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**ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA**

# Objectives of a Lebanese S&T Policy Based on Socio-Economic Needs (R & D Priorities)

## August 2003

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[*] *The views expressed in this report are those of the authors and do not necessarily reflect those of the United Nations Economic and Social Commission for Western Asia (UN-ESCWA).*

**Contents**

## ANNEXES

## TERMS OF REFERENCE

Several discussions have been held between the Lebanese National Council for Scientific Research (LNCSR) and ESCWA about the involvement of ESCWA in the development of a new Science, Technology and Innovation Policy for Lebanon. The following TOR have been formulated by the Secretary General of CNRS, Mr. Mouin Hamzé, in his letter to Ms. Mervat Tallawy the Executive Secretary of ESCWA, dated 1 February 2003:

*" I am pleased to inform you that the National Council for Scientific Research- CNRS - in cooperation with UNESCO and ALECSO is in the process of developing an advanced Lebanese science, technology and innovation policy- STIP- fully integrated with overall economic and social policies and objectives. The participation of ESCWA in this project is essential and highly appreciated.*

*With regard to past ESCWA efforts in relation to national S and T policy formulation and in particular recognition of more recent ones aimed at providing technical assistance by ESCWA experts (Messrs. Mohamad Mrayati, Omar Bizri, and Mansour Farah), we would much appreciate ESCWA participation in the current national policy formulation exercise conducted by the National Council for Scientific Research in Lebanon, in collaboration with the UNESCO Paris office.*

*I would like to emphasize that this exercise will have important repercussions for future socio-economic development and will involve the implementation of the following sectors or domains:*

1. *Basic sciences, Industrial technology, Engineering sciences;*
2. *Medical Sciences and Public Health;*
3. *Environmental sciences, Agriculture and Biological sciences.*

*The assistance of the above experts together with other ESCWA experts you may wish to suggest would be greatly appreciated particularly in:*

1. *Assisting the three teams (of the three sectors or domains) in carrying out the relevant socio-economic strategic analyses to identify specific strategic Lebanese objectives as a starting point for proposing research, HRD and dissemination priorities and activities;*
2. *Making available the information and data on: mechanisms that link R&D to industry and on S&T indicators in general, for the three sectors or domains. Helping in the establishment of a sustainable and institutionalized approach for gradually collecting the relevant S&T data on the Lebanese national innovation system;*
3. *Introducing the element of entrepreneurship as a drive in the Lebanese national innovation system, (with Dr. Gilbert Frade from École des Mines in Paris and Mr. Peter Tindemans from UNESCO);*
4. *Advising on information and communication technology infrastructure supporting research and higher education.*

*I am looking forward to ESCWA's agreement to our proposal and hereby reiterate my appreciation of ESCWA's contribution to this project."*

# PART I

## INTRODUCTION

The world economy is undergoing a dramatic transformation as countries move to an economy driven by technology industries and the application of new technology in traditional industries. To compete in this "new economy," states must have an economic base of firms that constantly innovate and maximize the use of technology in the workplace. Also critical is a strong research and development (R&D) base that can provide these technology-intensive companies with access to state-of-the art research, researchers, and research facilities.

### Elements of a Lebanese Technology–Based Economy

A technology-based economy requires:

1- A strong intellectual infrastructure, such as universities and public or private research laboratories that generate new knowledge and discoveries; Lebanon could have a comparative advantage in this respect;
2- Efficient mechanisms through which knowledge is transferred from one person to another or from one company to another;
3- Excellent physical infrastructure, including high-quality telecommunications systems and affordable, high-speed Internet connections;
4- A highly skilled technical workforce; and
5- Good sources of capital.

Each element has a direct impact on the Lebanese's R&D base and, therefore, on its ability to support a technology-based economy. Many countries are building their R&D base through initiatives that address these elements.

