphate has been going on for almost a century in some Arab countries; however, no Arab country produces any of the numerous phosphate by-products which play a major role in industrial and non-industrial processes.

Table 5 enumerates the GFCF figures for ESCWA member countries for the year 2005. Statistics on investments towards GFCF are often underestimated because they leave out many significant projects. Media figures are provided below to illustrate the vigorous rate at which investments are being made in the ESCWA region.

TABLE 5. GROSS FIXED CAPITAL FORMATION IN THE ESCWA REGION, 2005
(*Billions of US dollars*)

Bahrain	2.496
Egypt	15.786
Iraq	3.654
Kuwait	15.945
Lebanon	5.710
Oman	4.965
Qatar	15.066
Saudi Arabia	50.279
Syrian Arab Republic	5.660
United Arab Emirates	27.099
Yemen	3.568
Total	150.228

Source: Arab Monetary Fund (AMF), Arab Fund for Economic and Social Development, League of Arab States and Organization of Arab Petroleum Exporting Countries (OAPEC), *Joint Arab Economic Report 2006* (AMF, 2006) (in Arabic).

Investments provide numerous prospects for acquiring and accumulating technological capabilities through participation in project design and implementation. However, to do so, individual countries must establish their own national science and technology systems. Each project provides an opportunity for acquiring technology, creating employment and encouraging regional and international cooperation, in addition to improving the coherence and relationships among national and regional organizations. The objective of the ESCWA TC is to assist member countries to obtain greater benefits from their economic activities. Most importantly, the development of technology acquisition by a country provides it with the necessary ability to become involved in process and product innovation. A product that has been imported via a turnkey process will not contribute to the formation of such expertise, which is essential for process and product innovation. That is why it is vital for ESCWA member countries to acquire the competence and skills associated with their investments.

For example, the direct and substantive involvement of national consulting and contracting firms is needed for the design and implementation of projects. Such involvement would make it possible to acquire the know-how essential for upgrading processes and products, and the knowledge for repair and maintenance. Through the multiplier factor associated with each project, the national and regional economy would acquire a substantial boost; in effect, every project would become a powerful economic driving force, thus replacing the perpetual drain on the national economy resulting from the importation of repair and maintenance services and spare parts required for efficient future operation.

Technology-free transfers inevitably result in an employment deficit. Such a practice would certainly sustain and increase unemployment. Unemployment in the Arab world is amongst the highest in the world, "at above 15 percent in most countries, and close to 30 percent in Algeria. High unemployment hinders the reduction of poverty, adds to inequality, and feeds social instability in an already fragile region. As a result of slow growth and the slack in the labour market, real wages fell by 30-50 percent in 1980-1990, and have stagnated or fallen since. [...] According to estimates, 50 million new jobs would need to be created over the next 10 years to employ expected additional job seekers".[7]

[7] Dipak Dasgupta and others, "Making trade work for jobs: international evidence and lessons for MENA", *Middle East and North Africa Working Paper Series*, No. 32, July 2003 (World Bank, 2003).

Box 2. Objectives of the ESCWA Technology Centre

(a) To contribute to the strengthening of national STI systems;
(b) To develop capabilities in problem solving and policy formation;
(c) To foster synergy and complementarity at the regional level in the application of technology;
(d) To support the attainment of the Millennium Development Goals (MDGs).

Since the recent increase in oil prices, investments have far surpassed the figures shown in table 5. For example, it is estimated that the Gulf Cooperation Council (GCC) region will require an additional 750,000 hotel rooms by 2020, requiring an investment of $3 trillion in hotels and supporting tourist infrastructure,[8] implying that an investment of $230 billion a year until 2020 will have to be made in that sector alone. The management of such a programme, with a view to technology acquisition, application and development, would solve the unemployment problem in the Arab world. It would also contribute to massive industrial development, combined with an acceleration of economic growth.

New airport projects in the United Arab Emirates alone account for 60 per cent of all airport investments in the Gulf.[9] An estimated $13.2 billion will be spent across the five GCC countries, while the United Arab Emirates is expected to spend over $19.2 billion. Six airports are being built, with expansions at both Dubai and Abu Dhabi international airports, the construction of Dubai World Central and projects in Sharjah, Fujairah and Ras al-Khaimah. Dubai World Central International Airport, which is the largest investment at $8.1 billion, will handle 120-150 million passengers per year.[10] More than $1 trillion are being invested in infrastructure and real estate in the GCC countries. Plan Abu Dhabi 2030 states that the value of declared projects is worth $400 billion.[11] Similarly, Qatar has made a $12 billion investment deal with Exxon Mobil to supply liquefied natural gas to Britain.[12] The Saudi water industry needs $200 billion to meet demands over the next twenty years; however, 30 per cent of supplies are lost through leakages in the pipes.[13] Water leakages plague all Arab water systems. Plugging those leaks is neither difficult nor expensive, and would translate into the equivalent of billions of dollars per year in savings in both capital investment and operating cost.

It is clear that each project would provide opportunities for the countries in the region, boosting the technical skills and capacity to innovate both in process and product design, as well as creating employment and accelerating economic growth. Different approaches may be pursued to secure technological know-how by ESCWA member countries. The optimal approach would be one that benefits from past investments in human capital, organizations and industry. Thus, the most direct and sensible approach would be to mobilize and transform available capabilities. Furthermore, since at least some ESCWA member countries, principally in the Gulf region, are currently undertaking massive additional investments, it is recommended that those investments should also be utilized as channels for technological development. The processes in question have been successfully used by numerous developing countries to their technological capabilities.

The roles of national and regional consulting, contracting, engineering and industrial firms are critical in technology acquisition processes. They are the instruments expected to acquire and accumulate the desired technologies, and their role should be competitive and transparent. The process recommended organizes the procedures of bidding for contracts to involve local and regional consulting and contracting firms on a

[8] Rohit Talwar, chief executive of Global Futures and Foresight, at the 2007 Dubai International Exhibition Centre Hotel Show, reported by Shakir Husain in "$3tr needed for tourism industry", *Gulf News*, 4 June 2007.

[9] Ivan Gale, "UAE airport project spending dwarfs similar Gulf investments", *Gulf News* (23 May 2007), available at: http://archive.gulfnews.com/articles/07/05/23/10127140.html.

[10] "JXB's first runway to be completed in October 2007", *ArabianBusiness.com* (29 May 2007), available at: http://www.arabianbusiness.com/press_releases/detail/5540?ln=en.

[11] "Al Ahbabi outlines 'Plan Abu Dhabi 2030' at Cityscape", *AME Info* (9 May 2007), available at: http://www.ameinfo.com/119549.html.

[12] Agence France-Presse (AFP), "Qatar in 12-billion-dollar deal with ExxonMobil to supply gas to Britain", *Energy Bulletin* (Turkish Press, 17 December 2004), available at: http://www.energybulletin.net/3677.html.

[13] A. Dawson, "Saudi water industry needs $200bn", *ArabianBusiness.com* (30 May 2007).

commercial and competitive basis. It would seek international firms prepared to work in a technology transfer mode with willing and capable local and regional firms. At the same time, appropriate supporting measures would need to be adopted by ESCWA member countries to facilitate the process. In most newly industrialized and OECD countries, they are relatively standard measures. The ESCWA TC aims to contribute in a participatory mode with ESCWA member countries to evolve effective methods for the planning and execution of the economic activities. In doing so, South-South cooperation is essential since those countries provide tangible, indigenous and concurrent experiences.

Local and regional organizations

The ESCWA TC will involve national and regional technology centres, firms and organizations in its activities, thus leading to capacity-building and strengthening of such organizations. The Centre is intended to contribute to the development of consulting and contracting firms, research centres and to researchers at academic institutions, industrial firms, testing laboratories and services, vocational and technical schools and all other organizations undertaking technology- and management-related activities, in addition to adaptation and creation of technology. In a number of cases, the legal, financial and related institutions are of critical importance in the growth of technological progress, thus requiring attention.

All ESCWA member countries now possess entities undertaking research and development, consulting and contracting services. Examples include, but are not limited to, the following organizations:

(a) Bahrain Centre for Studies and Research (BCSR), Bahrain;
(b) National Research Centre (NRC), Egypt;
(c) Ministry of Science and Technology, Iraq;
(d) The Higher Council for Science and Technology (HCST), Jordan;
(e) Royal Scientific Society (RSS), Jordan;
(f) Jordan Construction Contractors Association (JCCA), Jordan;
(g) Kuwait Institute for Scientific Research (KISR), Kuwait;
(h) National Council for Scientific Research (CNRS), Lebanon;
(i) Sultan Qaboos University, Oman;
(j) Council for Scientific Research, Palestine;
(k) Scientific and Applied Research Center (SARC), Qatar;
(l) King Abdulaziz City for Science and Technology (KACST), Saudi Arabia;
(m) Higher Institute of Applied Sciences and Technology (HIAST), Syrian Arab Republic;
(n) Scientific Studies and Research Center (SSRC), Syrian Arab Republic;
(o) Centre of Excellence for Applied Research and Training (CERT), United Arab Emirates;
(p) Arab Science and Technology Foundation (ASTF), United Arab Emirates;
(q) Supreme Council for Scientific Research, Yemen.

A small number of internationally competitive consulting and contracting firms already exist in the domain of civil engineering in the region. With the required infrastructure available, they would be able to expand in strength and capability. Much is already known about what is required to empower such organizations for the region's benefit. Leading national oil and gas companies abound in the region, with the Arabian American Oil Company (ARAMCO) being in the forefront. Hence, the ESCWA region has a substantial set of capabilities; however, what is required is that those technological capabilities available on a national and regional level become accessible on a commercial basis.

In chapter II of this *Report*, it is recommended that non-core activities in major industrial firms throughout the region be considered for outsourcing. In other regions of the world, such outsourcing has been found to contribute to the improvement of technological services and to a reduction of their cost for industrial firms and the economy. The outsourced activities became available to small and medium enterprises (SMEs) at costs they could afford, while previously such enterprises had often been deprived of high-quality technology services. A net contribution of outsourcing is the creation of a complex infrastructure of technology services widely available within member States at international prices. Such a

structure would complement the services of consulting and contracting firms, industrial firms and research and development services to support process and product innovation.

The ESCWA TC is designed to work closely with existing national and regional centres. The relationship between national organizations and the Centre would be such that the acquisition of new technologies is undertaken by the national firms and organizations, rather than by the ESCWA TC. The purpose of such a cooperative pattern is to make sure that techno-acquisitions become an integral part of the national and regional economy. Additionally, the socio-economic benefits resulting from the process of acquisition would be acquired by the economies of member countries.

An extensive survey of research publications in international refereed literature notes that the Arab countries have steadily increased their research output over the past thirty years and that they now cover many fields of science and technology.[14] However, the publications are not well-disseminated and available capabilities are often unknown and underutilized in the Arab countries; hence, the projected directories and information services of the ESCWA TC would be specifically prepared to bring those existing capabilities within reach of the users who require their services.

For the ESCWA TC to cooperate effectively with national and regional organizations, it would need to prepare a comprehensive database on existing services, human resources and facilities, and their preferred modes of operation. Although there is a paucity of information on consulting, contracting and engineering firms, there are relatively recent compilations on research and development institutions[15] in the Arab region. However, such compilations need to be regularly updated and disseminated through the ESCWA TC. In that regard, the promotion of a network of national STI observatories would make of the ESCWA TC an information hub through which national and regional cooperation could be promoted and facilitated. The ESCWA TC would encourage those centres to establish constantly updated web pages to facilitate national and regional cooperation.

As a result of available modes of Internet communication, it should be possible to maintain an adequate to high level of communication at little cost. A minimal amount of face-to-face meetings is crucial to establish a basis for efficient cooperation. Conferences, workshops, summer schools and expert group meetings would be used to promote meetings between experts in the region to facilitate cooperation. Frequent cooperation should lead to a common understanding of terms and methods of approach, and an understanding of the specific wishes of each country and organization. Repeated activities, combined with systematic attention to institutional learning, should result in the creation of efficient and low-cost systems of cooperation. Extensive use of the Internet and Internet conferencing, application of special software for joint drafting of reports, standardization and pooling of databases, knowledge of working habits and attitudes of various experts and sharing of standard glossaries and technical terms, among others, should all help to accelerate work and eliminate problems.

B. THE BENEFITS OF A REGIONAL TECHNOLOGY CENTRE

There are two very good reasons for the establishment of a regional technology centre, namely: (a) the technology market of an individual ESCWA member country is limited, whereas the total ESCWA market is massive; and (b) ESCWA member countries can take over more of the benefits of their economic activities through regional cooperation. It is evident that the Centre would facilitate the carrying out of projects in a manner which contributes to the welfare of all member countries at no additional cost to any. The comparative advantages of each member country are sufficiently different to encourage neighbouring countries to cooperate.

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[14] See A. B. Zahlan, *Science and Technology in the Arab World: Progress without Change* (Centre for Arab Unity Studies, Beirut, 1999) (in Arabic).

[15] See ESCWA, *Directory of Research and Development Institutes in the ESCWA Member Countries* (United Nations, New York, 2001) (E/ESCWA/TECH/2001/2).

A characteristic of ongoing economic activities in the ESCWA region is that identical projects are currently being undertaken repeatedly in the same or different countries. They are often being carried out without the sharing of past experiences, and without the acquisition of the technology after repeated transfers. The limited extent to which technology is acquired means the perpetual dependence on importation of repair and maintenance services. It also means that innovation cannot be stimulated, and spare parts cannot be manufactured to meet local needs. The adoption of sensible and mutually beneficial forms of business cooperation should yield substantial benefits to all parties concerned. For example, even when the technology is acquired by one country, while the actual project is constructed in a second country, that country will also benefit from the expected lower cost of design and construction. Furthermore, the second country would ultimately profit from the lower cost of repair and maintenance services and the possibility of developing local or regional capabilities in process and product innovation.

The ESCWA TC would develop and suggest operational methods enabling ESCWA member countries to benefit from available knowledge which serves their common interests.[16] An important contribution such a centre can make is to promote the emergence of a rich regional technological infrastructure of capabilities, which would be transportable and accessed across the entire region. That infrastructure would not be located at the ESCWA TC, but rather in national and regional centres, private and public organizations and universities. Assisting in the establishing of a rich regional technology base of organizations and institutions should help investors and planners to benefit from, and engage in mechanisms available within an enabling environment that would:

(a) Reduce cost of projects;
(b) Establish powerful financial services to support technology acquisition and accumulation;
(c) Select optimal solutions;
(d) Facilitate industrial diversification;
(e) Work as a regional observatory for science and technology statistics and indicators;
(f) Acquire the capacity to innovate in both process and product design;
(g) Establish repair and maintenance capabilities and reduce their cost dramatically;
(h) Manufacture spare parts for the regional market.

The supply of regional capabilities would need to respond to Governments, entrepreneurs, academic planners, engineering societies, labour unions and information services. Changes in demand will be seen at the planning stage, giving time to the relevant authorities to adapt to the changing circumstances. Thus, the regional market for technology will be paralleled by a vibrant regional market in information, financial and insurance services, as well as labour.

During the past thirty years, there have been highly differentiated approaches to development throughout the ESCWA region. Many of the advances made in one country have not been learned in neighbouring countries. The differences found have not received adequate attention and have not been an object for regional emulation. The present conditions are a result of the absence of regional centres where best practices are studied and disseminated. For example, Saudi Arabia has made large investments in the agricultural sector and, as a result, the value added per farmer is approximately ten times that of an Egyptian farmer, as illustrated in table 7. What is even more noteworthy is that, in 2005, the contribution of agriculture to the gross national product (GNP) in Saudi Arabia was just over $10.2 billion, compared with close to $12.6 billion in Egypt. In 2005, Saudi Arabia was the second largest producer of agricultural products in the Arab world. Those facts merely emphasize the opportunities available to Arab countries in the agricultural sector.

The movement of some ESCWA member countries towards the GCC Common Market, the Arab Common Market and World Trade Organization (WTO) membership should facilitate cooperation and

[16] See ESCWA, *Annual Review of Developments in Globalization and Regional Integration in the Arab Countries* (United Nations, New York, 2007) (E/ESCWA/GRID/2006/30).

regional use of national organizations. The ability of Arab countries to compete in the international market would depend on the establishment of national low-cost suppliers of technology services. It would also depend on the enhancement of local innovative capabilities in both process and product design.

C. DIRECT BENEFIT TO THE HOST COUNTRY

The benefits accruing to the general population through increased employment and higher rates of economic growth are clear. However, specific benefits to sponsors and donors will accrue because of their close association with the ESCWA TC, and they will be more willing to participate and adopt the strategies and measures that result from its research activities. The Centre has been designed to yield tangible benefits to a wide category of users, sponsors and donors. A concrete example will be discussed to illustrate those benefits.

The construction industry and its associated input and technologies, namely, the manufacturing of input, machinery, labour, supplies, financial services, insurance and transport, among others, promise to offer a multitude of opportunities to all the countries in the region. However, the firms and persons who will gain the most are those who, as a result of their proximity and sponsorship of the ESCWA TC, would be amongst the first to implement the findings of its programmes. The influx of international specialists into the host country from the field of research and development and from academic institutions is an example of an indirect impact.

Various ESCWA member countries will derive different benefits from their association, with the comparative advantage of each country enabling it to focus on a different set of priorities. For example, the countries that will benefit from the employment opportunities generated by the new enabling environment for local and regional contracting firms will be those ESCWA member countries with a large number of available human capital. To employ or replace the 12 million expatriate labour force currently working in the construction industry in the GCC countries, it will be imperative for the labour-rich countries to invest in training, skills upgrading and site management. That would enable Arab contractors to raise labour productivity to a competitive level. Only then will it be possible to compete with low-cost labour, while increasing wages without necessarily having raised the cost of those operations.

In order to enable contracting firms located in ESCWA member countries to grow in size and competence, they will need to have access to financial services to fund their contracts. All the GCC countries are working hard to develop financial services, and financing construction contracts is one of the promising markets for banking services in that region. The technology for evaluating projects and contractors is well known, and it should be possible to acquire know-how in a relatively short time. Emerging GCC financial institutions will also be able to benefit from providing insurance services and loans to industrial firms investing in manufacturing input to the construction industry. For example, currently large investments are taking place throughout the ESCWA region in the production and manufacturing of cement, iron bars, electrical supplies, ceramics, glass, aluminium windows, polyvinyl chloride (PVC) and wood substitutes for panels and doors. The dimension of construction machinery has barely been considered. However, those factories are now being established throughout the region, with GCC being favoured. Moreover, those plants need consultants to design them, contractors to build them, workers to operate them and funding to finance them. Enabling ESCWA member countries to benefit fully from all those opportunities is the challenge that the ESCWA TC has to respond to. Furthermore, many of the new plants may soon be pressurized by market forces to merge, and those with dynamic managers will be taking over those that are doing less well. One of the major sources of profit of banks in OECD countries are their services to mergers and acquisitions, an activity that has started to be noticed by countries in the GCC region. Thus, the diversity of benefits and the complementarity of roles are evident.

I. REGIONAL NEEDS AND DEMANDS

The nature and degree of Arab underdevelopment is more widely acknowledged following the publication of the United Nations Development Programme (UNDP) annual *Arab Human Development Report* (AHDR) series 2002 to 2005. In brief, the ESCWA region faces three distinct major challenges, namely:

(a) Job generation, eradication of poverty and socio-economic development in general;

(b) Acquisition of scientific and technological capabilities associated with its industrial and development programmes;

(c) Benchmarking of science and technology progress through an agreed-upon set of indicators.