In recent years, Singapore, South Korea, and Taiwan have made tremendous strides in building a technology-based economy. South Korea and Taiwan, both major suppliers of computer components and equipment world wide, dramatically increased their patent activity in the late 1980s, and they continue to aggressively pursue technology commercialization. Singapore is making substantial investments to promote a climate for innovation. Through its National Innovation Framework, Singapore's National Science and Technology and Economic Development Boards have committed $2 billion during the next five years to support the development of industry-driven R&D. These funds will be used to build infrastructure, support university-industry collaboration, recruit and develop R&D-trained personnel, and commercialize technology. Taiwan's Industrial Technology and Research Institute, a government-funded, nonprofit intermediary organization, seeks to bridge the gap between university research and industry needs by coordinating research, analyzing industrial trends, conducting market assessments, and gathering global competitive intelligence. While Singapore and Taiwan are positioning themselves to participate fully in the technology-based economy, other countries, such as Ireland, have clearly established themselves as key competitors. Ireland succeeded in attracting a large number of multinational information technology and electronics corporations, and is now seeking to grow its base of technology companies, with an emphasis on software development. A key strategy is building a strong R&D base in its universities and businesses. Its National Research Support Funding Board administers grant programs that fund basic research and joint industry-university projects. Ireland also has made a commitment to encourage Irish industry to invest in R&D. The Research Technology and Innovation Initiative, launched in late 1997, provides grants to Irish companies meeting certain criteria to cover between 35 percent and 50 percent of the costs incurred for a research project, depending on its size.

Clearly, policymakers around the world are developing strategies to take advantage of the technology-based economy. Areas that thrive will boast a strong and vibrant research and development base. For Lebanon to develop that base, it must understand what sectors comprise the Lebanese R&D base and what elements are needed for a technology-based economy.

# I. MAJOR LEBANESE SOCIO-ECONOMIC ISSUES

The base of socio-economic statistical information in Lebanon needs new efforts to be comprehensive, updated, coherent, and sustainable. This informational base was seriously eroded in Lebanon during the civil war (1978-1991). The Central Administration for Statistics (CAS), which started functioning in 1993, has been actively trying to create this base. The LNCSR could take the initiative to create such a base for S & T indicators, and for Knowledge-Based Economy (KBE) indicators in general. A proposition for creating such a base is suggested at the end of this report.

Indicators of the KBE are tools to facilitate effective decision-making. They help in measuring sustainable development through:

- Improving the quality of information and simplifying its interpretation and management;
- Assessing environment and development trends overtime and in relation to goals and targets.

Such indicators are essential to:

- Provide information to the general public as well as early warning information;
- Help quantify the situation, highlight its significance, monitor progress and changing trends;
- Help simplify the data and present it in a form directly relevant to the problem being addressed;
- Guide decision-makers to the status of the current priorities;
- Enable decision-makers to evaluate and compare the implications of their policies/choices;
- Facilitate external scrutiny of decisions and policies, thus ensuring transparency and accountability.

Due to the lack of availability of consistent and coherent indicators, we were obliged to get such information from different sources, mentioned in the reference at the end of the report, including Ministry of Industry (MoI), Ministry of Education (MoE), Ministry of Environment (MoE), ESCWA, United Nations Development Programme (UNDP), and the Economist Intelligence Unit (EIU).

The table in annex -1- shows key indicators for the socio-economic status in Lebanon, covering the last two years. Major points of concern are: high unemployment rate, high debt, negative industrial and manufacturing growth rates, negative national saving rate, high budget deficit, high deficit in balance of trade, and low FDI. For all these issues S & T and innovation play a very important role, especially with the trend towards the KBE. On the other hand, Lebanon has many points of strength, opportunities and comparative advantages: Lebanon has one of the highest literacy rates in the region with advanced human resources and human capital. It enjoys free open market economy. The banking system used to be one of the richest in the region with the possibility to finance important local development initiatives and programs. Tourism sector used to be one of the most important in the region as Lebanon is the gate of the Middle East to the West with an important cultural legacy, historic cities, archeological sites, and natural recreation sites. Lebanon could be, and used to be, an attractive center for higher education in the region, with high ranking universities and colleges. Medical and health services could also become an important economic sector. Agro-industry has a potential for improvement. Finally, the most important potential and opportunity are revitalizing the existing industrial sector and creating new Knowledge-Based Industries. In all these opportunities and needs R & D could play a major role.