Those three areas of concern require different approaches and sets of policies. The ESCWA TC will not be concerned directly with individual investments, nor will it be involved with the choice of projects unless a member country asks for advice. The Centre will be expected to assist ESCWA member countries and the region as a whole in increasing their ability to obtain greater socio-economic and technological benefits from the projects they intend to implement. To do so, a number of systemic problems will have to be overcome. In essence, the Centre would utilize world experience to develop the tools to secure the effective transfer of technology and institution-building. There is great variation within and between ESCWA member countries in their abilities to manage various areas of technology; thus, the ESCWA TC would have to develop or promote a range of services in response to those different capabilities.

A. POVERTY ERADICATION AND SOCIO-ECONOMIC DEVELOPMENT

The ESCWA region has benefited from sustained attention to social welfare. Yet, there are substantial pockets of poverty where needs in housing, health services, education and employment are still to be met. Thus, the MDG on eradication of extreme poverty still has relevance for the region. The extent of poverty is measured in the proportion of the population living on below $1 and $2 per capita per day.

Global poverty is a serious challenge to the international community. The current estimate of those living below $1 per day is 1.2 billion, of whom 75 million are in the Arab world.[17] That translates to approximately 28 per cent of the Arab population. AHDR 2002 noted that Arab countries have done better than most other third world regions in reducing poverty. Nevertheless, impoverishment and inequality of wealth distribution remain high.

The Arab countries where a large proportion of the population is seriously poor are Mauritania, Palestine, Somalia, the Sudan and Yemen. The level of severe poverty in those countries is above 25 per cent of the population, and is often closer to 50 per cent. In Yemen, for example, the per capita GNP is $688 in terms of purchasing power parity (PPP), or less than $2 per day per capita. Conditions in Mauritania, Somalia and the Sudan are not much better. Table 6 shows the proportion of the population living below $1 a day in selected ESCWA member countries. Poverty in Egypt remains pervasive despite a significant increase in average household expenditures in the late 1990s, with close to 11 million people living in poverty in the year 2000. The number of people living below $1 a day was 1.7 million, while 25.9 million people lived on $2 a day, PPP adjusted.[18]

[17] Statistics on poverty in the Arab countries are scarce and rarely up to date.

[18] H. el-Laithy, M. Lokshin and A. Banerji, "Poverty and economic growth in Egypt, 1995-2000", *Policy Research Working Paper*, No. 3068 (World Bank, June 2003), p. 20. The figures are based on PPP conversion factors that make the relevant per capita poverty lines LE55.78/month and LE111.56/month, respectively, in 1999/2000.

TABLE 6. KEY ECONOMIC INDICATORS IN SELECTED ARAB COUNTRIES

	GNP per capita 1999 (US dollars)	GNP per capita growth rate 1990-1999	GDP growth 1990-1999 (percentage)	Rural population (percentage of total population)	Agricultural GDP (value, average annual growth) 1990-1999	GNP per capita 1999 (US dollars)	Poverty (percentage)
Egypt	1 400	2.5	4.4	55	3.1	3 303	27
Jordan	1 500	0.4	4.8	26	-4.6	3 542	12
Lebanon	3 700	5.8	7.7	11	3.5	4 129	15
Syrian Arab Republic	970	2.8	5.7	46	..	2 761	
West Bank and Gaza	1 610	-1.8	2.1	..	-9.8	..	26
Yemen	350	-1.0	3.0	76	5.0	688	25

Sources: World Bank, Rural Development, Water, Environment and Social Group, Middle East and North Africa Region, *Reaching the Rural Poor: A Rural Development Strategy for the Middle East and North Africa Region* (World Bank, July 2002; work in progress); World Bank, *World Development Report 2000/2001: Attacking Poverty*, available at: http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/0,,contentMDK:20195989~pagePK:148956~piPK:216618~theSitePK:336992,00.html; World Bank data.

Note: Two dots (..) indicate that data are not available.

Another perspective could be provided by examining the number of people who suffer from hunger. According to UNDP, there are 32 million Arabs who are undernourished,[19] or approximately 12 per cent of the total population. Moreover, in 2003, there were 44.8 million Arabs without access to adequate sanitation,[20] leading to ill health and a high mortality rate for children under five. Those persons have short lifespans and low levels of labour productivity.

Major international organizations have identified a number of measures to alleviate poverty. The World Bank,[21] for example, calls for the adoption of the following measures:

(a) Rationalize water management and policies;
(b) Improve access to social and economic infrastructure;
(c) Facilitate agricultural growth and competitiveness;
(d) Enhance rural non-agricultural economic activities;
(e) Improve the management of natural resources and the environment.

There are indicators that the poor can actively participate in the process of their own development. The success of microcredit banks has demonstrated that the empowerment of farmers and the rural poor through access to small financial loans does increase their economic output dramatically.[22] The fragmentary data that are available show that the rate of return on investments in the "poor" is much higher than in modern industry in the Arab world. The explanation may be found in the associated multiplier factor and the technological independence of poor man's economy compared with the technologically dependent and low associated multiplier factor. Experience has also shown the importance of adopting multiple and parallel approaches to poverty alleviation as some attempts may fail for a variety of reasons.[23] International experience has identified a wide range of measures instrumental in empowering the poor which could be tried simultaneously.

[19] UNDP HDR 2003, p. 54.

[20] UNDP HDR 2003, p. 59.

[21] World Bank, Rural Development, Water, Environment and Social Group, Middle East and North Africa Region, *Reaching the Rural Poor: A Rural Development Strategy for the Middle East and North Africa Region* (World Bank, July 2002; work in progress).

[22] Pankaj Jain and Mick Moore, "What makes microcredit programmes effective? Fashionable fallacies and workable realities", IDS Working Paper No. 177 (Institute of Development Studies, Brighton, United Kingdom of Great Britain and Northern Ireland, January 2003).

[23] India has a rich experience in that domain; see K.S. Jayaraman, "Technology and tradition clash in India", *Nature*, vol. 397 (7 January 1999), p. 9.

Poverty is essentially concentrated in rural areas. The high proportion of the population still residing in rural areas and dependent on agriculture is a measure of the challenges facing several ESCWA member countries, particularly Egypt, the Syrian Arab Republic and Yemen. The agricultural sector is the key to poverty eradication. In addition, rural areas in the Arab world have not been assisted to the same extent by educational, medical and infrastructural facilities as towns and cities. In industrial countries, rural communities have been enabled to increase their per capita income due largely to the application of technology and subsidies to the sector. Table 7 shows the value added per agricultural worker in selected Arab and industrial countries, and illustrates that the progress made by Arab farmers during the periods 1975-1985 and 1995-1997 was greater than the value added of Chinese and Indian farmers during the period 1995-1997.

TABLE 7. CHANGES IN AGRICULTURAL PRODUCTIVITY IN SELECTED COUNTRIES

	Agricultural value added per worker (US dollars)		
	A:1979-1985	B:1995-1997	B/A
Egypt	721	1 163	1.61
Jordan	1 447	1 634	1.29
Saudi Arabia	2 167	10 507	6.03
Yemen	..	305	..
China	162	296	1.83
India	253	343	1.36
Finland	16 956	28 296	1.67
France	14 956	34 760	2.32
Netherlands	21 663	42 836	1.98
Singapore	13 937	39 851	2.86

Source: World Bank.
Note: Two dots (..) indicate that data are not available.

Table 7 clearly indicates that Saudi Arabia has invested more in the agricultural sector than any other Arab country. During the periods 1979-1985 and 1995-1997, a six-fold increase is reflected in the changes in value added per worker. However, value added in Saudi Arabia was still about one third to one fourth of the corresponding figure for industrial countries. In all other Arab countries, the value added per farmer is about 5 per cent of that of farmers in industrial countries, clearly indicating that a great deal could still be achieved in the Arab agricultural sector.

The Arab region is the most arid of the world; hence, water shortage is an important factor in the difficulties faced by Arab farmers. Table 8 shows key indicators of the performance of the Arab countries with respect to water use in agriculture and total agricultural production. It is clear from table 8 that there are significant differences in the efficiency with which water is used, as is illustrated by the performance of Jordan and the Syrian Arab Republic compared with that of Lebanon. No Arab country measures well against European countries, particularly the Netherlands. There are only five Arab countries that are significant producers of agricultural output, namely, Algeria, Egypt, Morocco, Saudi Arabia and the Syrian Arab Republic. Iraq should be added to the table; however, the World Bank data did not include any information on that country.

The ESCWA TC could assist ESCWA member country Governments to build on the existing infrastructure and utilize available knowledge and resources more effectively. Such improvements should result in substantial economic returns to rural communities. Systematic planning at the local level would dramatically increase agricultural labour productivity and rural output. The mechanical management of water, combined with current technological development in agricultural sciences, would be instrumental in inducing a “mini” industrial/agricultural revolution.

The fact that the value added per Arab farmer is about 5 per cent of that of a farmer in industrialized countries gives a measure of the opportunities available to develop the sector, including significant mechanization and reduction of farm labour to 4 or 5 per cent of the labour force. Food and Agriculture Organization of the United Nations (FAO) statistics indicate that the share of the rural population in Egypt, the Syrian Arab Republic and Yemen changed only from 56 per cent, 53 per cent and 83 per cent, respectively, in 1979-1981 to 58 per cent, 50 per cent and 74 per cent, respectively, in 2004. Those changes indicate that the agricultural sector is not undergoing a sufficiently rapid transformation, and there is a need to accelerate the process.

TABLE 8. WATER USE AND AGRICULTURAL OUTPUT, 2000

	Agricultural value added to GDP (millions of US dollars)	Agricultural value added GDP per cubic kilometre of water used
Algeria	4 411.4	1 120.3
Bahrain	50.5	296.9
Djibouti	18.2	2 606.0
Egypt	15 513.0	288.1
Jordan	165.0	217.1
Kuwait	114.3	496.9
Lebanon	1 800.1	1 956.7
Morocco	4 610.5	418.8
Oman	373.7	304.5
Qatar	..	..
Saudi Arabia	9 338.6	605.4
Syrian Arab Republic	4 088.0	216.0
Tunisia	2 405.7	1 078.8
United Arab Emirates	773.1	491.3
Yemen	1 325.0	209.8

Source: World Bank, *MENA Development Report: Making the Most of Scarcity - Accountability for Better Water Management Results in the Middle East and North Africa* (World Bank, Washington, D.C., 2007).

Note: Two dots (..) indicate that data are not available.

Experience with agricultural development is now widely available. One of the major lessons of the past two centuries around the world is that agricultural technology is "location specific". Hence, local research is important in every region of the world, and what can be "imported" is the science. However, the appropriate methods of applying that science have to be tailored to local conditions.[24] What is needed is a broad range of carefully designed measures that span soil science, plants, labour saving machines, fertilizers, pesticides and water management.[25] Obviously, withdrawing labour from the sector is dependent on creating employment in the construction, transport, industrial and mining sectors.

The ESCWA TC could contribute to designing policies and procedures to facilitate the mobilization of local private and public resources for the support of rural development. Annex II presents a range of tested measures that could bring about large-scale rural development at relatively low cost. One such measure that is very important is the strengthening of municipal governments, with the objective of supporting, training and mobilizing rural entrepreneurship. Such a measure has been observed to lead to the diversification of the local economy. Providing the facilities to enable local entrepreneurs to initiate SMEs in food processing and storage would be a natural development. The use of tested low-cost civil engineering technologies[26] for the

[24] Vernon W. Ruttan, "Productivity growth in world agriculture: sources and constraints", *Journal of Economic Perspectives*, vol. 16, No. 4 (American Economic Association, 2002), pp. 161-184.

[25] Ibid.

[26] Those civil engineering technologies were developed by the International Labour Organization (ILO) and World Bank in the 1960s; however, the programme was curtailed to allow ILO to focus on industrial labour, though records are still available.

construction of rural transport systems, housing and infrastructural facilities should be implemented to improve rural living conditions. With the decrease of transport costs and the reduction of agricultural waste, such technologies would create an immediate and dramatic impact.

The technologies referred to above have been successfully used elsewhere and are readily available. Furthermore, most ESCWA member countries have the professional capabilities in place to use those techniques. The training of professional managers to run upgraded municipal governments can be rapidly undertaken with currently available graduates and resources at universities.

It is interesting to note that the Arab countries, although under extremely adverse water conditions, have performed better than China and India, as illustrated in table 7. Arab countries have accomplished more, both in the educational sector on the supply side and in the development of the agricultural sector. Those two achievements should provide an excellent starting point for more rapid development during the next decade.

B. GREAT DEMAND FOR MODERN TECHNOLOGIES ACROSS THE BOARD

The centre-periphery relationships that lead to unequal development arise from the losses of the multiplier factor associated with the planning and execution of projects. An example is the United States of America, which exported raw materials and agricultural products during the nineteenth century. Those exports were based on locally produced technologies and, thereby, led to substantial national development. The associated multiplier factors contributed to the amplification of the impact of the production and export of raw materials. By contrast, countries that export raw materials through the importation of technology services and labour lose the opportunities that lead to the acquisition of technology. They also lose the benefits accruing from the associated multiplier factors.[27]

A massive demand for advanced and modern technologies exists in the ESCWA region in all industrial fields, be they automotive, aerospace, construction, medical sciences, oil and gas, materials or ICT. The challenge is how that demand is to be managed to enable national organizations to progressively acquire and apply those technologies, rather than importing the final products on a turnkey basis.

C. CONSTRUCTION SUPPLIES AND MATERIALS

The region has one of the highest rates of construction in the world. Indications of the high pace of construction have been noted above. Construction has been substantially planned and performed by expatriate labour while national and regional labour is unemployed. In addition, inadequate attention has been given to the fact that some 80 per cent of the construction supplies are imported. There have been attempts to address that issue by locally manufacturing those supplies; however, demand has always exceeded supply. Large investments have been made in the cement, iron and steel industries; yet, most of those investments have not been associated with adequate technology acquisition. Thus, all the equipment and much of the servicing of those plants continue to be imported despite their substantial number in the region.

D. THE IMPORTANCE OF REPAIR AND MAINTENANCE TO SMES

The importance and need of repair and maintenance are rarely appreciated by planners in developing countries. Planners who have little experience with technology often forget about the importance and high

[27] Khalil Ibrahim Al-Kanaani reiterates the characteristics of the relationship between centre and periphery, but omits the crucial factor of technology. Developing countries during the nineteenth and twentieth centuries avoided that technology trap by seeking technology ownership. Those countries joined the ranks of industrial nations. See Khalil Al-Kanaani, "The integration attempts in the fourth world - the case of Arab world", paper presented at the Danish Research Unit for Industrial Dynamics (DRUID) Conference: Industry Evolution, Winter 2002 (Aalborg, Denmark, 17-19 January 2002).

cost of repair and maintenance and, consequently, do not make adequate allowances for its cost in project planning and investment. That oversight leads to equipment failing to be useful for the duration of its expected life. That is especially true for sophisticated hospital equipment, as well as for complex installations, physical infrastructure and factories. The neglect of repair and maintenance of farm machinery and irrigation systems has plagued agricultural development in developing countries.[28] Similarly, both public and private buildings in major cities of those countries often show signs of lack of repair and maintenance. By contrast, GCC countries, which devote large sums towards repair and maintenance, display well-kept buildings. As a general rule, the cost of repair and maintenance during the lifetime of a machine exceeds its cost. That is particularly true of cars and other instruments of transport, while the cost of repair and maintenance of buildings is even higher, since the lifetime of a building is much longer.

Acquiring the know-how to undertake the necessary range of repair and maintenance services in a modern economy is demanding and extensive. It is the domain of SMEs and generates considerable employment. In industrial countries, 25 per cent[29] or more of employment is in repair and maintenance services. Furthermore, repair and maintenance provides engineers and technicians with numerous opportunities to innovate, undertake reverse engineering and go into the manufacturing of spare parts. The know-how essential to undertaking repair and maintenance is acquired naturally in the process of design and implementation of a project; hence, the importance of the involvement of local and regional consulting and contracting firms in the entire process. Furthermore, it is critical that the specialist labour force is from the region for the technology acquired to become subsequently available. The reduction of the cost of repair and maintenance has always been an important factor in design and innovation, for example the great advances made in engine design.[30] Many working in the field of repair and maintenance have been known also to be innovators and inventors, thus, that activity is central to the national economy, as well as to a vibrant national science and technology system.

As an illustration of the significant market for repair and maintenance in the construction industry in GCC countries, the cost of buildings under construction in 2007 totalled $223 billion.[31] The estimated cost of maintaining them over 25 years is five times their actual cost. Thus, the market for the management of those facilities in the GCC countries alone for the next 25 years is estimated at $892 billion, or $36 billion annually.[32] That is mainly a market for SMEs, and for financial organizations providing the funding to enable them to carry such a large volume of work. The contribution of the ESCWA TC to the formation of SMEs is through the rationalization of the pyramid of contracting firms and the formation of appropriate professional organizations that sustain expertise and standards.

[28] For the importance of repair and maintenance, see David Edgerton, *The Shock of the Old: Technology and Global History since 1900* (Oxford University Press, 2006).

[29] Ibid.

[30] Ibid.

[31] Middle East Strategy Advisors (MESA), *MENA Report* "Gulf region: Facilities management market estimated at US$ 892 billion" (25 October 2006), available at: http://www.menareport.com/en/business/204920.

[32] Ibid.

II. DESIGN FEATURES OF THE ESCWA TECHNOLOGY CENTRE

Arab Governments have been responding to the issues indicated above but, due to the scale and complexity of the technological challenges, progress has been relatively slow. Cooperation among ESCWA member countries should accelerate the rate of change by sharing the burden and their complementary capabilities.

The substantial investments in education and industrialization made during the past forty years provide important tools for addressing the challenges facing the ESCWA region. The education of professional scientists involves more than twenty years of hard work. Thus, the available human capital is a strategic resource. A large proportion of highly qualified scientific and technological human capital has emigrated. However, it has been demonstrated that many of those talented and experienced persons can be recruited, given the appropriate working conditions.

Furthermore, considerable industrial and technological capabilities are sequestered in vertically integrated firms and organizations. Those firms function as isolated islands and undertake limited technological transactions within their societies. That was partly the case in most industrial countries until the 1960s, when those firms were restructured by outsourcing non-core functions in order to reduce cost, but also resulted in making such services more widely available within the country.

The challenges facing ESCWA member countries consist in mobilizing, transforming, supporting and complementing those various assets to establish requisite science and technology policies and infrastructure. With that in mind, one of the roles of the ESCWA TC will be to provide advisory services to both public and private organizations in member countries to secure optimal returns on their developmental and technological transactions. The Centre will also assist national organizations to become more effective instruments for the acquisition and accumulation of know-how. The contributions that the Centre would make need not be implemented simultaneously by all ESCWA member countries as, early on, most activities may be on a bilateral basis.

The services provided by the ESCWA TC are designed to optimize the rate at which member countries realize the benefits from their human capital, institutional and organizational resources. The Centre could make significant contributions by focusing its efforts on assisting ESCWA member countries to implement appropriate measures, subject to the availability of resources. It should be noted that delivery will be commensurate with the available mechanisms and deployed efforts. The measures required to be implemented by ESCWA member countries are set forth as follows:

(a) Overcome systemic problems;

(b) Create linkages between supply and demand;

(c) Assist in the promotion of university-industry relationships;

(d) Facilitate the processes of mergers and acquisition between firms in the region;

(e) Diffuse best practices;

(f) Transfer information on demand;

(g) Assist in the acquisition of expertise in the management and use of patents and intellectual property;

(h) Contribute to the formation and design of technology parks and incubators, in addition to a wide variety of similar activities;

(i) Identify best practices at the national level, as well as assisting on priority identification.

ESCWA member countries possess the human capital necessary to undertake much of the planning and implementation of their infrastructural projects. However, such human capital has to be structured in appropriate organizations, and must acquire the necessary support. In the interim period, ESCWA member countries are dependent on international firms. The contracts that are currently adopted with such firms need to be designed to transfer adequate amounts of the right technological skills and expertise to their national and regional counterparts to enable them to reach a point of technological parity.[33]

The growth of technology firms takes place through a series of expansions, combined with technology acquisition through joint ventures often involving international firms. Each successive project that is undertaken may be planned to transfer a substantial additional range of competences and capabilities. The existence of a large supply of national engineers with international experience should facilitate those processes.

A major constraint experienced by Arab consulting and contracting firms in securing major infrastructural contracts arises from the limited financial services available to them on a commercial basis, restricting their ability to compete with international firms in their home market even when they possess the relevant technological capabilities. Such limitations arise from the lack of expertise in financial organizations in risk assessment and management. As a result, national firms very often serve as subcontractors in a manner that does not enable them to move forward to prime contractor status. That drawback also reduces opportunities for Arab banks and financial organizations to engage in profitable business. To overcome those complex systemic problems, measures are called for at the interface between engineering, business, finance, law, politics, labour, testing services, standards, information and statistics. Many of those problems have been faced by firms in other developing countries and have been successfully resolved. Thus, there exists considerable international experience in accomplishing the same in the ESCWA region through acquisition, adaptation and training.

The various activities that the proposed ESCWA TC would need to pursue fall into four tracks. The following explanations define those activities in relation to the functions and organization of the Centre.

A. TRACK 1: INFORMATION SERVICES

Under Track 1 is a variety of services ranging from requests for simple information, to demands for complex information and expertise. The simplest service that the ESCWA TC would offer is a response to requests for information by a national private or public organization. Such requests could cover an enormous range of topics of various degrees of complexity. The idea would be to make both the placing of the request and the response to it as rapid and as low in cost as possible. In many cases, users should be able to access online the information they require. That will necessitate regionally-adapted programmes with participating centres to transfer the know-how and operational skills in that context.[34]

A second level of service would consist in assessing and providing complementary support to national organizations. That would facilitate and improve the capabilities of such organizations in undertaking specific tasks. In addition, such a service may entail information on the provision of specific expertise. In such cases, requests would be received by a clearing unit, which would fall under the Division of Systems and Projects, as illustrated in figure 2. The staff of the clearing unit would study the request and propose a solution; if the proposed solution is accepted, implementation would follow. Under that category, problems that arise could involve a ministry and an industrial, consulting or contracting firm. Thus, the solutions for that class of problems are generally clear, though complex, and could be promptly undertaken.

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[33] See, A. B. Zahlan, *The Arab Construction Industry* (Croom Helm, London and Canberra, 1984); and A. B. Zahlan, *Acquiring Technological Capacity: A Study of Arab Consulting and Contracting Firms* (Macmillan, London, 1991). The first reference provides a detailed account of the factors that constrain the Arab construction industry. The second reference discusses the simple methods employed by the Government of the Republic of Korea to overcome the constraints that still limit the growth of Arab contractors.

[34] In preparing this *Report*, the most recent data have been used; see tables 3, 4, 6, 7 and 8. Scattered data are available in certain cases; however, trends remain the same.

In all of the above, staff would be trained and equipped to highlight similar instances which have already received attention at the Centre, or are currently under examination. Subject to the approval of users, the solution of similar problems may be combined and/or coordinated.

The ESCWA TC, as a recipient and disseminator of information, will operate through the specifically developed portal within the Information and Data Management Division. As part of the promotion of STI policies, it will support the establishing of national STI observatories, as well as mechanisms for the improvement of relevant statistical services in the respective countries and, hence, the region.

B. TRACK 2: SYSTEMIC ISSUES

Track 2 would include services focusing on systemic problems, namely, activities that address structural obstacles, whose removal is essential to accelerating the rate of development and technology acquisition.

As already noted, the organizations, both public and private, involved in technology acquisition and application in the region need additional support and capabilities to yield their full services. Systemic problems may occur at the level of contract negotiation. An example would be the adoption and development of contract forms that facilitate the involvement of qualified subcontractors with the express objective of promoting the acquisition of technology.

Similarly, systemic problems may arise because of the inadequacy of the enabling financial services to the consulting and contracting industry, and/or the slowness of legal services resorted to by contractors. Such services might be so protracted as to make it impossible to finish a project on time and within budget. Often, organizations may possess substantial, but incomplete technological capabilities to undertake some specific work, and may wish to extend those capabilities to enable them to do so. The ESCWA TC could assist such organizations by recommending the missing capabilities and by providing procedures for securing them.

It is known that labour productivity in the Arab countries leaves much to be desired. Increasing labour productivity is of considerable economic importance, despite the fact that it is a slow, long-term process. The ESCWA TC could advise on procedures for increasing labour productivity. It is also recommended that the Centre offer services that aim at increasing and improving skills certification and labour mobility services in the region, in view of the fact that available national statistical services on labour productivity are inadequate and need to be improved.

Very often, system bottlenecks occur due to conflicts among the parties that control the different resources needed, and/or the decision-making processes involved in undertaking a specific task. For example, the parties could be the water company, the municipality and consumer associations, and at times such conflicts could paralyze the system, resulting in the impossibility of it to move forward. The Centre could introduce a variety of mathematical models and approaches enabling the parties at such variance to resolve their conflicts. Those systems are designed to help identifying solutions that are optimal for the parties. In other words, although no party would obtain its maximum objectives, all parties could secure sufficient concessions to agree on a solution.

In order to address those systemic challenges, it would be necessary for the ESCWA TC to present programmes to ESCWA member countries that identify obstacles and propose solutions. What follows is a brief mention of five major activities that respond to the two challenges:

(a) The rationalization of consulting and contracting services in the region to promote systematic technology transfer to national and regional organizations;

(b) The initiation of a process, both nationally and regionally, on outsourcing non-core activities to enrich the technological infrastructure.

1. *Systematization of technology transfer*

The acquisition and accumulation of technology depends on the direct participation of national human capital and labour in all phases of a project. The ESCWA TC could develop systematic measures and policies whose adoption by national economic policies would promote the acquisition, adaptation, utilization and accumulation of technology. In that way, successive investments by private and public organizations would be able to benefit from previously acquired capabilities. That process should result in reducing the cost of projects and increasing the multiplier factor associated with them.

The long-term advantages of such participation would thus contribute to the following:

(a) Increasing technology acquisition and employment;
(b) Decreasing operating cost of new installations;
(c) Preparing the grounds for process and product innovation;
(d) Reducing the cost of repair and maintenance;
(e) Promoting subcontracting linkages between large enterprises and SMEs;
(f) Expanding the capacity of the national economy to productively absorb human capital.

2. *Project and contract design*

According to available media sources, ESCWA member countries are currently involved in discussing and implementing some $2 trillion in investments.[35] Although that figure is the best estimate available, it serves to set a vision of optimism and establishes high market demand for technological services, and each project could become a vehicle for the transfer and acquisition of technology in the ESCWA region.

The use of ESCWA member country-based firms and labour should contribute to economic growth and cost reduction in construction, repair and maintenance. It would result in a progressive ability to undertake similar projects independently. Those acquired capabilities would also be reflected in the increase of the national technology base, the capability of exporting consulting and contracting services, the growth of research and development activities and the promotion of national organizations specialized in process and product innovation.

3. *Outsourcing*

The major parastatals in the Arab world already possess significant expertise in the wide range of technologies needed to perform their tasks. Those services are industry-related and include engineering, management, planning, undertaking of research and development, preparation of software, consulting, testing, quality control, packaging, auditing, publishing, marketing and market studies, information, and legal and insurance services. However, that expertise is usually "locked inside the firm", particularly in developed countries, and is not available to the rest of the economy and region. The ESCWA region is a large importer of industry-related services. Such services are imported whenever an international firm designs and constructs a project. In many cases, those services are provided by suppliers of equipment and raw materials; in some cases, such services are in effect "packaged" with the raw materials or equipment items. There is a need to intensify the availability and dissemination of knowledge embedded in industry-related services. OECD firms discovered that, though all of those services were vital to the performance of a firm, they were not required all the time. In other words, the firm was keeping employees who were not needed full-time.

During the 1960s and 1970s, there was a widespread revolution in industrial firms within OECD countries to outsource non-core in-house capabilities. There was a dual purpose for doing that, namely: (a) it

[35] Reference material is attached in annex III.

reduced the cost to the firm; and (b) it made such capabilities available to the rest of the economy. That process has also been called externalizing and "de-integration". Once such services are outsourced, they could be easily made to expand to service larger markets and additional technologies. The development of outsourcing has been driven by the process of globalization. Outsourcing made it easier for industrial firms to subcontract a wide range of manufacturing activities internationally. Industrial firms in OECD countries were thus able to reduce their costs by procuring parts in such low-wage countries as the People's Republic of China, the Republic of Korea and Taiwan Province of China. Similarly, firms in developing countries were able to contribute industrial components that went into the manufacturing of such major products as computers, cars and aeroplanes. Each one of those processes of subcontracting contributed to technology transfer.

The outsourcing firm reduced its capital requirements and increased its flexibility. It retained and strengthened its capability to innovate, research, design and market. Its capacity to subcontract depended on its ability to exercise quality control over its purchases. Improvements and cost reduction of the means of transport and communication have reduced the importance of distance from the firm. An increase in employment occurred in the OECD countries which undertook outsourcing, as well as a reduction in the cost of production. Many SMEs in the Arab countries import technical services at great cost. The outsourcing by major firms in the region of industry-related services would make those services promptly and efficiently available in the country and region at a much lower cost.

It is proposed that the ESCWA TC should organize such activities as expert group meetings, summer schools, workshops and conferences with a view to bringing to the attention of firms the advantages of outsourcing. The adoption of outsourcing of industry-related services should have an immediate and dramatic impact on the enabling environment and the articulation of the many industrial activities in the ESCWA region, both regionally and globally. Financial services might be needed for the establishing of outsourcing activities.

4. *Multiplicative characteristics of industry-related services*

An important feature of scientific and technological knowledge are its multiplicative characteristics. Unlike material resources, technological capabilities improve with use. Every time industry-related services are used, the provider has the opportunity of improving it. Furthermore, such services contribute to linking organizations with each other.

By contrast, when organizations import industry-related services, the cost is higher and foreign exchange is required. Moreover, the greatest loss to the economy is that there is no multiplicative factor associated with the operation. Every time the same organization imports industry-related services, it does so de novo; no technological residue remains in the country after each consultation. Imported industry-related services under conditions where effective technology transfer takes place result in a multiplicative component. If the transfer is successful, the local firm will be able to undertake the same work at a later date on its own.

5. *Industry-related services and industrialization*

Subcontracting provides SMEs with the opportunity of specializing in small-scale industrial operations; thus, a firm may specialize in making components for cars. That makes it possible for a country to develop its manufacturing capabilities in small, simple steps and eventually manufacture an entire car. On a national scale, the annual cost of car maintenance, including spare parts, exceeds the annual investment in new cars. The capital and know-how required to manufacture car parts are far less demanding and risky than making the entire car.

The major industrial output of newly industrialized countries is performed under subcontracting arrangements. It is easier, but less profitable to manufacture under subcontracting arrangements than to market under an individual label. Subcontracting involves less risk, less difficulty and less profit than initiating an industry single-handedly. It provides a "ladder" for the entrepreneur to climb at his/her own

pace; the more innovative the entrepreneur is, the faster the pace. For example, newly industrialized countries in Asia progressed through the various stages of subcontracting, licensing and own design manufacturing to finally launch their personal brand manufacturing.[36] Outsourcing and subcontracting facilitate technology transfer because they reduce the size of each transfer. They also eliminate the need to concurrently acquire large-scale technological capabilities.

The adoption of positive policies towards outsourcing in ESCWA member countries would make a dramatic contribution to the development of forward and backward linkages. It would also be self-financing; hence, the Centre's programme should contribute to increasing employment and economic growth of SMEs, and should pay for itself. Subcontracting and outsourcing are available to all firms in developing countries wishing to benefit from globalization.

In conclusion, the purpose of Track 2 is to mobilize existing resources and potentialities. The process of mobilization, as shown above, is through enabling and unlocking existing capabilities. The process in itself releases considerable economic benefits and, thus, is not only self-financing, but also contributes to economic growth and releases financial resources to fund additional growth. The process of mobilization will lead to the establishment of a substantial national and regional scientific and technological infrastructure, which will facilitate basic technological operations, research and development, and process and product innovation.

C. TRACK 3: THE REGIONAL TECHNOLOGY MARKET

Since the founding of the League of Arab States over sixty years ago, Arab countries have been seeking the development of a common market and common economic policies. Arab Governments realize the importance of a common market; the fact that they have not fully succeeded in their efforts does not mean that they have not invested considerable energy and determination towards that objective. There have been notable successes in the oil and gas industry, in shipping and, currently, in renewed efforts to complete the Arab common market.

On its own, no Arab country can sustain the required technology infrastructure to support its economic activities and to secure satisfactory returns on investments. Thus, regional cooperation is essential to secure the scale necessary to support internationally competitive activities. The scale of the ESCWA market for technology is more than adequate to sustain a flourishing consulting, contracting and research and development industry.[37]

The technological capabilities required to execute the investment projects and operate industrial investments can only be provided by large-scale organizations, which can be sustained by working regionally and globally. The products required can only be produced by large and diversified industries that serve the entire region. Hence, it is important to have a regional perspective in undertaking economic activity in the global market.

Support for the evolution of national organizations can be justified on the basis of the following factors:

(a) Reducing the cost of the operations underlying economic and industrial activities, and increasing the multiplier factor associated with those activities;

(b) Creating employment for highly skilled human capital to stem the brain drain;

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[36] Michael Hobday, *Innovation in East Asia: The Challenge to Japan* (Edward Elgar, Cheltenham, United Kingdom of Great Britain and Northern Ireland, 1995).

[37] A. B. Zahlan, *The Technology Dimension of Arab Unity* (Centre for Arab Unity Studies, Beirut, 1981) (in Arabic). The increase of the Arab market for technology since 1980 strengthens the need for regional cooperation.

(c) Acquiring the capability to undertake optimal selection, design and development in an adaptive manner best suited to national conditions;

(d) Acquiring the capability to undertake repair and maintenance;

(e) Increasing the rate of economic growth through the impact of the multiplier factor and employment;

(f) Acquiring capabilities for managing a competitive economy;

(g) Securing the know-how for planning and undertaking forward and backward linkages;

(h) Acquiring the capacity to innovate in both process and product design;

(i) Establishing the foundation for a knowledge-based economy.

D. TRACK 4: SELF-ORGANIZED CRITICALITY

In the past few decades, a field of study has emerged which has introduced a revolution in the formation and propagation of "solutions". The origins of those studies were in forest fires; the behaviour of physical systems, for example the movement of sand dunes; the spontaneous arrangement of molecules in a solution; the networking of insects and people; and the mobilization of volunteers, for example the preparation of the Linux operating system. Another example could be the preparation of the online encyclopaedia *Wikipedia*, authored by tens of thousands of enthusiasts. It is now 10 times larger than the *Encyclopaedia Britannica* and is considered to have the same accuracy.[38] That field of study acquired the name of self-organized criticality.

Reviewing the experiences of firms who have applied that approach successfully on a commercial basis, it was discovered that an organization that can define a problem could appeal to the public via the Internet for assistance. Some commercial firms have offered financial rewards for useful contributions, while in other cases no rewards were provided. When a large number of experts are dispersed, such an approach would be valuable to identify solutions to definable problems. Such a type of approach would be Internet-based and low in cost.

Research and development in that area could have both a national and/or a regional perspective. Through collaborative work, the ESCWA TC would endeavour to promote Internet-based networking with the objective of seeking solutions to national and regional problems. That approach may be especially important in efforts to eradicate poverty.

[38] Don Tapscott and Anthony D. Williams, *Wikinomics: How Mass Collaboration Changes Everything*, (Penguin, 2006). This book provides numerous illustrations of how this approach has been successfully applied. The case of Goldcorps of Canada is an example of direct self-organized criticality application. The company was able to uplift itself from debt to being worth billions of dollars by requesting input through the Internet. Feedback from numerous interested parties led to the discovery of 8 million ounces of gold.

III. INITIAL SCOPE OF ACTIVITIES

Technology covers a very wide range of expertise, and it will not be possible for the ESCWA TC to provide services in all fields. The Centre would need to focus on areas of the greatest urgency and for which demand exists in the ESCWA region.

Initially, it would take some time for the public and private organizations to become familiar with the ESCWA TC and make full use of its services. During the first two years, the Centre should sponsor conferences, workshops, expert group meetings and summer schools to diffuse knowledge of its capabilities and the type of services on offer. All should be couched in the format of the type of services that is thought to be most effective in unlocking the latent resources and capabilities of the region.

A. VISION AND FLEXIBILITY

The establishment of the ESCWA TC has to be associated with a vision of targeting critical issues whose solution would make a major difference. As problems are being solved, the Centre should move on to other areas and topics. When an obstacle has been identified and suitable measures to overcome it defined and applied in one or many cases, it does not mean that the region does not need the services of the Centre to overcome the remaining similar cases. However, once the methods are fully developed and a sufficient number of national organizations have mastered their applications, it is clear that the ESCWA TC has no further role in that domain and should shift its resources to solve other problems. National organizations and private firms will continue the process of implementing solutions. When the approach adopted for the Centre is recognized as successful, similar organizations will be established to focus on other technological topics. Ideally, every ESCWA member country should establish a similar type of organization; hence, the importance of flexibility and vision. The only fixed point in the mission of the ESCWA TC should be targeting issues that matter and avoiding insignificant routine problems.

It is recommended that the ESCWA TC organizes an annual conference, inviting researchers and political leaders to discuss the issues facing the region. Through such systematic efforts, the Centre should always remain close to the challenges facing the region. It should avoid becoming attached to those problems and methods on which it had become an expert, or issues that have been resolved. Thus the network of cooperating national and private organizations should enable the Centre to continuously unload areas of expertise to firms and organizations interested in specializing in those topics. Such a process should make commercial sense. The Centre can only maintain its creative capabilities through the pursuit of new challenges.

B. INITIAL SET OF PRIORITY DOMAINS

In this *Report*, the highest priority has been assigned to programmes that account for a significant share of GDP, and can thus make considerable contributions to increasing the rate of economic growth. Those involve technologies that are the easiest to acquire and implement, namely, civil, mechanical and chemical engineering; technologies for which ESCWA member countries have already made considerable investments and which are, in principle, readily available. Though such technologies have been "acquired" in the sense of human capital, the appropriate organizations and institutions and the enabling environment are in a different phase of development in the region. Focused effort is needed to identify those shortcomings. Remedying those systematic obstacles is within the grasp of national and regional organizations, given the necessary efforts. A primary role of the ESCWA TC is providing assistance to ESCWA member countries or organizations in that regard.

The recommended priorities are derived from the examination of prevailing economic conditions and, thus, their adoption will increase the pool of available technologies in the region, and will contribute to employment across the board, from unskilled to skilled and highly qualified personnel.