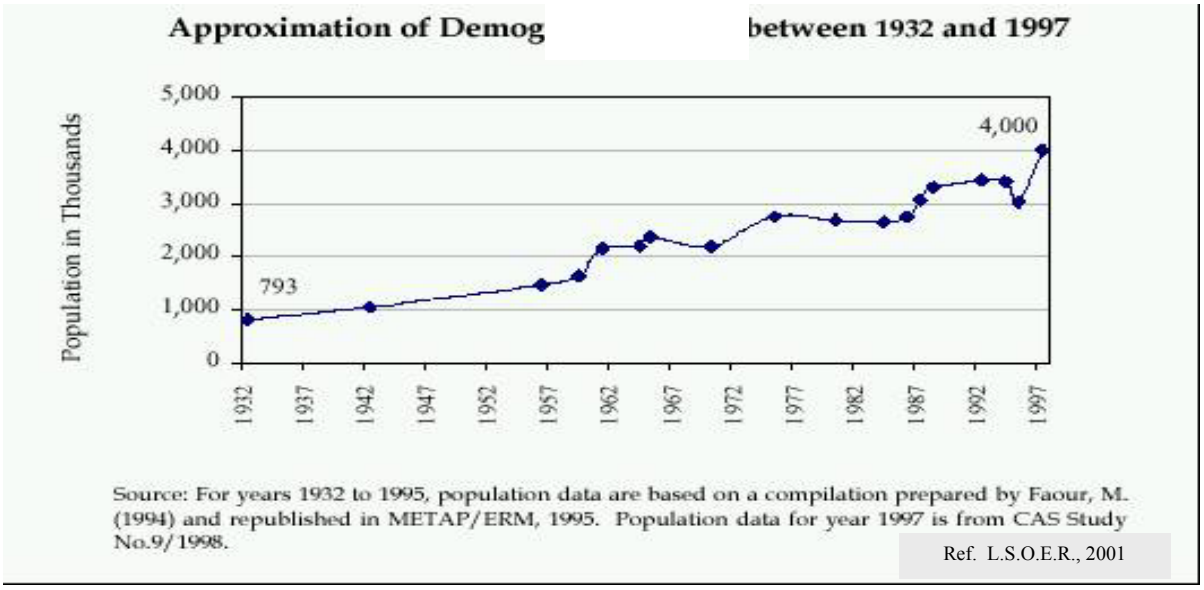
In the following subsections a summary of the major socio-economic issues and needs will be surveyed. This will include the population and education, the general economic performance, the industrial sector, agriculture, health and medical sector, national resources, tourism and the financial sector.

## A. POPULATION AND EDUCATION

Lebanon enjoys a steady population growth; Figure -1- shows this trend. The actual population is estimated to be around 4 millions inhabitant. Percentage of youth in this population is high. The population under 20 represents about 39% of the total in 1997, while the population under 40 represents 73% of the population (see Tables 1 and 2). This high percentage of young population could be a positive factor for

economical growth, since this population is well educated and represents an important human capital. Illiteracy rate is low for this young population for both males and females (see Table 3).

**Figure 1**




Population distribution over the different Governorate in Lebanon in 1997 is given in Table -4-. A major issue is brain drain within Lebanon from remote Governorates to large cities, and outside Lebanon towards foreign countries like: Canada, Australia, Europe, and the Arab Gulf. A major socio-economic need is the creation of high added value production and services sectors to offer attractive jobs in all Lebanese Governorate. Knowledge-based industry and services are the most appropriate for responding to this socio-economic need.

**Table 1**

| **Population Evolution by Age Group Between 1970 and 1997** | | |
|---|---|---|
| **Age Group** | **Percent of Total Population** | |
| | **1970** | **1997** |
| 0-19 | 53 | 39 |
| 20-39 | 25 | 34 |
| 40-59 | 14 | 18 |
| Above 60 | 8 | 10 |
| **Total** | **100.0** | **100.0** |

*Source: CAS Study, No. 9/1998*

*Ref: L.S.O.E.R. 2001*

**Table 2**

| **Population by Age Group, mid-1997** | | |
|---|---|---|
| **Years** | **No. ('000)** | **% of Total** |
| 0-19 | 1,559 | 38.9 |
| 20-59 | 2,051 | 51.2 |
| 60+ | 396 | 9.9 |
| **Total** | **4,005** | **100.0** |

*Source: Central Statistics Administration, Household Survey, 1997.*

*Ref: EIU, CP-2002, Lebanon*

**Table 3**

| Illiteracy Rate by Age Group and Gender, 1996 (%) | | |
|---|---|---|
| **Years** | **Male** | **Female** |
| 10-14 | 2.0 | 2.2 |
| 15-19 | 3.6 | 3.6 |
| 20-24 | 4.1 | 4.8 |
| 25-29 | 4.6 | 7.0 |
| 30-34 | 5.5 | 8.5 |
| 35-39 | 5.8 | 11.5 |
| 40-44 | 6.9 | 16.8 |
| 45+ | 22.1 | 46.0 |