Thus, the ESCWA TC should focus on major and priority economic activities. Those priorities will change with time, as well as from one country to another, and other latent needs might develop. It is, however, useful here to illustrate some of the types of domains and modalities to which the ESCWA TC expects to make significant contributions.

1. *Outsourcing*

The large industrial firms that exist in the region already possess considerable technological capabilities. The challenge is to make those capabilities readily available to SMEs via outsourcing. Outsourcing those capabilities will provide a considerable market for financial organizations, as well as expanding the domain of SMEs.

2. *Agriculture*

Internationally competitive and tested space technologies have been developed and widely used elsewhere. Such technologies can be adapted and the methods of self-organized criticality utilized, as described in Track 4, to transform at modest cost the agricultural sector.

3. *Water*

The fact that the Arab world is in the driest zone known makes it imperative that extensive attention be given to water supplies. Once more, space technologies provide a powerful tool for aquifer recharge studies. Although such methods are already used on a small scale, the efforts could be intensified and more widely applied.

4. *Construction industry*

The largest industry in the Arab world with a permanent market is construction. The technologies used have been almost totally indigenized, and the basic infrastructure for achieving international competitiveness is in place. However, there are still a number of missing support systems that need to be established for the sector to attain full international compatibility and status.

5. *Industrial technologies*

Internationally competitive organizations and industries already exist in the region, and more are being established. The technologies involved are basic, and large numbers of citizens have already specialized in those fields, while others have migrated as part of the brain drain, but could be enticed to return. Those industrial technologies cover petroleum, petrochemicals, water desalination, power generation, electronics and the automotive industry. The function of the ESCWA TC will not be to specialize in any of those areas, but rather to assist in constructing industrial plants in such a way as to lead to technology acquisition and accumulation.

6. *Information and communications technology*

As a rapidly growing sector, ICT provides numerous possibilities for development and innovation. Thus, the importance of ICT to any economic activity calls for a concerted effort by the ESCWA TC to assist organizations specialized in such technology. Increased competencies in ICT, as well as in ICT facilities, are critical to economic expansion and productivity.

7. *Energy*

Given the current situation of the energy market, developing new forms of energy, rather than relying mainly on fossil fuel, becomes imperative. The ESCWA TC should promote and facilitate research in the

acquisition, development and use of new and renewable sources of energy, as well as the use of traditional energy sources, in a sustainable and environmentally sound mode.

8. *Other technologies*

The recommended focus on macroaspects of the economy and employment does not mean that existing efforts in such advanced scientific fields as nanotechnology, molecular biology and elementary particles, as well as research on perennial versions of major cereals and machine translation of Arabic, should not be expanded and sustained. In fact, all such research will be of no value unless the ESCWA region generated the capital resources and the human capital to invest in the applications of such scientific advances. Those priority areas provide such opportunities.

C. CONSULTATIONS WITH THE BOARD OF GOVERNORS ON CHANGING PRIORITIES

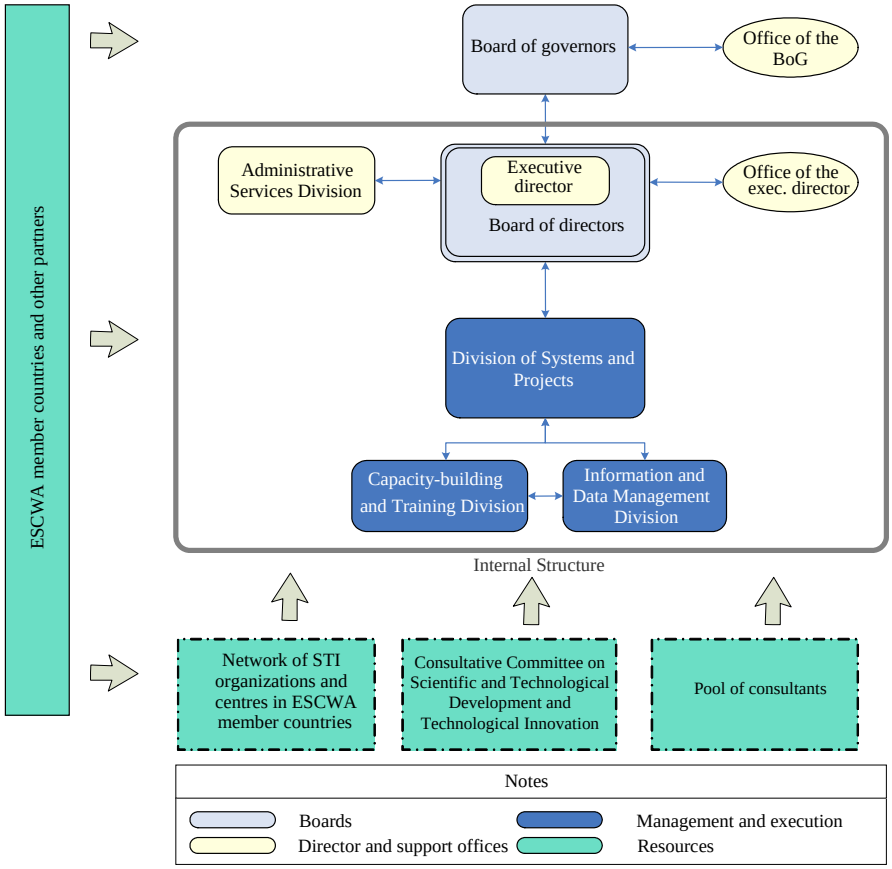
After the third year, when the ESCWA TC is expected to be fully functional, and after consultation with ESCWA member countries, the executive director should recommend to the board of governors priority areas to be covered during the following five years. The Centre should have the means to respond to changing demand, and also be able to alter its priorities when ESCWA member countries require such changes.

IV. ORGANIZATION OF THE ESCWA TECHNOLOGY CENTRE

The ESCWA TC will be affiliated to ESCWA and will have the potential to outsource some of the divisions and activities to ESCWA member countries willing to host those structures and activities. The ESCWA TC should not be part of an already existing line management structure, but should be a semi-autonomous entity with proper checks and balances in line with United Nations regulations.

The ESCWA TC is envisioned as a small, tightly-knit organization. Initially, it could be most efficiently run as one team by the executive director, without the establishment of divisions, while as the organization grows, it will become necessary to create subdivisions. A proposed outline of the ESCWA TC management structure is presented in figure 2.

Figure 2. Proposed ESCWA TC structure



It would be more effective to adopt a horizontal management system and to reduce the amount of red tape. The formation of informal management groups, combined with written records of all activities and frequent consultations, should obviate the need to establish a bureaucracy with red tape. The organization, structure, management, staffing and services provided by the ESCWA TC are crucial to its performance.

A. BOARD OF GOVERNORS

Governance of the ESCWA TC will consist of the authority and responsibility invested in one exogenous body, namely, the board of governors. Such a body would not be part of the internal organizational structure of the Centre, but would have the authority and responsibility for determining its policies within a prescribed enabling constitution. That would entail, amongst other responsibilities, the

review and approval of the programme of activities, the monitoring and approval of financial operations, and the appointing of the executive director, who would become an ex-officio member of the board of governors.

The board of governors will be composed of prominent persons from ESCWA member countries, ESCWA representatives and eminent members of the Arab STI diaspora living in the United States of America, the EU countries and Latin America. They will ensure the high profile of the ESCWA TC and be instrumental in forging relationships and securing funds for its long-term sustainability.

The advantage of a small board of governors of 9 or 11 members is that it would make it easier for meetings to occur more frequently, and for members to take a direct interest in the activities of the Centre. It is expected that the board of governors would make significant contributions to the development of the ESCWA TC; thus, the competence of the individual members of the board is of crucial importance. The members should have the time to attend at least two meetings a year, and must be interested in the type of activities that the Centre would be engaged in.

The establishment of the ESCWA TC will require the services and support of the board of governors at several levels. The most important areas where its support is essential and extensive would be during the establishing of the Centre, when the following tasks have to be executed:

(a) Negotiate with the host country for the establishment of the ESCWA TC;
(b) Raise the necessary funding;
(c) Nominate the executive director;
(d) Approve the programme of activities.

The board of governors is also expected to play a leading role during the first three to four years in organizing the planning, negotiating and supporting of the development of collaborative procedures between the Centre and national and regional private and public organizations. In that context, it should be noted that ESCWA, through its various divisions, including the Information and Communication Technology Division (ICTD), the Sustainable Development and Productivity Division (SDPD) and the Economic Analysis Division (EAD), is engaged in activities related to various aspects of science, technology and development. Those activities will provide opportunities for complementarity, mutual support and independent assessments.

B. BOARD OF DIRECTORS

The board of directors will be the operational arm of the ESCWA TC. It will initially be composed of senior staff, with the executive director serving as its chairman. The board of directors will engage in matters related to project design, approval and implementation, in addition to routine functions of the Centre. It will always be in operational mode, preparing the periodic work plans and reporting to the board of governors through the executive director. As the Centre grows in size and the specialized divisions develop, the respective division heads will constitute the board of directors under the chairmanship of the executive director.

C. EXECUTIVE DIRECTOR

The appointment of the executive director is probably the single most important decision to be taken by the board of governors, since that position represents the operational arm of the ESCWA TC, with responsibility for the implementing of the conjoint plans as indicated by the board. The executive director should be a person with extensive management experience in eminent and diversified consulting firms, and have a demonstrable experience in non-bureaucratic management. The position will be physically stressful, since it will require extensive travelling and long working hours; hence, age is an important consideration. The preferred age bracket would be 40 to 50 years. Skills should include full competence in public speaking in both the Arabic and English languages.

The executive director should be a person with distinguished intellectual output, and with a proven performance in the solution of serious technological, policy and economic problems. A good background in science policy or economy of innovation is an asset. Main duties will include managing multidisciplinary problem-solving activities; thus, a master's degree or doctorate in science and/or technology would be a distinct advantage. The executive director is expected to intervene in all activities of the Centre on a professional, rather than a managerial or administrative, basis, and has to provide the unifying and creative leadership to organize and efficiently manage limited resources. Ideally, the executive director should have had a broad background in multidisciplinary work and should have had working experience with more than one leading non-engineering consulting organization. The expertise needed is one that requires a scientific/technological background and a multidisciplinary analytical capability.

The appointment of all senior staff for the higher positions would be on the basis of nominations by the executive director to the board of governors.

From the start, it is advisable to establish informal and formal mechanisms for exchange of information between the staff members to enhance the multidisciplinary nature of the operations of the Centre and the multidisciplinary expertise of the staff. Seminars, talks and various other devices should be used to break down barriers to communication and increase discussion and the sharing of expertise.

D. DIVISION OF SYSTEMS AND PROJECTS

Track 2 relates to the core mission of the ESCWA TC, with the activities anchored in the Division of Systems and Projects being multidimensional and involving a host of participants including other divisions, resource persons and centres in ESCWA member countries. The activities will be mostly centred within the Division, while operating along a number of axes in order to meet the ESCWA TC objectives in a timely and well-structured manner.

Activities will involve research by senior staff to identify systemic obstacles and to develop procedures for overcoming them. Findings will be disseminated through conferences, summer schools, workshops, lectures, publications and consultancies. It is assumed that there will be about 26 requests annually under Track 2, and that each request would involve an average of one senior work-month.

Some of the roles of the Division of Systems and Projects will include monitoring and evaluation activities, as well as the designing, launching and monitoring of regional activities and programmes in order to promote socio-economic development in ESCWA member countries and the region. The Division will also provide policy advice and high-level training for STI policymakers, including such public and private enterprise organizations as chambers of industry, agriculture and commerce.

The Division of Systems and Projects will have access to a virtual network of regionally and internationally based experts, who may be readily consulted to explore the various ways to approach each specific project. The process of analysis will take place in close cooperation with the requesting party.

The Division would use a variety of in-house resources to classify the request, and to identify the appropriate person to serve as project manager. The Division will have access to the resources of the Information and Data Management Division, including databases on human capital available at local and regional organizations, as well as in the virtual network. The analysis may be allocated to an expert anywhere within that network. A Control Unit, initially operated by senior staff, will be responsible for ascertaining the quality of the analysis and the speed with which it is performed.

As operations grow in quantity and scope, the Division, hereto having operated under the leadership of the executive director, will be subdivided into satellite divisions, including Policies and Quality Control, to be headed by senior staff.

E. THE SUPPORT DIVISIONS

Initially, there will be three support divisions, namely, Information and Data Management Division, Capacity-Building and Training Division and Administrative Services Division. The perception of those divisions is such that the first two could either be anchored over existing units within the United Nations system or, conversely, be grafted into an existing similar structure in one of the partner organizations, either in the host country or in another country. Outsourcing will depend on the availability of manpower and facilities in the host country, and on the willingness of the host country to sustain and support any of the divisions.

1. *Information and Data Management Division*

Access to a wide variety of information, including patents, literature on science, technology and innovation, and statistical data, is of vital importance to planners and researchers. Such access is generally lacking throughout the ESCWA region; often the expertise is in place, but is paralyzed through lack of information.

In lieu of having a comprehensive supply of information on site, the ESCWA TC will develop comprehensive access via the Internet and via such commercial services as those provided by the British Library and others. The Information and Data Management Division will consist of expert information officers who possess the tools to access established sources. Some of those services will be freely available, while others will be available for a fee and/or by subscription.

National public and private organizations may possess most of the capabilities required for a particular activity, but lack a critical capability to pursue a technology-independent programme. The ESCWA TC should develop information services that would be tapped into directly by users to secure such specific knowledge. The contribution of the ESCWA TC may involve the supply of information, expert advice, human capital and/or networking with other competent organizations.

Statistical services

Accurate and up-to-date statistical information is of vital importance for all phases of economic activity. Such timely and accurate information is often lacking in the ESCWA region.

Access to a wide range of databases and relevant national and international literature is essential for the adoption of effective planning measures. The ESCWA TC will cooperate with owners of databases to make their data available in a user-friendly form. Opportunities exist to integrate the needs of the ESCWA TC with those of other organizations in the region, with a view to reducing cost and sharing databases. For instance, United Nations agencies possess extensive databases, as do numerous Arab organizations. Examples of the latter are the Economic Research Forum for the Arab Countries, Iran and Turkey, the Arab Fund for Economic and Social Development (AFESD), the Arab Planning Institute (API) and the Organization of Arab Petroleum Exporting Countries (OAPEC). Various attempts are presently underway to upgrade statistical services in the Arab world, and the ESCWA TC should be expected to contribute studies to support those efforts. The Centre may also have to further contribute by providing comparative statistical data. Such activities could be advertised, and provided and promoted through a specially-designed website.

Through the services of ICTD/ESCWA, the Centre could place considerable emphasis on its online presence. A portal will be designed and implemented with a view to enhancing the activities of the ESCWA TC and facilitating management of information and knowledge of those activities, providing additional services to partners and contributing to funding campaigns.

2. *Capacity-building and Training Division*

In order to promote the Centre and its activities, the ESCWA TC will conduct summer schools, workshops, conferences, seminars and other events on priority issues for ESCWA member countries. As far as possible, such activities will be planned and implemented in coordination and cooperation with relevant national, regional and international institutions, in addition to stakeholders in both the private and public sectors. Training activities will be designed in order to maximize possibilities for the creation of focal points throughout the region, which will take up further dissemination and integration of STI capacity-building approaches and implementation modalities.

Awareness of the role of STI in economic development should be raised at the decision-making level and within the public perception. With the current trend in the region towards more democratic and transparent practices, Government financing and the size of funding to be allocated greatly depends on how activities promoted by the ESCWA TC are viewed. Although the Capacity-building and Training Division will have its core staff, the executive director and the members of the board of directors are also called upon to promote those activities.

3. *Administrative Services Division*

The Administrative Services Division will be in charge of human resources, management and operations, financial matters, maintenance and procurement.

F. TRANSPARENCY AND GOOD GOVERNANCE

The operations of the ESCWA TC should be transparent and open to the public. Institutional learning and sound quality control require detailed and clear records of all operations, guaranteeing a high level of transparency. The complexities of the issues that have to be undertaken jointly by the Centre and national teams require the highest standards of good governance.

ESCWA member country Governments and the United Nations system have adopted policies that support gender equality. Thus, the Centre will practice and meet international standards and agreements on gender equality.

G. STAFF MANUAL

The ESCWA TC should prepare a staff manual, defining all aspects of the duties and responsibilities of its staff, both permanent and consultant. Every effort should be made to guarantee compliance with those regulations.

Special Activity B described in the Pre-feasibility Study specifically deals with the issue of preparing the by-laws and regulations of the ESCWA TC, taking into consideration United Nations regulations in general, and the operational modes of the host country. The task of preparing a staff manual should be implemented the soonest following the appointment of the executive director.

H. FUNCTIONAL RELATIONSHIPS WITH ESCWA MEMBER COUNTRIES AND USERS

For the ESCWA TC to be effective, its services must be easily accessible to users. Since those services incur a cost, it will be necessary to rationalize those relationships. The ESCWA TC would have a fund used to cover the cost of services to selected ESCWA member countries as approved by the board of directors. Other users may establish a paid subscription to facilitate access.

Access to additional services would be negotiated on a job-by-job basis. An example would be the ESCWA TC management assessing a request for a service and quoting a price. The requester would then decide whether the quoted figure for the cost of the service is acceptable or not.

Every effort should be made to reduce delays caused by red tape. Users should be able to track their projects online, and they should also be able to identify and communicate with the project manager in charge.

I. MULTI-CLIENT SERVICES

Frequently, several organizations may be jointly involved in a single project. Such dealings would provide excellent opportunities for developing regional cooperation, sharing existing expertise and strengthening regional cooperation.

J. QUALITY CONTROL OF OPERATIONS

The attainment of high quality standards is important for multiple reasons. Failure to attain satisfactory quality increases the cost of the activity and reduces the confidence a client has in the purveyor of the service. Thus, it is vitally important for the ESCWA TC to build into its operations instruments that, as a routine matter, increase the capacity of its own staff, as well as that of the staff of collaborators and consultants, in order to meet high standards.

The ESCWA TC should make sure that its operations are of high quality as a matter of course and, thus, does not need to devote much attention to that issue. Nevertheless, the Centre will have to be organized to respond promptly to any failures, as well as benefit from quality control observations on its activities, to improve the speed and reduce the cost of its operations. It is recommended that the executive director appoints a committee of senior staff to study the experience of ESCWA in the area of quality control of its programmes. Here, the purpose should be twofold, namely: (a) to learn from the experience gained in the region in handling quality control issues; and (b) to learn how to instil quality control techniques in such a way as to enable the individual staff member and consultant to automatically meet high quality standards.

The committee should then examine a variety of total quality control management systems as practiced by major consulting firms. On the basis of those surveys, it is recommended for the executive director to adopt systems that have been successfully used to ensure good performance. The ESCWA TC will be an organization dealing with concepts and knowledge. In a region where several languages are in use and where experience varies greatly, it is vitally important that each request be carefully analysed and confirmed by the client before planning and commitment are made. Special effort should be deployed by the Centre to verify and confirm all requests in order to define clearly the subject of an agreement and the scope of work.

It may be anticipated that the ESCWA TC will have to establish two quality control audit units, namely, one reporting to the board of governors and assuming responsibility for large projects, with a second unit reporting to the board of directors and being responsible for small-scale projects. The objective of quality control is not simply to determine that everything was performed satisfactorily, but as importantly to study the following factors:

(a) The merits of alternative approaches that have a direct bearing on cost and speed;
(b) The optimal qualifications of needed staff;
(c) The effectiveness with which available knowledge on a topic has been utilized.

Since the ESCWA TC will be involved with national public and private centres and firms in the execution of its programmes, it is natural that quality control is covered in the agreement entered into by the

Centre in such collaborative arrangements. Partner organizations may identify specific staff members who are "quality compliant" to work on ESCWA TC projects.

The problem of quality control will arise at two different levels, as set out below:

(a) *Quality control of simple and short-term projects and inquiries*

For simple and short-term projects and inquiries, the use of procedures to secure total quality control may be readily adopted. It may also be useful to invite users to provide an assessment of the quality of the service received, with the responses of users to be directed to the internal audit reporting to the executive director.

(b) *Quality of major programmes*

Each major programme will have a senior staff member in charge. Those programmes have to be approved by the executive director and be designed in some detail and costed. All major programmes should be carefully reviewed by senior colleagues, both to secure their professional input and to diffuse expertise and information on ongoing activity. The audit of major programmes and projects should be by an auditor appointed by the board of governors solely for that purpose. Alternatively, the board of governors may appoint a consulting company to serve as an external auditor.

K. INSTITUTIONAL LEARNING

An important aspect of the ESCWA TC is to learn from past experiences. To do so, there will be many aspects to problem solving that need to be monitored, including the type of expertise utilized in relation to various types of problems and the sequence of actions taken. Other features that should be monitored are the cost of the different phases of design and implementation, the organizational and management solutions examined, the associated social and legal aspects of the project and, whenever relevant, the regional and international aspects. Documentation on each problem-solving exercise will be valuable information for the assessment of alternative approaches to the same problem.

Since making and keeping accurate and detailed records is expensive, every effort should be made to benefit from the combined professional and administrative records. The ESCWA TC may need to utilize specialized external consultants to design an efficient and low-cost system for managing institutional learning and for quality control.

L. COOPERATIVE ARRANGEMENTS WITH NATIONAL ORGANIZATIONS

During the past fifty years, considerable investments have been made in the ESCWA region to develop public and private research and consulting services, and there are a substantial number of such firms and organizations. It is a challenging task for the proposed ESCWA TC to mobilize those resources in order to move ahead faster. Thus, a survey was commissioned to examine in greater detail what is available, and to learn of the experiences acquired in the domain of cooperation between those centres, as well as with the users of their services. The regional survey showed that the major issues to consider in developing cooperative activities include the following needs:

(a) The need to prepare adequate information on national firms and organizations;

(b) The need to define appropriate relationships between the ESCWA TC and collaborating centres;

(c) The need to define fees and standards to measure the services provided, and establish appropriate facilities for funding cooperative services.

1. *The need to prepare adequate information on national firms and organizations*

Importance should be placed upon the developing of a directory of national centres and consultants. The cost of compiling information from original sources is high, and delays in attending to a problem caused by the need to find the appropriate organization is costly; hence, companies and Governments may opt for an international firm about whom the necessary information is readily available. A relatively small operation as the ESCWA TC will not be able to cope with such high cost and delays. It is thus imperative that the Centre take the leadership in organizing a large-scale effort to convince private and public firms and organizations to publish comprehensive information about their capabilities, track records and ongoing activities. Making such information publicly available will increase the abilities of all such firms to market their services nationally, regionally and internationally. Furthermore, staff members need to know one another to ease cooperation.

Private consulting, contracting, research and testing services are potential collaborating parties for the ESCWA TC. Consulting services in the domain of management, law and finance will most probably originate in private and public firms and organizations. Such information must be made available in digital form to enable fast searches of potential sources of expertise. The final choice of a collaborator will partly depend on geographic location, with a qualified national centre located in the requesting country being the first choice.

It is clear from the survey, and from information in earlier ESCWA studies, that current data available on firms and centres varies widely in degree of detail. In general, the available information is inadequate for fast and reliable service. Considerable and sustained effort has to be undertaken to encourage all of the national centres to prepare such information on a routine basis to promote the use of their services, and also to facilitate cooperation and collaboration.

The appointed national focal points should be able to assist in the preparation of regional directories and in the formation of clusters. With those national centres having numerous opportunities to cooperate with each other and to market their services nationally, regionally and internationally, it is expected that the preparation of a directory and the work with the ESCWA TC should increase opportunities for collaboration and cluster formation.

2. *The need to define appropriate relationships between the ESCWA TC and collaborating centres*

In order for the ESCWA TC to be cost efficient, it must operate with a minimal amount of bureaucracy. The two ESCWA-commissioned studies on the experience of the Asia and Pacific Centre for Transfer of Technology (APCTT) of the Economic and Social Commission for Asia and the Pacific (ESCAP) and the survey on ESCWA member countries in that regard indicate that the use of focal points and collaborating through hierarchical systems is time-consuming and ineffective. It is evident that an alternative mode would be to adopt horizontal and direct expert communication. In such an operational mode, it is imperative that the legal and managerial impediments be made explicit at the onset.

For centres that agree to cooperate, it should be possible for ESCWA TC staff to contact directly their expert staff and determine promptly the feasibility of cooperation. If cooperation is impossible because the centre in question may be otherwise committed, it is imperative that the ESCWA TC continue the search for a free partner.

In time, the ESCWA TC may find a relatively small proportion of all firms and centres with which it can cooperate efficiently and productively. Nevertheless, the board of governors may decide that it would want the Centre to take additional risks by testing new partners and other modes of collaboration on a continuous basis. A large number of possibilities may be, in time, examined with the expectation of contributing to the development of national centres.

3. *The need to define fees and standards to measure the services provided, and to establish appropriate facilities for funding cooperative services*

The efficiency of cooperation depends on the frequency with which the practice is undertaken. Launching such activities on a substantial scale will call for patience and a learning period, which will add to the cost. Setting standards for performance may be more difficult, and will take more time than setting standards for fees. The entire operation of establishing the ESCWA TC and promoting cooperation with national centres has a developmental objective. Cooperation will initially be more expensive than the Centre employing directly its own consultants; however, in time, the cost should go down with repetition. Once national centres fully acquire the know-how, they will be able to offer the service directly to the clients who would previously have used the ESCWA TC for such service. Those are some of the positive developmental consequences of an initially complex method for solving problems.

The fact that the initial cost of such cooperation may be higher than direct employment of consultants warrants study by the Centre, ESCWA and ESCWA member countries. The participating centres will gain expertise and benefit directly from the cooperation. Thus, there may be a good reason for subsidizing those activities by member States. For example, ESCWA member countries could share the cost of contracts granted to centres and firms in their respective country.

M. PUBLIC-PRIVATE PARTNERSHIPS IN RESEARCH AND DEVELOPMENT IN THE ESCWA REGION

The proposed study on cooperation with participating centres referred to above prompts special attention to public-private partnerships. They are activities that have been undertaken differently in various ESCWA member countries. Some countries have been encouraging such partnerships since long, while others have only recently started promoting the adoption of such activities.

Public-private partnerships can vary in type and size. There are major industrial firms that are partly owned by the public sector and partly by the private sector. That type of partnership is probably the oldest and most widespread in the region. More recently, other types of support systems are emerging. Taking Jordan as an example, the Jordan Innovation Centre (JIC) illustrates one type of public-private partnership. The organization aims to enable entrepreneurs to develop their investment ideas by providing them with the services and support they need to achieve their objective. JIC is the result of the cooperation of four organizations in Jordan, namely, the Royal Scientific Society (RSS), Amman Chamber of Industry (ACI), Jordan Engineers Association (JEA) and Euro-Jordanian Action for the Development of Enterprise (EJADA). Those partnerships are especially important for the formation of SMEs.

V. SIZE AND FACILITIES OF THE ESCWA TECHNOLOGY CENTRE

The ESCWA TC will require the services of a highly specialized and efficient staff. ESCWA member countries and regional organizations would be expected to offer jobs to staff members at the Centre. In fact, it will be an objective of the Centre to facilitate the introduction of professionals in the diaspora to organizations and Government ministries in the ESCWA region. In other words, recruiting from the ESCWA TC staff would be considered one of the services provided by the Centre to ESCWA member countries.

Theoretically, the size of the proposed ESCWA TC could be varied at will. However, for the Centre to become functionally useful to the 13 ESCWA member countries, it would need to be able to provide a steady stream of services to all member countries simultaneously. Those services have to be provided promptly and effectively, otherwise ESCWA member countries will not make it a habit to turn to the Centre for such services. In order to estimate the minimum size of the ESCWA TC, the considerations described below should be taken into account. Table 9 illustrates the total number of professional staff required.

A. STAFFING FOR TRACK 1

The main activities of Track 1 deal with requests for information and short-term advisory services. Each activity will be discussed separately below. In the process of building the staff at the ESCWA TC, the first priority is thus the appointing of a statistician. The head of statistical services should have good knowledge of such services in the ESCWA region and be capable of transforming existing statistical information into user-friendly format for direct client use and developing information facilities. The senior statistical staff will play an important role in encouraging Arab statistical services to standardize presentation and increase availability of data. The ESCWA TC itself will not compile any primary statistical information, but will contact ESCWA member countries and international organizations to secure access to what is available. Furthermore, the staff will cooperate with ESCWA member country statistical services to develop and standardize the formats in which the data are available in order to make them more user-friendly.

The second priority concerns the recruitment of an experienced information officer. The prospective candidate should have a broad international experience in securing information, and be well-versed in various computer-based communication systems. There already exists a wide range of software that facilitates Internet-based collaboration among team workers. The Centre will be a heavy user of such facilities, and the information officer will be called upon to introduce training programmes in the use of such systems.

It can be assumed that each ESCWA member country would request a minimum of 20 items of information per year, translating into a total of 260 such requests annually. In addition, there would be demands by the private sector, which would be charged at cost plus, allowing the Centre to add staff in the event the number of such requests is significant. Requests will vary in complexity, but on average it is estimated that each will require five work days. That implies that the Information and Data Management Division would need 1,300 work days, or five work years. The requested services could be provided by research assistants supported, when needed, by senior staff and an information technology (IT) engineer. The senior staff members would be chiefly involved in establishing and developing the service, and in training and managing the research assistants.

In total, the following posts are recommended:

Position	*Number*
Statistician	1
Information officer	1
IT engineer	1
Research assistant	3
IT technician	1

B. STAFFING FOR TRACK 2

During the first year, highly qualified senior staff members would undertake surveys and research with the assistance of senior research assistants, and in collaboration with other divisions when needed. In addition, they will be serving as project managers for assignments in response to client demand. For the Division of Systems and Projects to be able to deliver the required services, the following positions will have to be considered:

Position	*Number*
Macroeconomist	1
Microeconomist	1
Systems analyst	4
Industrial management expert	1
Financial services expert	1
Research assistant	8
Technical assistant	2

By the end of the second year, all staff should have been recruited by the board of directors upon the recommendation of the executive director. Some of the posts could be filled temporarily by consultants.

C. STAFFING FOR TRACK 3

Two senior staff members will be required to undertake research and to diffuse their findings so as to promote the formation of a regional market for technology. The research will involve legal, economic, managerial, administrative and political research to identify obstacles. The development of analytical methods for overcoming those obstacles through the application of conflict-resolution methods is also needed. The two senior staff members will be heavily involved in those activities. They will be supported by four research assistants and one technical staff member, as illustrated below.

Position	*Number*
Senior staff	2
Research assistant	4
Technical assistant	1

D. STAFFING FOR TRACK 4

During the first year, Track 4 will be mostly experimental. One senior staff member, supported by one research assistant, may be sufficient during that time frame, as illustrated below. The purpose would be to develop suitable models for the organization of mass collaboration and rapid diffusion of solutions.

Position	*Number*
Senior staff	1
Research assistant	1

E. CONSULTANCY SUPPORT FOR TRACKS 1 TO 4

At this point, it is not possible to determine the requirements of specialized consultants for the conduct of normal work of the ESCWA TC. A reasonable assumption is that a minimum of 10 man-years of senior consultants would be needed per year. Table 9 summarizes information on human resources requirements during the first two years.

F. Administrative Services Division

Initially, key positions will be those of administrator, finance officer and human resources officer. Auditing problems could be relegated to a private auditing firm. To be effective, the Administrative Services Division will need two research assistants and nine technical staff to cover such activities as IT needs, and the manning of the reception and telephone switchboard, as well as a driver.

Position	*Number*
Administrator	1
Finance officer	1
Human resources officer	1
Research assistant	2
Technical assistant	9

It should be noted that not all of the staff should be recruited simultaneously. Provisions could also be made for the secondment of some of the staff, provided they meet the professional requirements of the post, by the host country or other ESCWA member countries at no extra cost to the project.

G. The office of the executive director

The office of the executive director will be composed of the following staff members:

Position	*Number*
Executive director	1
Executive assistant	1
Secretary	1

H. The office of the board of governors

An executive assistant to the chairman of the board of governors and a secretary should be recruited during the initial phase of establishing the ESCWA TC. Alternatively, those responsibilities could be devolved temporarily to other members of the Administrative Services Division. Unlike for the Divisions, the staffing of the office of the board of governors begins during the initial phase and continues with little change.

I. Virtual network of experts

The ESCWA TC will have to address a wide variety of specialties by using consultants. To do so, the Centre should primarily depend on local and regional organizations for human capital. It will also establish a local, regional and international virtual network of experts who could be employed at short notice, the number of whom entered in the database would depend on the scale of operations and on specialties in demand. Since the ESCWA TC will often have to respond to urgent requests, it will need alternative expertise in commonly requested fields. That would be necessary since the experts within the network database would not be able to always leave their permanent posts at short notice.

Every opportunity should be used to meet with the experts and have them progressively involved in the activities of the Centre. The ESCWA TC would use its regional network to promote the invitation of those experts to conferences held in the region. That would assist in encouraging the interaction of diaspora experts with local experts and organizations.

It should be expected that, as the ESCWA TC establishes its reputation as an effective problem solver, it will receive additional requests for its services. That would require a steady rate of expansion.

TABLE 9. TOTAL NUMBER OF PROFESSIONAL STAFF

	Senior staff	Middle management	Research assistants	Technical staff	Total
Office of the executive director	1	-	1	1	3
Administrative Services Division	-	3+1*	2	9+1*	16+
Track 1	2	1	3	1	7
Track 2	8	-	8	2	18
Track 3	2	-	4	1	7
Track 4	1	-	1	-	2
TOTAL	14	5	19	15	53

Note: * One executive assistant and one secretary for the office of the chairman of the board of governors.

J. OVERALL ASPECT OF SPACE FACILITIES

In order to meet the staff requirements for space and the operational needs of the ESCWA TC, provisions should be made to accommodate senior and middle management staff in individual offices with adequate environmental and IT facilities. Research assistants could be accommodated two per office or, alternately, open-space cubicles could be considered. There should be five small meeting rooms with IT facilities, one room for video conferencing and one lecture room to accommodate about 150 people. There should be a boardroom with proper secretarial annexes. Additionally, provisions should be made for storage space, a cafeteria cum restaurant and a library. The building should be located in a quiet area, with easy access to the centre of the city and the airport, and include parking facilities for staff and visitors.

VI. PROCEDURE FOR THE ESTABLISHMENT OF THE ESCWA TECHNOLOGY CENTRE

The establishment of the ESCWA TC will be accomplished during four phases. The first phase, during which ESCWA will be fully in charge, begins with the approval of the recommendations of the Pre-feasibility Study, and this *Report*, and ends with the appointment of the first board of governors. The second phase starts with the appointment of the board of directors and ends with the appointment of the executive director, with the third phase ending with the Centre moving to facilities made available by the host country. During the final phase, the ESCWA TC will be fully established and operational in the host country. Table 10 illustrates the proposed activity timeline for the first three years of operation.

A. FIRST PHASE: ESCWA

The expected duration of the first phase is six months.

The following actions are to be taken by ESCWA during the first phase.[39]

(a) Approval of the recommendations considering the establishment of the ESCWA TC;

(b) Successful negotiations between ESCWA and the host country;

(c) Establishment of a board of governors through negotiations between ESCWA member countries and the host country;

(d) Establishment of a fund to sustain the Centre;

(e) Subcontracting for the execution of Special Activity B, as defined in the Pre-feasibility Study for the development of administrative regulations, including management aspects defining the authority and responsibility of the board of directors, its officers, chairman and the executive director, as well as relevant performance criteria for each.

B. SECOND PHASE: BOARD OF GOVERNORS

The expected duration of the second phase is six months.

Once a board of governors is constituted, it will assume responsibility for all subsequent actions. The board has to undertake a set of actions to prepare the grounds for the establishment of the ESCWA TC.

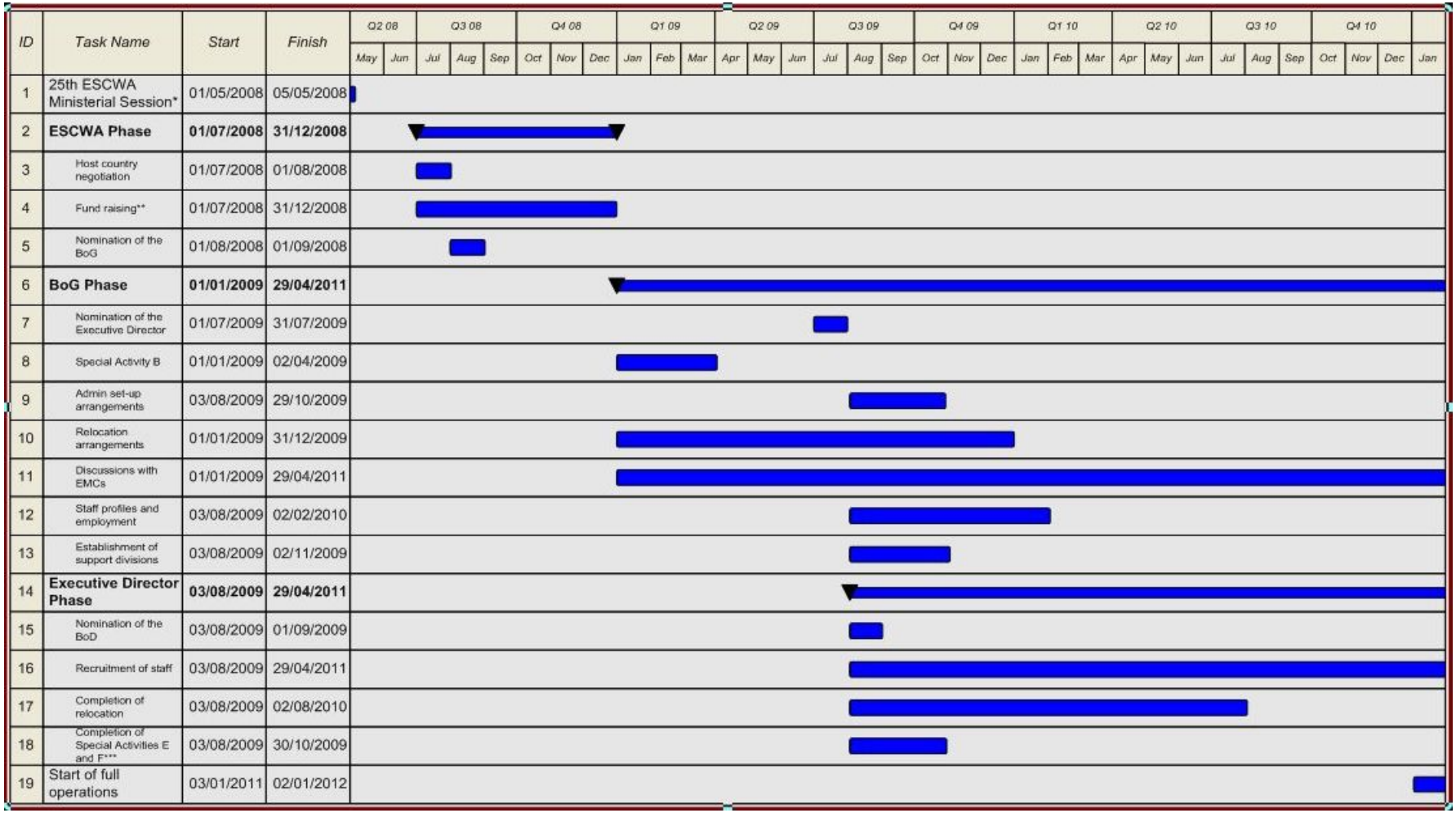
The board of governors should establish its own secretariat. It is important that it appoints one of its members, initially on a full-time basis, to follow up and implement its decisions. The board should also expect to meet frequently, at least once a month during the first six-month period.