*Source: UNDP*

*Ref: EIU, CP-2002, Lebanon*

**Table 4**

| Population Distribution by Governorate, 1997 (mid-year; '000) | | |
|---|---|---|
| | **No.** | **% of total** |
| Mount Lebanon | 1,508 | 37.6 |
| North Lebanon | 808 | 20.2 |
| The Beqaa | 539 | 13.5 |
| South Lebanon | 472 | 11.8 |
| Beirut | 403 | 10.1 |
| Nabatiyeh | 275 | 6.9 |
| **Total** | **4,005** | **100.0** |

*Source: Central Statistics Administration, Household Survey, 1997.*

*Ref: EIU, CP-2002, Lebanon*

## B. GENERAL ECONOMIC PERFORMANCE

Lebanon has an economically open, service-based economy. Annex -1- shows major economic indicators for the last two years. Table -5- compares selected indicators between Lebanon, Jordan, Syria, and Egypt. Figure -2- shows the relative position of Lebanon' GDP/capita between the Middle East countries. Lebanon GDP/capita is the highest of the non oil-producing Arab countries. The current account-balance as a percentage of GDP is by far highly negative. External debt/capita is very high. Export and import levels are highly imbalanced (see figures -3,4-). This trade imbalance is estimated to be around 5 billion US dollars.

**Table 5**

**Comparative economic indicators, 2001**

| | Lebanon | Jordan | Syria | Egypt |
|---|---|---|---|---|
| GDP (US$ bn) | 16.5 | 9.0 | 19.8 | 84.8 |
| GDP per head (US$) | 4,635 | 1,730 | 1,154 | 1,299 |
| GDP per head (US$ at PPP) | 7,539 | 3,957 | 3,424 | 3,468 |
| Consumer price inflation (av; %) | 0.5 | 1.8 | 0.4 | 2.3 |
| Current-account balance (US$ bn) | -4.1 | 0.1 | 0.2 | -0.1 |
| % of GDP | -25.0 | 0.6 | 1.1 | -0.1 |
| Exports of goods fob (US$ bn) | 0.9 | 2.3 | 5.0 | 7.0 |
| Imports of goods fob (US$ bn) | -6.7 | -4.3 | -4.2 | -15.8 |
| External debt (US$ bn) | 15.2 | 8.2 | 22.3 | 28.6 |
| Debt-service ratio, paid (%) | 35.5 | 12.2 | 6.4 | 10.5 |

Source: Economist Intelligence Unit, CountryData.