Among the priority activities to be undertaken by the board of governors should be the review of management regulations defining the authority and responsibility of the board, its officers, chairman and executive director, as stipulated in Special Activity B in the Pre-feasibility Study on the development of administrative regulations, including management aspects. Following that, the board would work on the draft criteria used to assess the performance of the executive director.

The most important decision to be taken by the board of governors concerns the search for and selection of an executive director of the ESCWA TC. The board may wish to appoint a special search committee to pursue that matter in an organized and effective manner. It would be advisable if the board could be in a position to announce the appointment by the fourth month of its tenure to enable the executive director to assume his/her duties within two or three months.

[39] The activities are not necessarily listed in chronological order.

TABLE 10. ACTIVITY TIMELINE FOR THE FIRST THREE YEARS



ID	Task Name	Start	Finish
1	25th ESCWA Ministerial Session*	01/05/2008	05/05/2008
2	**ESCWA Phase**	**01/07/2008**	**31/12/2008**
3	Host country negotiation	01/07/2008	01/08/2008
4	Fund raising**	01/07/2008	31/12/2008
5	Nomination of the BoG	01/08/2008	01/09/2008
6	**BoG Phase**	**01/01/2009**	**29/04/2011**
7	Nomination of the Executive Director	01/07/2009	31/07/2009
8	Special Activity B	01/01/2009	02/04/2009
9	Admin set-up arrangements	03/08/2009	29/10/2009
10	Relocation arrangements	01/01/2009	31/12/2009
11	Discussions with EMCs	01/01/2009	29/04/2011
12	Staff profiles and employment	03/08/2009	02/02/2010
13	Establishment of support divisions	03/08/2009	02/11/2009
14	**Executive Director Phase**	**03/08/2009**	**29/04/2011**
15	Nomination of the BoD	03/08/2009	01/09/2009
16	Recruitment of staff	03/08/2009	29/04/2011
17	Completion of relocation	03/08/2009	02/08/2010
18	Completion of Special Activities E and F***	03/08/2009	30/10/2009
19	Start of full operations	03/01/2011	02/01/2012

Notes: * The final date has not been decided yet.
** This has to be a continuous process; however, it will be imperative to secure funding at the onset for the first three years.
*** Relate to the work plan, awareness campaigns and a detailed business plan.
**** Q2, second quarter; Q3, third quarter; Q4, fourth quarter.

The second, equally important activity of the board of governors is to prepare the ground for efficient and effective collaboration between the ESCWA TC and national organizations, both public and private. The expertise needed in the performance of projects is widely diffused and is not restricted to national research and development organizations; hence, it would be helpful if the board's approach to potentially collaborative organizations is all inclusive.

Inter-Arab cooperation between scientists, technologists and professionals, and organizations and institutions, as well as on technology policies is limited, heavily bureaucratic and cumbersome. Such slowness increases cost and reduces effectiveness. In order that the ESCWA TC can serve the region effectively and at low cost, it will be required to establish fast and efficient working relationships. It would be useful if the board of governors initiate informal discussions with ESCWA member countries about the principles, procedures, costs and benefits underlying cooperation with the Centre.

Those activities to be undertaken by the board of governors would require serious and substantial work. The board should examine the potential sources of conflict, and attempt to find appropriate measures for overcoming them. The board may find it necessary to appoint a consulting firm to assist in that domain. The complexity of those difficulties should not be underestimated, nor the positive rewards that will accrue to the region from overcoming them.

The ESCWA TC could operate on a bilateral basis, without the cooperation of national and regional organizations. However, such a mode of performance will reduce the benefits to the region, and it is thus important to encourage the Centre to perform in collaborative modes.

One of the difficulties that will arise during the early part of the second phase is the priority and cost of the services rendered by local organizations to joint projects. Such joint projects will be of two types, namely: (a) projects undertaken entirely within the country of the participating organization; and (b) projects undertaken partially or wholly outside the country in question.

The priority given to a project by a collaborating organization is of vital importance to the ESCWA TC. By priority is meant whether the participating national organization would give such collaboration precedence over all other work. When the Centre is responding to a request, it is expected to take action with speed and expediency. On the other hand, national organizations will have their own priorities. When a national organization is approached for collaboration by the ESCWA TC, it should specify whether it can provide the requested support within a specified time frame. If the service is not available within the time frame required by the Centre, other collaborators will have to be sought. Hence, it is important to have multiple potential cooperating organizations in each ESCWA member country.

The second aspect of collaboration is cost. Initially, there would be additional expenses arising from facilitating the management of such a relationship between a national organization and the ESCWA TC. The question then is who should assume responsibility for carrying that cost. One approach could be that the Centre should cover the total cost; however, that may be too great a burden. The development of the Centre would be significantly enhanced if, during the first three years, each ESCWA member country provided a fund to their national organizations to cover the cost of their respective collaborative relationship. If each country established a fund ranging from $0.2 to $1 million per year, it should greatly facilitate the functioning of the ESCWA TC.

Since the ESCWA TC is responsible for the outcome of each project, it will be solely accountable for the selection of collaborating parties. ESCWA member country Governments cannot take the decision on behalf of the Centre as to which entities should be involved in a particular project. It is to be expected that some choices may not work out well. During the initial period, the Centre will have to plan fail-safe measures to compensate for such outcomes, and those measures will add to the cost. The ability of the ESCWA TC to make sound choices regarding collaborating professionals would depend on the accuracy of available information.

During the second phase, the board of governors shall also initiate and continue the preparation of a number of systems that are essential for the functioning of the ESCWA TC. They are set forth as follows:

(a) Management system;

(b) External accounting and audit systems;

(c) Staff manual, as stipulated in Special Activity B on the development of administrative regulations, including management aspects;

(d) Design of physical facilities for the construction of the Centre, or adaptation of existing premises.

It may also be advisable for the board of governors to establish a consulting group to prepare a detailed report on available statistical services. An assessment of the work that needs to be done is necessary, as is the converting of the available data into an accessible and user-friendly format. During the past few years, there has been an international effort to upgrade statistical services worldwide.[40] Conversely, such services could be supplied by existing ESCWA facilities, in addition to short-term consultants. In such a case, that could be the nucleus of the Information and Data Management Division.

C. THIRD PHASE: EXECUTIVE DIRECTOR

The expected duration of the third phase is one year.

1. *Administrative set-up*

Once the board of governors appoints an executive director, it will cease to undertake certain functions as those would become part of his/her responsibilities. The board will, however, continue to deal with issues of funding and the modalities of collaboration between the ESCWA TC and national organizations. In both activities, the board will coordinate closely with the executive director.

The executive director will have to review and take appropriate action concerning advances made on the following topics:

(a) Management system;
(b) Accounting and audit systems;
(c) Design and construction of physical facilities.

The third phase will be mostly devoted to establishing the ESCWA TC. It would also be the time to engage in an intensive learning process about the issues, procedures and prevailing idiosyncrasies. The Centre will have to provide a large number of services in order to demonstrate its mode of operations. It will also provide learning opportunities to both its own staff and staff members of collaborating organizations and the users.

2. *Premises*

The ESCWA TC will have its headquarters in one of the member countries, and eventually develop satellite centres in other ESCWA member countries if there is a need for doing so. Accordingly, in the light of the advances made to date in the construction of permanent facilities, the premises should provide modern working facilities that are energy-efficient and environmentally friendly. The infrastructure should minimize its carbon footprint and should be equipped with advanced ICT hardware and software, including conferencing and networking options.

[40] Only a small number of Arab countries participate in the Partnership in Statistics for Development in the 21st Century (Paris 21), founded in 1999 by OECD, the World Bank, the European Commission (EC), the International Monetary Fund (IMF) and the United Nations; available at: http://www.paris21.org/.

3. *Staff recruitment*

The executive director would have to initiate an extensive recruiting programme of senior, junior and administrative staff, with the hiring of senior staff being priority.

(a) *Senior staff*

The senior staff at the ESCWA TC will need to undertake tasks which are multidisciplinary and based on systematic work, positions that require persons with expertise, diversity of experience and proven track record, as well as strong personality. Recruiting the quality of staff needed to fill the senior posts cannot be undertaken solely by advertising or through employment agencies, as persons with that class of expertise do not always respond to such methods. It is also desirable that the senior staff be bilingual in Arabic and English. Recruiting within the diaspora and within the Arab world will require the adoption of appropriate methods. Because of the small size of the ESCWA TC, every effort should be made to search for staff possessing complementary capabilities and expertise. The responsibility of the executive director is to select senior staff members with the appropriate capabilities, and to integrate them into efficient operational teams.

(b) *Research assistants and technical staff*

Junior staff members would be mainly trained at the ESCWA TC. Their most important characteristics would be excellence within their field of expertise and appropriate work experience wherever possible. The Centre should not be adverse to the recruitment of fresh graduates in advanced disciplines, and should plan and manage a substantial number of senior and junior staff training programmes.

The executive director would also have to develop a work programme for the first year. Depending on the speed of recruitment of senior staff, the executive director may wish to employ experienced and senior consultants for that task, who should begin by identifying major issues and initiate discussions with the board of governors to set in motion the priority services of the Centre.

It would also be advantageous if the board organizes a series of informal meetings between the executive director and potential users of the services the ESCWA TC is to provide. Thus, the board could transfer its achievements in developing a cooperative supportive environment for the Centre to the executive director.

4. *ESCWA and the Technology Centre*

Once the ESCWA TC enters its second year, it will be necessary to establish a working group consisting of staff from ESCWA and the Centre to discuss areas of common interest and complementarities. It will be required for the two organizations to cooperate to avoid overlap, and both should have access to the resources of each other. Regarding the paying for the exchange of services, it should not be too difficult to find a suitable mode of mutual accommodation. However, the process of negotiations should not begin before the Centre has recruited sufficient staff and an adequate level of work has been undertaken.

D. FOURTH PHASE: HOST COUNTRY

It is expected that the construction of permanent facilities of the ESCWA TC, securing funding and appointing the board of governors and executive director, as well as key officers, should be completed within two years. Once the Centre moves into permanent premises and has completed its staffing, it should rapidly reach a steady state of activities.

The activities of the board of governors towards developing a cooperative environment and the willingness of ESCWA member countries to facilitate cooperation should enable the Centre to function effectively. The ability of the Centre to function successfully will depend on the imagination and expertise of its staff to design alternative procedures. Such actions would be achieved to overcome constraints beyond the control of the Centre. In other words, the executive director and the staff will have to be on alert to utilize available technologies and parallel planning, and develop tools to compensate for unexpected difficulties, uncertainties and risks beyond the control of the Centre.

VII. FINANCIAL MATTERS

A. FUNDING

For the purpose of discussion, this *Report* presents plausible guidelines on the subject of financing and the budget. However, this subject is programmed to be undertaken as part of a business plan, as recommended and approved in the Pre-feasibility Study under Special Activity F: Detailed business plan for the Technology Centre.

It is anticipated that the ESCWA TC will need funding during the first five years. It is expected that during that period, the benefits derived by users of services provided by the Centre should make a good case for charging for those services in the future. Although being a non-profit organization, the ESCWA TC should have the option of charging the private sector for its services when needed.

It is recommended that the board of governors should begin to consider planning for the transition to fee-paying services during the second year. Charging clients will have an impact on the accounting systems and the type of services undertaken, including compiling data on costs of different services. Thus, early planning is necessary for the Centre to be able to levy charges on certain categories of services in the fourth year, and increasing the share of services for which there are fees in the fifth year. The earnings from those early sales of services could be utilized in later years to subsidize selected services within poverty-eradication programmes.

The funding of the ESCWA TC during the first five years could take different forms. The most straightforward option will be that of an endowment type. ESCWA member countries could donate to a fund a stipulated sum of money, whose returns could cover the running expenses. The Centre could provide a paying service after five years, then it will be possible to raise a self-liquidating endowment; in other words, the capital requirement plus the earnings on that capital will decrease annually and reach zero at the end of the fifth year.

Alternatively, the Centre could be supported by advanced, quarterly payments. In other words, the sponsor, or sponsors, could begin by donating the full cost of one fully operational year, and then donate on a quarterly basis one fourth of the estimated annual budget.

In addition to its basic funding, the ESCWA TC should be able to receive funding and support for undertaking specific projects. The Centre also should be able to raise funds locally, regionally and internationally to expand some of its activities; for example, the programme for the eradication of poverty may be able to receive considerable support and, thus, it should be possible to expand that activity. Furthermore, the ESCWA TC should be able to raise participatory funds from ESCWA member countries, and contributions could be forthcoming from ESCWA, the World Bank, the Islamic Development Bank (IDB), AFESD and the European Investment Bank (EIB), with additional sources of funding from beneficiaries to be forthcoming once the Centre is fully operational.

B. BUDGET

The running cost of the ESCWA TC will change continuously during the first three years, thenceforth, it will begin to attain a steady state. At this stage, it is only possible to provide approximate estimates of budgetary requirements, as they will change periodically depending on the cost of living in the host country and the overall work programme of the Centre. It will become feasible to form more precise estimates only after the host country has been selected, and the Centre has some experience in responding to ESCWA member country requests and established efficient collaborative relationships with national organizations. Table 11 illustrates the estimated annual operations and set-up costs.

TABLE 11. ANNUAL OPERATIONS AND ESTIMATED SET-UP COSTS

Item description	Unit	Number	Cost	Per year	Annual amount (US dollars)
Annual operations					
Board of governors	Member	9	3 000	4 missions	
Travel and accommodation[a/]	Member	9	5 000	4 sessions	108 000
Honoraria	L/S				180 000
Consultancies and operations					500 000
Subtotal					**788 000**
Personnel[b/]					
Executive director	Staff	1	15 000	12	180 000
Senior staff	Staff	14	12 000	12	2 016 000
Middle management	Staff	5	8 000	12	480 000
Research assistants	Staff	19	2 500	12	570 000
Technical assistants	Staff	15	1 500	12	270 000
Consultants	Work year	10	8 000	12	960 000
Subtotal					**4 476 000**
Operations and services[c/]					
Contractual services	L/S				2 000 000
Trainings, workshops, expert group meetings	L/S				500 000
General operating expenses and supplies	L/S				250 000
Travel of staff	L/S				200 000
Travel of consultants	L/S				400 000
Subscriptions and janitorial services[d/]	L/S				250 000
Unforeseen	L/S				100 000
Subtotal					**3 700 000**
Subtotal annual operations					**8 964 000**
Set-up costs[e/]					
Acquisition of references and documents	L/S				500 000
Basic office equipment	L/S				250 000
IT and office equipment	L/S				250 000
Vehicles	Vehicle	2	50 000	1	100 000
Contingency	L/S				1 000 000
Subtotal set-up cost					**2 100 000**
Total					**11 064 000**

Notes: The figures here are estimates; final figures will be available once a work plan and a business plan have been prepared and approved (Special Activities E and F) and the host country selected. However, they will not be expected to be much different.

a/ During the first year, there will be more frequent meetings of the board of governors. For these calculations, an average four annual meetings are estimated on the basis of $3,000 for travel and accommodation per person.

b/ Figures given for salaries include benefits; thus, they are higher than those suggested in the Pre-feasibility Study.

c/ Although these are estimated annual costs, they will not be reflective of operational costs in the first six months, which will be much lower. However, once operations assume normal capacity at the end of the second year, these figures will serve as guidelines.

d/ The host country will be expected to provide premises, either in an existing building or constructing suitable accommodation, as well as covering maintenance costs, and water and electricity consumption. Janitorial services could be outsourced.

e/ Set-up costs do not include expenses for major furnishings or decorative items as regards the premises in general or the lecture room.

Abbreviation: L/S, lump sum.

The Pre-feasibility Study recommends the establishment of a board of governors, which would be assuming substantial responsibilities, particularly during the first three to four years. The executive director is expected to have a technical background and, due to time constraints, is not expected to devote much attention to the development of relationships between the Centre and ESCWA member countries.

It is important to note here that the flexibility recommended for the design and establishment of the ESCWA TC has implications for the budget. For example, the board of governors may, after it is established, determine to modify the proposed organization of the Centre by appointing a full-time chairperson of the board. Such a person would, thus, replace the three or four members devoting time to the support of the formation of the Centre. In addition to having the appropriate professional qualifications, the chairperson should be well versed in the issues the Centre is designed to address and support its mission. However, he/she would only be responsible for such external relationships of the Centre as funding and collaborative relationships.

The services provided by the ESCWA TC within its first four years should be sufficiently constructive and beneficial to ESCWA member countries so that it can progressively shift to charging for such services. The Centre may be able to work out an arrangement to secure loans for ESCWA member countries to finance the cost of those services. The banks providing such loans would recover their advances from the increased revenue generated by the services provided by the Centre. Since the board of governors would be the main driving force in designing the transformation from that of a subsidized service to a paying service, the role of the chairperson is extremely important.

C. START-UP MODALITIES

The scale of the ESCWA TC proposed in this *Report* aims to provide a comprehensive minimal illustration of what can be undertaken with available capabilities and know-how. The scope has been dictated by the current scale of the economies of ESCWA member countries, whose GNP is approaching $1 trillion. Regardless of the start-up modality applied, implementation could be phased out in time, vertically and/or horizontally.

If, for any reason, it is desired to work on a more modest scale and scope, it is possible to contract the range of activities proposed in this *Report*. The impact of the ESCWA TC on the economies of ESCWA member countries will depend on the scale and diversity of the adopted activities. However, a reduced operation will translate into a slower rate of adoption of new technologies, a slower rate of employment creation and SME proliferation and much slower economic growth.

Should the overall objective of the ESCWA TC be trimmed down to modest levels, the scale of activities will not be economically efficient to emphasize cooperation and collaboration on the scale envisaged. It will then be necessary to eliminate Track 1, as the maintaining of a substantial Information and Data Management Division will not be justifiable. A multiphase approach would then be pursued, with the Centre initially focusing on one, two or three activities, depending on the desired scale, to reflect the financial constraints. The Centre would associate a few national centres in the performance of those activities, and would then phase out its involvement in each of those as the national centres become proficient. The Centre would then initiate activities in a new area, domain or sector, replacing the one phased out.

In all probability, the smallest operation that can be envisaged would cost one third of the budget proposed in table 14. In order to provide the most concentrated professional capabilities, it is advisable to trim activities to two or three system analysts, combined with the supporting research assistants and consultants. All support services would be purchased when needed. The board of governors would be reduced to three members, and the board of directors eliminated. The Centre would then use the facilities of ESCWA to organize conferences and meetings; the idea being to focus staff action on undertaking professional work, and to reduce to a minimum administration and services. That may increase the unit cost of activities, but it should reduce unnecessary services until such time that the Centre has grown in size to warrant full-scale permanent services, including information and statistical services, approximately along lines of the scaled-down suggestions of the Pre-feasibility Study.

1. *First phase: proposed activities*

It is proposed that during the first phase, the ESCWA TC should adopt three different activities; their cost will be small, and their impact could be considerable if successfully communicated to ESCWA member countries. The three proposed activities are set forth below.

(a) *Activity 1*

The first activity is to focus on contract design, irrespective of technology, with a view to maximizing technology transfer to national and regional consulting and contracting firms. In doing so on the reduced scale, it may not be possible to attend to all the associated problems that such changes in contract design would involve. For example, in the extended model of the Centre, that would involve simultaneous attention to enhancing financial services through the adoption of risk assessment and management, in addition to upgrading and reforming the legal system to enable it to provide faster services.

Depending on the Centre developing good directories of expertise, the comprehensive service would also include assisting individual firms by adding necessary expertise to overcome some organizational weaknesses. The substitute would be to direct the firms to the use of consulting services, which would be more expensive and may deter the firms from engaging in such activities.

(b) *Activity 2*

The second activity could be the use of space technology to intensify and improve water management through saving a larger proportion of rainwater in aquifers. The professional capabilities already exist in national centres specialized in accessing and analysing space data. Applying such technology on a large scale calls for a combination of analysis of data and the proposing of simple practical solutions.

(c) *Activity 3*

The third activity may be directed at rural and local development. That could be the promotion of the concept of graduate programmes, master's degree level, to train professionals capable of assisting entrepreneurs to develop and operate a wide range of simple technologies that are useful in rural areas and in municipalities. The departments that are established in universities for that purpose have to be staffed by qualified academics with useful expertise based on field research.

2. *Second phase: proposed activities*

Phase two could switch projects to other areas, including such activities as set forth below.

(a) *Activity 1*

The ESCWA TC could initiate a programme to draw attention to outsourcing. The first part of the programme would be to investigate the likely problems that would arise in the process of outsourcing, the benefits that will be derived and the support systems needed to enable the formation of efficient and successful SMEs. That would then be followed by Expert Group Meetings presenting the findings to industrial firms and management consultancies to enable them to offer their services to carry out the work in companies that desire to adopt the proposed approach.

Depending on the resources of the Centre, the scope of work could be limited to one industry or two. The largest industries in the Arab world where outsourcing would be important are the public sector and the oil, gas and petrochemical industries, as well as cement, iron and steel.

(b) *Activity 2*

The ESCWA TC could promote the application of space technology to improve the use of land resources, and the selection of appropriate agronomic technologies. Alternatively, the Centre could focus on some other systemic problems in agriculture.

(c) *Activity 3*

The ESCWA TC could attract attention to the issue of labour productivity. The Centre could focus on the supervision aspect of labour productivity that derives from effective management and/or on skills certification and formation. That activity should be integrated with the restructuring of the construction market to become more amenable to using local and regional labour. Such a programme would involve national Governments undertaking to invest in the improvement of labour training and skills certification to increase labour mobility and employment.

From the information presented in the Pre-feasibility Study, it is clear that the construction industry in ESCWA member countries needs considerable number of skilled workers, and that those are not being trained or their training is not being constantly improved to raise their productivity. Raising labour productivity is essential in order to facilitate the wage increases necessary to make those occupations attractive to local and regional labour.

3. *Third phase: proposed activities*

In phase three, the ESCWA TC would have attained sufficient first-hand knowledge of the region that it could add the activity of promoting projects that are designed to benefit from random cooperative behaviour, as discussed under Track 4.

(a) *Activity 1*

Self-organized criticality may be applied to rural areas where there are a multitude of relevant technologies which can be easily communicated to centres of diffusion. The Centre could introduce training programmes for staff and senior students in rural schools and technical institutes, staff at rural municipalities, small shop-keepers and others to use and diffuse such information.

Similarly, the method could be applied to provide farmers with up-to-date information that may be useful to forming cooperatives, benefitting from knowledge of the latest market prices and learning about transport cost to wholesale markets. Furthermore, self-organized criticality may be applied to assist non-governmental organizations (NGOs) to improve their performance and diffuse their findings.

(b) *Activity 2*

The ESCWA TC could identify specific problems in repair and maintenance, as well as in the manufacturing of spare parts, in specific industrial sectors with a good regional market. The Centre would then generate methods to acquire the technologies to build on existing capabilities to benefit from market possibilities.

D. COST OF THE BOARD OF GOVERNORS

A minimum of three members of the board of governors would initially have to work full-time for up to one year toward the establishment of the ESCWA TC and its operations. That commitment from the board should cover the first three to four years until the Centre is fully operational and has established a substantial track record.

There is the added cost of holding about four board meetings a year. ESCWA will need to decide whether to award an honorarium to the members of the board.

The board will commission a number of activities, ranging from the setting up of the internal management system to helping with the recruitment of the executive director. Those costs may be debited directly to the ESCWA TC and not included in the budget of the board.

In the estimated budget, illustrated in table 11, provision is made for travel costs and honoraria for the members of the board. Additionally, a sum of $250,000 has been earmarked for the operational costs that the board members will initiate during the first phase. Those will include the design and establishment of internal management systems, including accounting and auditing, and the designing of physical facilities, information services and recruiting services, among others. Even though some of the management systems could be adapted from United Nations models, the ESCWA TC would still need some advice on how to select and adapt the most appropriate systems and train its staff in their use. Some of those consulting fees may be due to various United Nations agencies instrumental in undertaking that work.

VIII. REVIEW OF PROFILE OF SIMILAR ENTITIES

The APCTT originated as the Regional Centre for Technology Transfer (RCTT), established by ESCAP in Bangalore, India, on 16 July 1977. At the forty-first session of ESCAP, RCTT was renamed the Asian and Pacific Centre for Technology Transfer of Technology under the terms of the statute adopted at that session. To simplify the presentation below, RCTT will be referred to as APCTT throughout.

APCTT was relocated from Bangalore to New Delhi in 1993. The host country agreement according the Centre the status of a United Nations institution with the applicable immunities and privileges was formally signed by ESCAP and the Government of India on 7 April 1994.

ESCWA commissioned a study of the experiences of APCTT over a period of thirty years, with a view of benefiting from that experience. It is noteworthy that ESCAP was the only regional agency of the United Nations to establish a regional technology centre in 1977.

The experience of APCTT will be reviewed along the following themes: (a) finance and institution-building; (b) objectives of the organization; (c) programmes adopted and types of activities; and (d) lessons that may be learned.

A. FINANCE AND INSTITUTION-BUILDING

At the time of establishment in 1977, it was estimated that the total budget for the first five years of operations would be $6.5 million. However, due to financial constraints, those funds were not available. Yet, the Centre was founded and provided with limited resources; though, a director could not be appointed until 1982.

Clearly, a weak financial base was damaging to a nascent organization. In the succeeding years, the fortunes of APCTT varied from period to period, depending on rather small donations which permitted limited activity. Those fluctuations in financial resources persisted, and meant that APCTT found it very difficult to maintain a permanent core staff so essential to the development of its objectives.

Until 1985, APCTT activities were guided by a series of meetings of national focal points and such funding agencies as UNDP and other United Nations organizations, and the Governments of Australia, Japan and the Netherlands. ESCAP committees on industry, technology, human resources and the environment, as well as intergovernmental meetings gave overall policy directions to the Centre; however, there was a multiplicity of input as a result of having no director to oversee the integration and coordination.

Ever since the adoption of the APCTT Statute in 1985/1986, the management and implementation of work was reviewed by the Governing Board, constituted in 1986, and the Technical Advisory Committee.

APCTT sought to develop through the active participation of the focal points of affiliated member states. Thus, APCTT functioned as a project centre. When funding was available, it was possible to organize workshops at those member organizations and to publish reports and studies.

In 1978, the meeting of the national focal points identified the following priority areas:

(a) Food and agriculture: agro-waste utilization, rice husk ash cement, processing of essential oils and medicinal plants, and post-harvest and packaging technologies;

(b) Industry: low-cost automation and machine tools, metal processing, leather, textiles, ceramics and handloom;

(c) Housing: rice husk ash cement;

(d) Energy: mini-hydro, biogas, wind, solar and coal;

(e) Natural resources: mineral processing;

(f) Health: food fortification and family planning.

Clearly, the themes that were adopted, though all important, were still fragmentary and did not include any strategic and systemic objectives. The Centre lacked the organizational leadership and the capacity to set goals.

The Centre found it difficult to collect even modest subscription fees from its members and, in 1990, staff members were on monthly contracts.

In the early 1990s, budgetary constraints, particularly for institutional support, led ESCAP to look for countries that could provide finance for the post of director and also support the programmes. While that solved the budgetary problems, it brought in other issues, for example the APCTT programmes became more donor-driven than needs-driven. That experience is particularly important to note. It is critical that the ESCWA TC should be properly funded in a long-term and stable manner, in order that it is able to secure qualified staff and be enabled to develop a stable and strategic programme for ESCWA member countries.

B. OBJECTIVES OF THE ORGANIZATION

As noted above, the initial objectives of the APCTT were fragmented. They were the results of the deliberations of the representatives of the focal points of member States. It was in the early 1980s that the Centre began to have sufficient resources to appoint a director. The emergence of a central leadership progressively evolved an institutional objective when, by 1984, the following objective was set for APCTT: to strengthen the capabilities of developing countries of the ESCAP region in technology transfer and development;

To be achieved through:

(i) Improving policy and institutional infrastructure dealing with technology;

(ii) Enhancing the capabilities for assessment, choice, negotiation, application and assimilation of imported technologies;

(iii) Fostering linkages between the production sectors and research and development units engaged in the adaptation of imported technologies, as well as the production of endogenous technologies;

(iv) Streamlining the system of collection, processing and dissemination of technological information.

Though by 1984, there was a moderate improvement in the financing of APCTT, it was not sufficient to enable the organization to pursue the objectives it set in a sustainable manner.

C. PROGRAMMES ADOPTED AND TYPES OF ACTIVITIES UNDERTAKEN

The activities of APCTT consist in organizing workshops and publishing manuals. For example, the Centre has published a reference manual for national technology policymakers and planners, which discussed in detail lessons learned from the experiences of various countries, and grouped them under the following five broad aspects:

(a) Technology as a key for development;
(b) Critical problems and important issues;
(c) General framework and overall setting;
(d) Technology policy formulation and planning;
(e) Integrated technology planning.

In 1987, country studies on technology policies and planning were extended to cover Australia, the Republic of the Fiji Islands, the Islamic Republic of Iran, Papua New Guinea and Viet Nam.

To develop a decision support tool for STI policymakers at different levels, APCTT initiated the Technology Atlas project for Asia and the Pacific in 1986, funded by the Government of Japan. Phase I of the project resulted in the following major output over two years:

(a) Methodology for assessing the status of technology;
(b) Methodology for assessing national technological capabilities;
(c) Methodology for assessing national technological needs.

From 1994 to 2002, the Centre received generous institutional and programme support from the Government of Germany. During that period, APCTT greatly expanded its activities and cooperation. It has developed a new-generation business portal for technology-led SMEs in Asia and the Pacific[41] to facilitate effective and focused communication and interaction among entrepreneurs, investors, technologists, business development experts and policymakers, including e-coaching and e-learning services, as well as databases for matching prospective technology and investment partners. It also serves as a reference source on innovation management for business executives and business facilitators.

The restructuring of the programme of work of ESCAP in 2001 under three themes, namely, poverty reduction, managing globalization and addressing emerging social issues, led to an external evaluation of APCTT for reorienting its work in line with those priority themes. Those events resulted in restructuring of the APCTT secretariat, with the post of director being funded through ESCAP, and redefining the focus of work. Current programme themes are integrated innovation management; application of new and emerging technologies, including environmentally-sound technologies; grassroots and rural development and women empowerment; value-added technology management services to SMEs; and the building of technology-specific regional networks. The Centre actively participates in the recent drive by the United Nations to align its regional activities for system-wide coherence entitled “Delivering as One”.

D. Lessons that may be learned from the APCTT experience

The ESCAP and ESCWA regions differ in a variety of ways. Their populations, resources, political cultures and specific needs are different. Yet, they are both developing areas, and they both need to acquire scientific and technological capabilities.

Both APCTT and the ESCWA TC aim to provide services to member countries to assist them to attain their developmental objectives. APCTT sought to achieve its objectives through supporting the development of national organizations and institutions. The present design of the ESCWA TC aims to achieve a similar purpose through providing services that enable ESCWA member countries to identify specific systemic obstacles and the policy and procedural means to overcome them. In that process, the ESCWA TC aims to collaborate in depth with national organizations and institutions and to collectively identify and design the appropriate measures. The ESCWA TC is designed to cooperate with staff members of national centres and firms specialized in problem solving. The Centre aims to maximizing their input, as well as facilitating their acquisition of the competences derived from each activity. In other words, those national centres and firms are expected to undertake repeat activities in the ESCWA region, rather than leaving that to the Centre.

The proposed approach should be effective in the ESCWA region because of extensive past investments in the formation of human capital, as well as the accumulation of a variety of technological capabilities currently embodied in large industrial complexes. Those capabilities are currently under-utilized, and one of the objectives of the Centre is to assist ESCWA member countries to identify and mobilize those dormant capabilities. The ESCWA TC will seek know-how from all regions of the world, and plan to benefit from those different experiences.

[41] Available at: http://www.technology4sme.net/.

IX. SELECTION OF HOST COUNTRY

The ESCWA TC host country is expected to provide the physical facilities, funding and acceptance of standard conditions for a United Nations organization, promote cooperation between the Centre and local organizations and, in general, have an infrastructure that facilitates the work and functioning of the Centre and its staff. Staff members will be frequent users of air travel, information services will require fast Internet connectivity, and visitors and participants in activities at the Centre will require accommodation and travel services. The legal status of the ESCWA TC and its staff should conform to those generally awarded United Nations agencies. Furthermore, the host country should be concerned in the development of its own national capabilities.

The following terms should be taken as a minimum. More importantly, the host country should provide an environment conducive to the sustainability of activities undertaken by the Centre, and offer an intellectually stimulating and friendly atmosphere where staff can secure useful support for their work.

A detailed list would include the following factors crucial to the ESCWA TC to be provided or facilitated by the host country:

(a) Appropriate physical facilities, in addition to awarding the Centre the right to own those premises and to expand them if required;

(b) Partial funding of the operation and activities of the Centre;

(c) Cooperation between the Centre and national organizations to be facilitated;

(d) Freedom of information, namely, the Centre to be free to import and export information by Internet, mail, fax and any other means;

(e) Freedom of movement of staff and visitors. The main activity of the Centre is concerned with meetings and travel of both staff and visitors; thus, there should be an absence of exit and entry visa requirements for staff, and it should be possible for visitors to enter and leave the host country;

(f) No customs fees on imports and exports by the Centre;

(g) Efficient communications services, including Internet, telephone, fax, mail and courier services;

(h) Access to an airport with good onward connections, and availability of hotel and restaurant facilities at reasonable prices;

(i) Access to local libraries for staff of the Centre;

(j) No interference in the recruitment and staffing of the Centre;

(k) Locally available servicing of equipment, as well as local suppliers of office equipment and supplies;

(l) Local availability of such technical services as computing, printing, publishing, design and others of importance to a research centre;

(m) Existence of one or more universities and academic institutions for cooperation with the Centre;

(n) Availability of multilingual local personnel for office work.

The following factors crucial to the staff of the ESCWA TC are to be provided or facilitated by the host country:

(a) Ease of travel to and from the host country for citizens of ESCWA member countries;

(b) Good medical services;

(c) Good schools and university facilities;

(d) Reasonable cost of living, including availability of good housing and household and food supplies at reasonable cost;

(e) Recreational activities;

(f) Legal possibility for spouse to accept employment in the host country;

(g) Availability of personal banking facilities and freedom of staff to transfer earnings;

(h) Possibility of staff and their families to continue to reside and accept alternative employment in the host country after leaving the Centre;

(i) Right of ownership of residential property and retention of that ownership after end of employment with the Centre.

With the ESCWA TC being a regional centre, the host country should extend the above privileges, when applicable, to users and visitors of the Centre, with unhindered access of the Centre available to ESCWA member country citizens.

ESCWA shall contact member countries and learn of their interest in hosting the Centre. Subsequently, ESCWA would then visit those countries that have expressed interest in hosting the Centre and discuss in greater detail the terms and conditions in order to determine the most suitable location.

Annex I

RESOLUTIONS ON ESTABLISHMENT OF THE ESCWA TECHNOLOGY CENTRE

A. RESOLUTION 254 (XXIII)

The Economic and Social Commission for Western Asia,

Noting United Nations Security Council resolution 54/201 concerning the effect of science and technology on accelerating development and on their status as one of the priorities of the United Nations; the report of the Secretary-General on strengthening the use of science and technology in achieving the Millennium Development Goals (MDGs) contained in the Millennium Declaration (E/CN.16/2004/2); and Economic and Social Committee report No. 68/2004 concerning the utilization of science and technology for the purposes of development,

Appreciating that the trend in the global economy is towards a knowledge-based economy that is built on science, technology and innovation as the foundation for competitiveness and the achievement of sustainable development goals at the national level; and the linkage between economic growth and the growth of the independent capacities of countries in fields relating to modern technology, and the transfer and adaptation of technology required for such growth,

Affirming that the generation of opportunities for employment and the reduction of poverty require high levels of economic growth and the diversification of sources of national revenue, which in turn require the provision of a solid basis of science, technology and technological innovation,

Taking into consideration the ESCWA initiative to activate the role of science, technology and technological innovation in achieving MDGs, which was adopted by the twenty-second session, and for the ideal accomplishment of which the establishment of a specialized institutional structure is required,

Noting that United Nations regional commissions have established special centres to assist member countries in their endeavours to build independent capacities in the fields of science and technology that have greatest priority for their sustainable development,

Appreciating the important role that must be assumed by a similar centre in the ESCWA region in assisting national efforts to build independent capacities in science and technology and to coordinate cooperation at the regional and international levels in building such capacities,

1. *Requests* the Executive Secretary to produce a detailed study, financed by extrabudgetary resources, on the establishment of a technology centre that would undertake activities aimed at building national technological capacities and harness those capacities in achieving MDGs and strengthening economic and social development and regional and international cooperation in technological fields;

2. *Also requests* the secretariat to submit that study to the ESCWA Consultative Committee on Scientific and Technological Development and Technological Innovation before submitting a report on the establishment of a technology centre to the twenty-fourth ESCWA session.