Ref: EIU, CP-2002, Lebanon

**Figure 2**

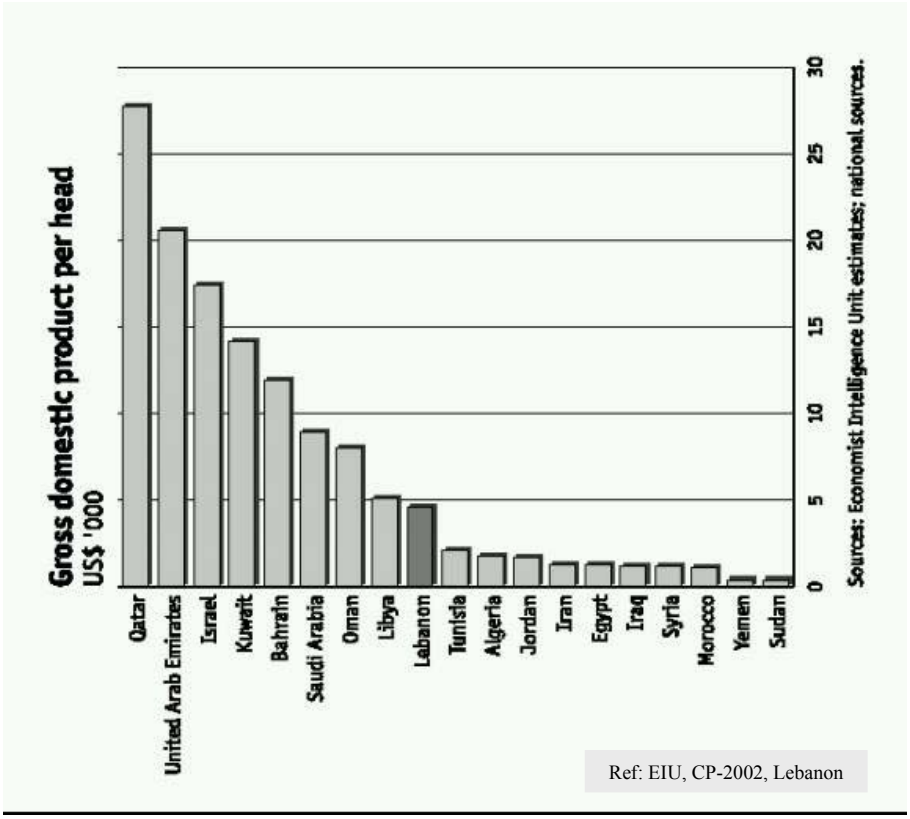



Figure -4- shows changes in current and estimated major economic indicators for Lebanon between the years 2001-2004. They include GDP which is expected to rise, inflation which is expected to fall, current account balance that is expected to improve, budget balance as a percentage of GDP and debt-service ratio which are also expected to improve.

The distribution of GDP by sector is shown in table -6-. The industry share including water and energy is estimated to be around 17.5 % of GDP, agriculture 12.6%, construction 9.4%, and commerce 13.5%. These estimates go back to 1995. On the other hand, the share of industry and manufacturing as percentage of GDP between 1990 and 2000 has been on the average declining (see key indicator given in annex -1-).

Finally, Table -7- shows the composition of imports by use. It is clear that less than 45% of imports are for intermediate goods and capital goods. Taking into account the high imbalance in trade (imports and exports), great efforts are needed to improve the export capacity of production and services sectors in Lebanon. These efforts are based on building the national technology transfer absorptive capacity. Promoting innovation activities in these sectors is essential for improving the Lebanese economic performance.

## 1. GDP

Real GDP growth is estimated to be 1.5% in 2002, and expected to accelerate to 2.3% this year(2003). The modest upturn reflects the positive impact of the Paris II accord on domestic and foreign confidence. The disbursement of project-specific funding for capital projects under Paris II will also boost capital spending, although this is unlikely to be apparent until 2004 given the government's difficulties in meeting lender conditions. The economic upturn is expected to gain momentum during 2004, although higher import volumes will limit the overall pace of expansion to around 2.5%.

2. *External Sector*

Lebanon's overwhelming dependence on imported goods will ensure that the trade and current-account deficits remain high during the forecast period. The value of the trade deficit will fall slightly this year, however, to around US$ 4.86bn, as strong export growth offsets a modest pick-up in import spending. Export earnings will rise further in 2004, but stronger import demand coupled with a further weakening of the US dollar will see the deficit widen to close to US$ 5bn. The complete absence of data on non-goods trans-actions makes projections of the current account highly unreliable. However, we forecast that some further strengthening of service and income credits and a slowdown in income debits growth (as a result of Lebanon s new access to concessional foreign debt) will see the current account register a deficit of just under US$ 3bn in 2003-2004! slightly below the estimated outturn for 2002.