B. RESOLUTION 274 (XXIV)

The Economic and Social Commission for Western Asia,

Recognizing the role of science and technology in accelerating development and on their status as one of the priorities of the United Nations as indicated in General Assembly resolution 60/1 of 16 September 2005 on the 2005 World Summit Outcome, in the report of the Secretary-General on promoting the

application of science and technology to meet the Development Goals contained in the Millennium Declaration[42] and in Economic and Social Council resolution 2004/68 of 5 November 2004 on science and technology for development,

Referring to ESCWA resolution 254 (XXIII) of 12 May 2005 requesting the secretariat to submit a report to the twenty-fourth session on the establishment of a regional technology centre that would undertake activities aimed at building national technological capacities and at harnessing those capacities to achieve the Millennium Development Goals (MDGs) and to strengthen economic and social development and regional and international cooperation in technological fields,

Cognizant of the evolution of the global economy towards a knowledge-based economy that is built on science, technology and technological innovation as the foundation for competitiveness and the achievement of sustainable development goals at the national level, particularly with regard to the creation of opportunities for generating employment and the reduction of poverty,

Taking note that some regional commissions of the United Nations have established special centres to assist their member countries in the endeavours to build independent capacities in the fields of science and technology to which they accord priority for achieving sustainable development,

Recognizing the need for such a centre in the ESCWA region to assist national efforts to build capacities in science and technology and to coordinate cooperation at the regional and international levels,

Bearing in mind the pre-feasibility study on the establishment of the ESCWA Technology Centre[43] and on the recommendation of the Consultative Committee on Scientific and Technological Development and Technological Innovation at its third meeting, held in Beirut on 6 and 7 March 2006, which supported the establishment of the ESCWA Technology Centre,

1. *Approves*, in principle, the establishment of the ESCWA Technology Centre as defined in the pre-feasibility study;[44]

2. *Requests* the secretariat to follow up with member countries with respect to the hosting of the Centre and securing its sources of finance;

3. *Also requests* the secretariat to take the necessary actions aimed at establishing the Centre and to submit a report to the twenty-fifth session of the Commission in that regard.

[42] E/CN.16/2004/2.

[43] E/ESCWA/ICTD/2006/WP.1.

[44] Op. cit.

Annex II

MEASURES FOR POVERTY ERADICATION

This annex presents a number of tested and powerful technologies that may be readily applied in the ESCWA region to contribute to the eradication of poverty.

A. REMOTE SENSING, GEOGRAPHIC INFORMATION SYSTEMS AND ICT

Remote sensing, geographic information systems (GIS) and ICT generate information at low cost, speed the delivery of relevant information, contribute to risk reduction, improve use of land and water resources and contribute to the classification of soil resources. Those technologies would also monitor the environment in real time, assist in optimizing aquifer recharge and, simultaneously, provide consistent information for several levels of decision makers ranging from farmers to ministers.

The National Aeronautics and Space Administration (NASA) initiated the practical application of remote sensing technology in the 1970s by sponsoring the Large Area Crop Inventory Experiment (LACIE). The project diffused the use of Landsat images to evaluate soils, water use, plants and projected crop amount. It succeeded in engaging farmers and companies, and from that time on, the private sector in the United States of America took over those activities. Many other countries developed and applied the same technologies. One example is India which, through the Indian Space Research Organisation (ISRO), developed the use of those technologies to attain self-sufficient food production in less than twenty years.

In 1995, Canada established the System of Experts for Intelligent Data Management (SEIDAM) to respond to queries about its forests, the country's most important renewable resource, and the environment in general. For monitoring, SEIDAM integrated satellite and airborne remote sensing data with GIS using multidisciplinary knowledge.[45] Within the Middle East and North Africa (MENA) region, there has been substantial movement towards benefiting from remote sensing.[46] The technology for applying remote sensing and GIS combined with ICT to the farm level is now available. However, such technology still has to be Arabized to make it understandable to Arab farmers. Although many Arab countries have established facilities for analysis of remote sensing, full use of those capabilities has yet to be made. The substantial advances in distance learning and IT of the past thirty years should facilitate the production of materials that are immediately understandable and usable by farmers and extension services personnel. The establishment of institutional facilities for acquiring, adapting, Arabizing and integrating IT, including artificial intelligence, with remote sensing and GIS remains to be done.

A search of the literature during a five-year period revealed 63 relevant publications on the application of remote sensing and GIS technologies in the MENA region. Those publications refer to a whole range of relevant aspects covering the assessment of soil salinity, soil classification, management of aquifers, rainfall harvesting and management, and many others.

Such publications fall in the areas of watershed management, macromeasures for aquifer protection and management and control of polluting agents and activities. They also research the construction and management of irrigation systems, soil surveys and soil management and provide integrated and systematic services to farmers where seed selection is related to soil analysis and water supplies, along with weather forecasts and others. An improvement in the management of any of those areas should result in positive

[45] A.K. Bhogal and others, "SEIDAM for forestry: intelligent fusion and analysis of multi-temporal imaging spectrometer data", paper presented at the Twenty-sixth International Symposium on Remote Sensing of Environment: Information Tools for Sustainable Development, held in Vancouver, Canada, 25-29 March 1996.

[46] Farouk El-Baz, *The Arab World and Space Research: Where do we stand?* Emirates Lecture Series No. 14 (The Emirates Center for Strategic Studies and Research, Abu Dhabi, 1998).

economic benefits to rural areas. Substantial improvements could be achieved through the effective utilization of such technologies.

Forty-eight per cent of the 63 publications that were found were undertaken at universities in Europe and the United States of America, with 5 per cent, namely, three publications, carried out by FAO, the International Center for Agricultural Research in the Dry Areas (ICARDA) and the Kuwait Institute for Scientific Research (KISR). Some members of the research teams in Europe and the United States of America were Arabs. The remaining publications were from Egypt, 25 per cent; Jordan, 3.2 per cent; Lebanon, 6.4 per cent; Morocco, 8 per cent; the Syrian Arab Republic, 3.2 per cent; and Tunisia, 1.7 per cent. Those publications exclude research falling outside the ESCWA region. For example, the Algerian Laboratory of Remote Sensing at the National Centre of Spatial Techniques in Oran has done interesting research on the management of pastoral activities in the semi-arid Algerian steppe. The researchers have successfully combined remote sensing and GIS methods to identify causes of degradation and improve grazing.[47]

The 63 publications showed little duplication in the type of research work between countries, yet most studies had relevance to the Arab region. For example, a research project on the use of remote sensing for assessing water quality was undertaken in Egypt, and that technology is of value to all Arab countries.[48] Similarly, a project undertaken in France on combining the General Systems Theory with GIS to the study and management of soils in Tunisia is also of general importance.[49]

At the moment, there is no effective mechanism for diffusing that knowledge within the region; hence, it is unlikely that the benefits of the research will accrue to the entire region. The pattern in many developing countries has been to "reinvent the wheel", rather than to cooperate and remain abreast of developments elsewhere. Since 50 per cent of the research in question was undertaken in the Arab world, Arab scientists will need to cooperate and communicate on a national, regional and global scale. The total number of Arab scientists involved in remote sensing and GIS technologies may be around 200. As those technologies will become of greater use in the region, the number of scientists will increase. The development of effective methods to communicate within the region will contribute to the diffusion of those technologies.

B. TECHNOLOGIES FOR WATERSHED, AQUIFER AND BASIN LEVEL MANAGEMENT

Remote sensing technologies provide economic and efficient methods for monitoring large areas that have a very low population density, and remote sensing techniques have been demonstrated to yield useful information on water resources in arid regions. Many of the recent publications focus on the monitoring and management opportunities that remote sensing and GIS provide. Since 1997, there has been considerable research on those topics, and if those technologies are adapted and applied, they should make a significant contribution to the macromanagement of water resources.

The application of the combined technologies of remote sensing and GIS has instituted wide use. A geological analysis of a region provides clues of fractures which could facilitate aquifer recharge in time of flash floods. For example, satellite imagery was used to manage rainfall in a specific coastal region of the Republic of Syria through better utilization of faults, fissures and fractures. The findings allowed the

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[47] See, for example, Z. Smahi and A. Bensaid, proceedings of the Twenty-seventh International Symposium on Remote Sensing of Environment: Information for Sustainability, held in Tromso, Norway, 8-12 June 1998.

[48] Kh. Dewidar and A. Khedr, "Water quality assessment with simultaneous Landsat-5 TM at Manzala Lagoon, Egypt", *Hydrobiologia*, No. 457 (Kluwer Academic Publishers, the Netherlands, 2001) pp. 49-58.

[49] E. Braudeau and others, "The soil-SRIS for the irrigated area of Cébala", *La gestion des périmètres irrigués collectifs à l'aube du XXIe siècle, enjeux, problèmes, démarches: actes de l'atelier du Pcsi, 22-23 janvier 2001* (Montpellier, France, 2001) pp. 225-245 (in French). The General Systems Theory was developed by Ludwig Von Bertalanffy and states that the whole may be more than the sum of its parts.

management to follow rainfall and collect the water behind dams and in lakes, and/or to recharge aquifers.[50] The research was undertaken at the Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD) in cooperation with Damascus University. Remote sensing could substantially increase aquifer recharge in areas with erratic rainfall patterns.[51]

C. CHOICE OF CROPS, SOIL CLASSIFICATION AND LAND MANAGEMENT

FAO has developed Ecocrop, the crop environmental requirements database, to assist in the choice of plants suitable for specific soils and climates. A combination of Ecocrop with remote sensing and GIS technologies introduces a powerful system that provides technical support to the farming community, reducing the cost of determining optimal use of particular soils and water supply.

Improvement to the technology with specific reference to Tunisia has been carried out,[52] while work done in Egypt on Wadi el-Natroun has resulted in the identification and classification of sub-areas in this region. Assessment of spatial variability of land and management of sugar beet planting was the object of research there, and the study made a range of recommendations concerning soil salinity, drainage and ploughing.[53] Through the use of remote sensing and land information systems to map an area of 3,000 square kilometres in the Egyptian south-eastern desert, it was established that the region was suitable for sustainable development.[54]

The literature shows that expertise in the Arab world for employing effectively remote sensing and GIS techniques for a variety of uses already exists. The challenge is to expand and diffuse those capabilities.

D. CLIMATE FORECASTS

Climate has become increasingly important in development planning. Climate forecasts are important to prepare for floods, droughts and the timing of planting in relation to rain-fed agricultural areas, and for aquifer recharge. Although it is impossible for countries to completely protect themselves against the ill effects of droughts and floods, they could be better prepared in reducing the extreme effects.[55] Some Arab countries have been taking steps to reduce the impact of some types of floods they had been exposed to in the past. For example, the High Dam in Egypt was instrumental in protecting the country from droughts experienced in Ethiopia and in tropical Africa.

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[50] A. Bilal and O. Ammar, "Rainfall water management using satellite imagery - example from Syria", *International Journal of Remote Sensing*, vol. 23, No. 2 (Taylor and Francis, London, 2002) pp. 207-219.

[51] See E. Bou-Zeid and M. El-Fadel, "Climate change and water resources in Lebanon and the Middle East", *Journal of Water Resources Planning and Management*, vol. 128, No. 5 (American Society of Civil Engineers, Reston, VA, United States of America, September-October 2002) pp. 343-355. Also see F.A. El-Awar and others, "A hydro-spatial hierarchical method for siting water harvesting reservoirs in dry areas", *Applied Engineering in Agriculture*, vol. 16, No. 4 (American Society of Agricultural and Biological Engineers, St. Joseph, MI, United States of America, 2000) pp. 395-464. The authors develop a method for siting water and harvesting reservoirs in dry areas, with research work undertaken at the American University of Beirut (AUB).

[52] See: E. Braudeau and others, "The soil-SRIS for the irrigated area of Cébala", *La gestion des périmètres irrigués collectifs à l'aube du XXIe siècle, enjeux, problèmes, démarches: actes de l'atelier du Pcsi, 22-23 janvier 2001* (Montpellier, France, 2001) pp. 225-245 (in French).

[53] M. Bahnassy and others, "Utilizing GIS/RS/GPS for land resources assessment of Wadi el-Natroun, West Delta Fringe, Egypt", *Alexandria Journal of Agricultural Research*, vol. 46, No. 3 (University of Alexandria, Alexandria, Egypt, 2001) pp. 155-165.

[54] S.I. Abdel Rahman, A.Gad and M.A. Abdel Rahman, "Soils and agriculture potentialities of Marsa Shaa'b area, south eastern desert of Egypt: an integrated RS and LIS approach", *Egyptian Journal of Soil Science*, vol. 40, No. 3 (2000) pp. 305-316.

[55] Z.W. Kundzewicz and others, "Coping with variability and change: floods and droughts", *Natural Resources Forum* 26, United Nations Department of Economic and Social Affairs, Division for Sustainable Development (Blackwell Publishers, Oxford, United Kingdom of Great Britain and Northern Ireland, 2002) pp. 263-274.

Use of short and long-term climate forecasts is becoming increasingly important, and effective use of such forecasts to protect agricultural production depends on close cooperation between decision makers and scientists in diverse fields.[56] Weather forecasts, together with expert opinion, could enable farmers in rain-fed areas to better utilize the combination of weather conditions, seed selection and optimal agronomic practice. Such practices are widely used in developed countries to combat the deleterious impact of variable weather conditions.

E. BIODIVERSITY

The Middle East is known to be the original host of many of the plant and animal species in economic use today. Thus, it has been a rich source of valuable species and biodiversity. Both arid zones and coastlines provide a valuable diversity of unique plants and animals. The full study and classification of those life forms is a challenge and, to date, the task of classification is not complete. The study of biodiversity can be combined with the documentation of traditional knowledge,[57] which would reinforce two vital activities.

Fragmentary efforts have been made to compile and assess traditional medical herbs and plants. The introduction of new plants is going on at a high pace. It is important that attention be given to collateral damage to rare species. A 1995 FAO report provides detailed account of the seriousness of the current situation.[58]

An examination of the literature in the Arab countries shows that there is inadequate attention devoted to the subject of biodiversity and molecular biology in research activity.

F. GENETIC ENGINEERING: GENETICALLY MODIFIED SEEDS AND FOOD

The farmers in the Arab world would be severely affected, both directly and indirectly, by developments in genetic engineering. The longer the region remains marginal to research in genetic engineering and molecular biology, the deeper the negative impact.

Genetically modified (GM) food and seeds are major items of international controversy. There is disagreement concerning the safety of using GM food, although the United States of America has authorized such use. There are also disagreements concerning the environmental impact of GM seeds; the destruction of plant diversity is one generalized fear.

On the subject of utilization, economic fears exist of becoming hostage to multinationals, which have a monopoly on the supply of GM seeds. The use of self-destruct seeds will force farmers to purchase new seeds each year. That will deepen the dependence of farmers and their countries on multinational companies. The bestowing of intellectual property rights to protect ownership of plant genes has been controversial. In 2001, an international agreement was secured, although both the United States of America and Japan abstained.

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[56] H.S. J. Hill and J.W. Mjelde, "Challenges and opportunities provided by seasonal climate forecasts: a literature review", *Journal of Agricultural and Applied Economics*, vol. 34, No. 3 (Southern Agricultural Economics Association, University of Georgia, Athens, GA, United States of America, 2002) pp. 603-632.

[57] S. Laird (ed), "Biodiversity and traditional knowledge: equitable partnerships in practice", *People and Plants Conservation Series* (Earthscan Publications, London, 2002).

[58] FAO, *Report of the Sub-regional Preparatory Meeting for the Mediterranean*, FAO International Technical Conference on Plant Genetic Resources, Tunis, 16-19 October, 1995.

G. Vegetative micropropagation

Several Arab countries have developed vegetative micropropagation through tissue culture for a select number of trees. High-yielding and disease-resistant palm trees have attracted special attention in Saudi Arabia, as well as in Algeria, Morocco and Tunisia, and there is great scope for further applications in that field.

H. Geothermal and renewable sources of energy

Rural development cannot proceed far without sources of low-cost energy. Pumping and moving water depends on a source of energy. Similarly, all farm and home activities today depend on a supply of electricity. There are many remote areas in the Arab world where low-cost fossil fuels are not readily available. It should be possible to develop other sources of energy in impoverished and remote regions, including geothermal, wind and solar energy, as well as harnessing energy from waterfalls.

I. Civil engineering

Civil engineering and construction materials are essential tools of development; in fact, it is very difficult to undertake any serious large-scale work without their use. Civil engineers are needed to undertake surveys, level and terrace land, design and construct irrigation systems, construct dams, charge aquifers and construct dwellings.

The Arab world is well endowed with civil engineers and large numbers of them are unemployed in urban centres. However, there has never been an effort to develop their expertise to respond to the specific challenges and needs of rural areas.

Annex III

INVESTMENT IN CONSTRUCTION

The figure of $2 trillion worth of investment in the Arab world is presented merely to indicate the scope of the imagination of investors and of government officials in the ESCWA region. The GCC subregion alone has $1.7 trillion worth of real estate being planned or in the process of being constructed.[59]

According to a study undertaken by the Arab Petroleum Investments Corporation (APICORP), the Arab countries are planning to invest $220 billion in energy projects during the period 2006-2010.[60] The investment made in industrial projects by the GCC countries during 2006 was $118 billion, of which $70 billion in chemical and petrochemical projects.[61]

Some of the projects noted by the media will not materialize while most of those that are implemented will take several years to be completed. Hence, GFCF associated with those projects will be a fraction of the $2 trillion; yet, that fraction, possibly $500 billion, will be substantial according to the historical record of the region.

The figure of $2 trillion is thus an estimate based on the various programmes being discussed by officials, the business community and the media. It was derived at through studying the following sources:

(a) The Saudi Arabian General Investment Authority (SAGIA) having facilitated over $300 billion worth of investments from German investors;[62]

(b) The need of Saudi Arabia to invest $200 billion into its water industry over the following twenty years to meet demand;[63]

(c) The need of the Saudi Electricity Company of $50.6 billion in further investments until 2015 to meet projected demand;[64]

(d) The Ras Tanura Integrated Project for chemicals and plastics production in Saudi Arabia estimated at $20 billion;[65]

(e) The Kuwait National Petroleum Company tender for a 615,000 barrel-per-day oil refinery at Al Zour, estimated to cost $12 billion.[66]

The above examples cover only a fraction of ongoing investments. Excluded are projected investments in transport, the cement and iron and steel industries, and in agriculture and food production.

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[59] Robert Ditcham, "Cement Prices Bring Smiles to Producers, Tears to Others ", *Gulf News* (30 June 2007), available at: http://archive.gulfnews.com/articles/07/06/30/10135880.html.

[60] *OAPEC Monthly Bulletin*, "Evolutions of investments in the Arab energy industry: challenges and prospects", editorial (July 2006) p.1.

[61] Shakir Husain, "Investment in chemicals rise", gulfnews.com (15 June 2007), available at: http://www.gulfnews.com/business/Oil_and_Gas/10132446.html.

[62] Habib Shaikh, "SAGIA attracts $300b German investments", *Khaleej Times* (6 June 2007), available at: http://www.khaleejtimes.com/DisplayArticlesNew.asp?section=business&xfile=data/business/2007/june/business_june148xml.

[63] Adam Dawson, "Saudi water industry needs $200bn", *ArabianBusiness* (30 May 2007), available at: http://www.arabianbusiness.com/index.php?option=com_content&view=article&id=13563&tmpl=component&Itemid=1&page=.

[64] "Saudi Arabia needs SR190bn investment in electricity to meet rising demand", *Arab News* (18 June 2007), available at: http://www.menafn.com/qn_news_story_s.asp?Story1d=109315661.

[65] Carl Gutierrez, "KBR soars on Dow/Aramco contract", *Forbes.com* (12 July 2007), available at: http://www.forbes.com/markets/2007/07/12/kbr-dow-aramco-markets-equity-cx-cg-0712markets25.html.

[66] "Kuwaiti firm issues tender for 615,000bpd refinery", *Gulf News* (18 June 2007), available at: http://archive.gulfnews.com/articles/07/06/18/10133131.html.

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