**Figure 4**

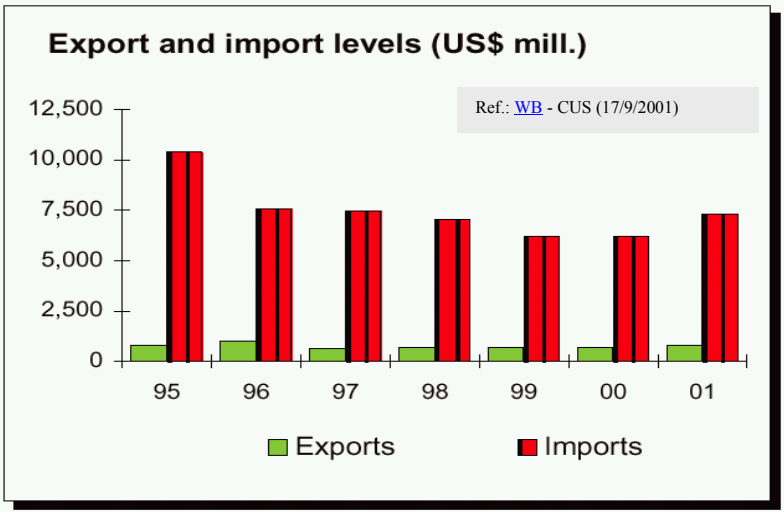
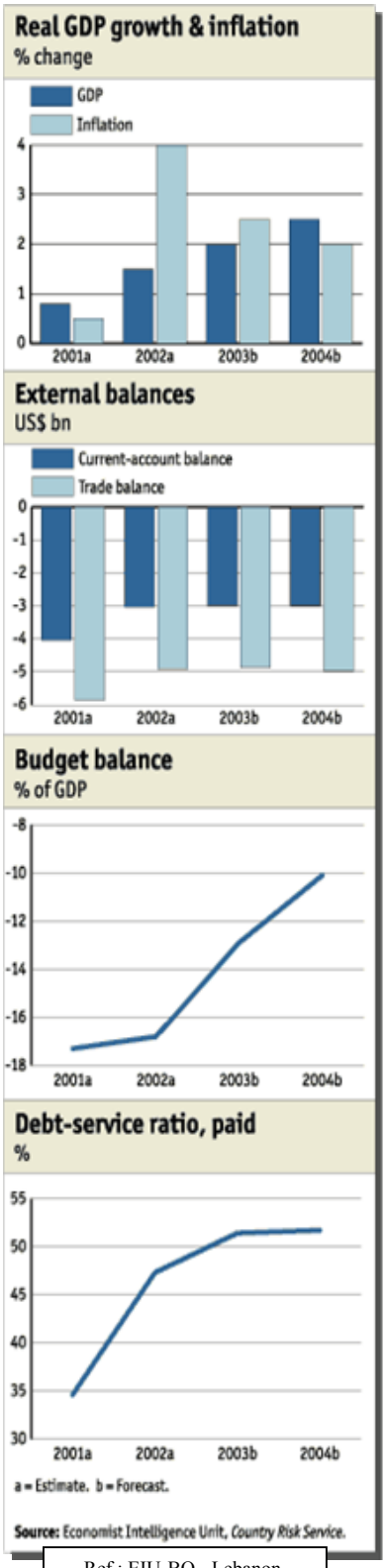



**Figure 3**




Ref.: EIU-BO - Lebanon,

**Table 6**

**Gross domestic product by sector, 1995[a]**
(% of total)

| | |
|---|---|
| Commerce | 30.5 |
| Water, energy & industry | 17.5 |
| Other services | 16.6 |
| Agriculture | 12.6 |
| Construction | 9.4 |
| Public administration | 7.5 |
| Housing | 4.2 |
| Transport & communication | 2.9 |
| **GDP** | **100.0** |

[a] A one-off survey, which has not been repeated, but it is believed the composition has changed little since 1995.

Source: Central Statistics Administration.

Ref: EIU, CP-2002, Lebanon

**Table 7**

**Composition of imports by use**
(% of total unless otherwise indicated)

| | 1995 | 1998[a] | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| **Intermediate goods** | **37.9** | **31.6** | **30.3** | **31.6** | **34.7** |
| Agriculture & animal husbandry | 2.8 | 4.4 | 4.5 | 4.4 | 4.2 |
| Industry | 23.5 | 18.1 | 17.7 | 20.1 | 24.4 |
| Construction | 5.7 | 5.6 | 4.7 | 4.4 | 3.8 |
| Services | 5.7 | 2.9 | 2.7 | 2.7 | 2.3 |
| **Capital goods** | **14.9** | **11.5** | **10.7** | **9.0** | **10.2** |
| Agriculture & animal husbandry | 0.2 | n/a | n/a | n/a | n/a |
| Industry | 4.1 | n/a | n/a | n/a | n/a |
| Construction | 1.1 | n/a | n/a | n/a | n/a |
| Services | 8.5 | n/a | n/a | n/a | n/a |
| Unclassified | 0.9 | n/a | n/a | n/a | n/a |
| **Consumer goods** | **47.2** | **42.8** | **42.4** | **38.6** | **39.1** |
| Perishables | 29.3 | 26.4 | 26.2 | 24.0 | 23.5 |
| Durables | 18.0 | 16.4 | 16.2 | 14.6 | 15.6 |
| **Multiple use** | **n/a** | **8.2** | **10.0** | **14.1** | **12.0** |
| Petroleum products | n/a | 5.5 | 7.5 | 11.8 | 9.6 |
| Uncategorised | n/a | 5.8 | 6.5 | 6.1 | 3.5 |
| **Total** | **100.0** | **100.0** | **100.0** | **100.0** | **100.0** |
| US$ m | 7,303.0 | 7,081.4 | 6,217.2 | 6,234.7 | 7,302.7 |

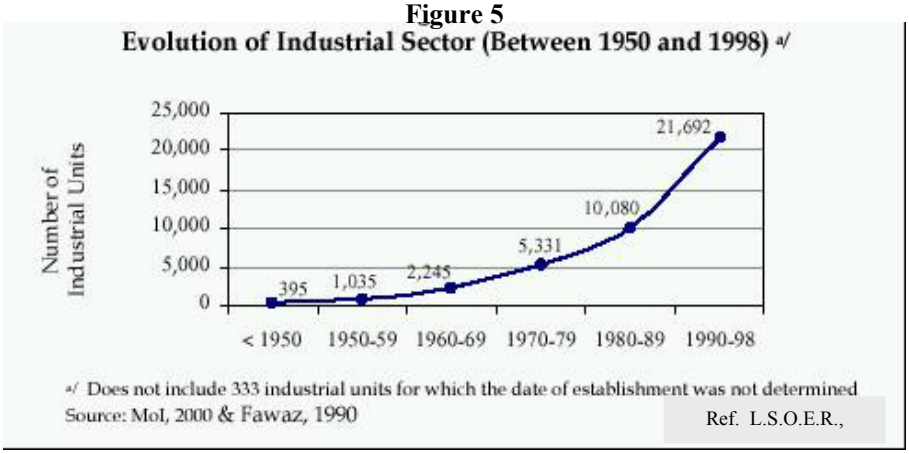
Source: Central Statistics Administration.

Ref: EIU, CP-2002, Lebanon

3. *Current Situation of the Industrial Sector*

The industrial sector has been evolving in Lebanon since the fifties. It represents about 17% of GDP recently. Figure -5- shows the evolution of numbers of industrial units in Lebanon. These numbers, which are around 22,000 units in 1998, are distributed over the six regions as shown in figure -6-. Half of theses units exists in Mont Lebanon, 12% in Beirut while the rest, which is only 36%, is distributed all over the rest of Lebanon.

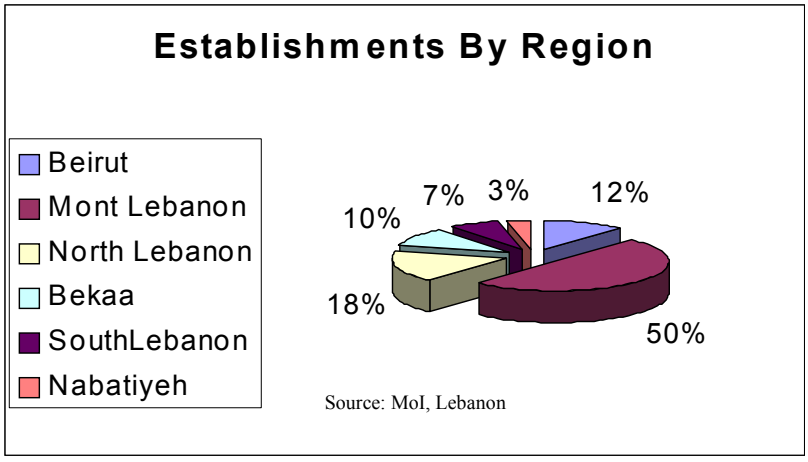
**Figure 5**




The output by region is represented in figure -7- where 74% of the output comes from Mont Lebanon and Beirut. Figure -8- shows the percentages of workers by region, and figure -9- shows the distribution of workforce by category.

Again it is clear that the concentration of workforce is in Mont Lebanon and Beirut, representing 66% of the total number of workers. Finally, figure -10- shows the distribution of workforce by activity. Unlike many states in the region, Lebanon never passed through a period when the government sought to create large nationalized industrial firms. Instead, it has historically relied on import for the majority of industrial and consumer goods (see balance of trade and table -7-). The industrial sector as seen from the above mentioned figures is composed almost entirely of small family owned firms employing less than ten people, converting semi-finished imported goods for the local market, or producing bulk items, such as furniture, paper products and beverages. Value added industries are confined to a small jewellery-finishing sector and an equally limited fashion industry. There is also a small market for time-sensitive and delicate goods, such as unprocessed food. As a result, most Lebanese manufacturers are located around population centers to reduce transport costs.

**Figure 6**



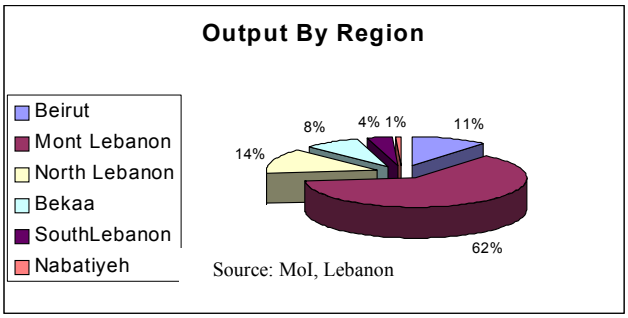

Serious efforts were exerted in the last few years to develop the industrial sector in Lebanon. The private sector and the MoI deploy these efforts. One of the main objectives is to increase industrial exports and reduce imports.

According to the MoI, the Industrial Sector (IS) in Lebanon represents 17% of the GDP. A detailed description for the IS cannot be established due to the lack of updated information. According to industrial surveys conducted by the MoI in 1994 and Arthur D'Little in 1996, the number of industrial firms in Lebanon was estimated at 22,107 employing around 145,000 employees.

Sales total to $3.72 billion, where the value-added amounted to $1.82 billion, corresponding to 49% of the sector's sales ($80,000/firm, $12,500/labor).

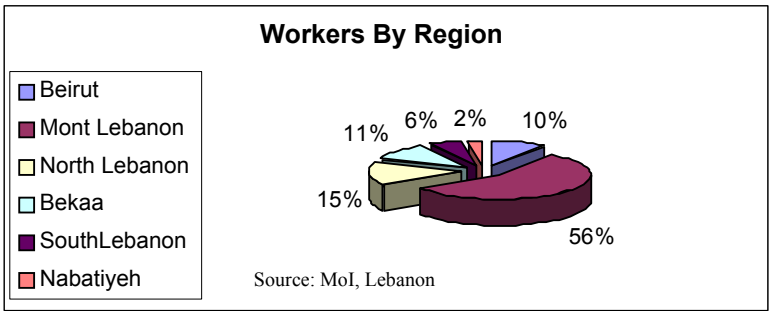
In addition, the survey showed that 69.9% of the 22,107 firms employ less than 5 workers (Per hour workers); while firms employing more than 10 employees represent only 9.5%. However, those employ around 42.5% of total employees and generate 61.4% of sales.

**Figure 7**




If we categorize the IS, we will find that 20.2% of the production goes to the food and beverage industry, 16.3% for furniture, 13.9% for metal products, 13.6% for clothing and 6.6% for wood products. Yet, these productions represent only 71% of the total industrial sector. The remaining 29% are concentrated on other manufacturing products, but employ 40.4% of the labor force of the IS and generate 48% of total industrial output.

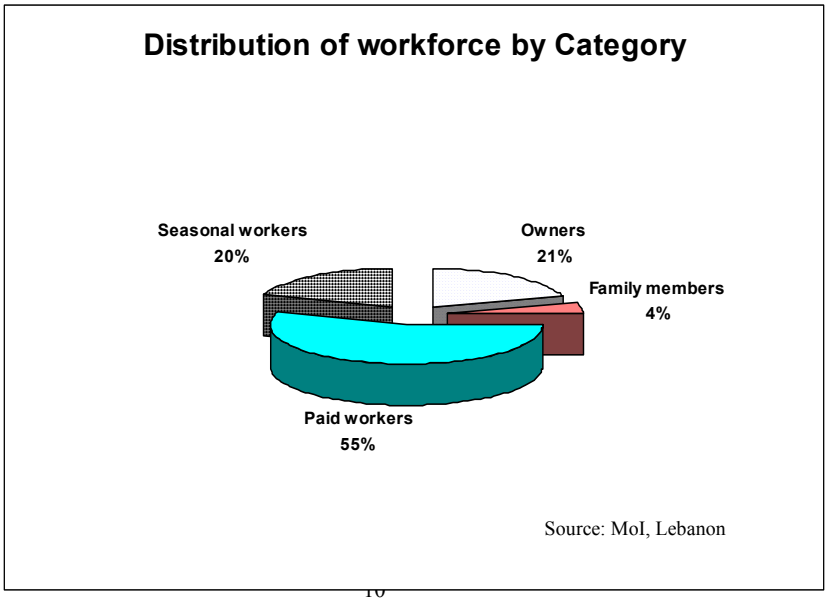
**Figure 8**




The main results of the two surveys were summarized as follows:

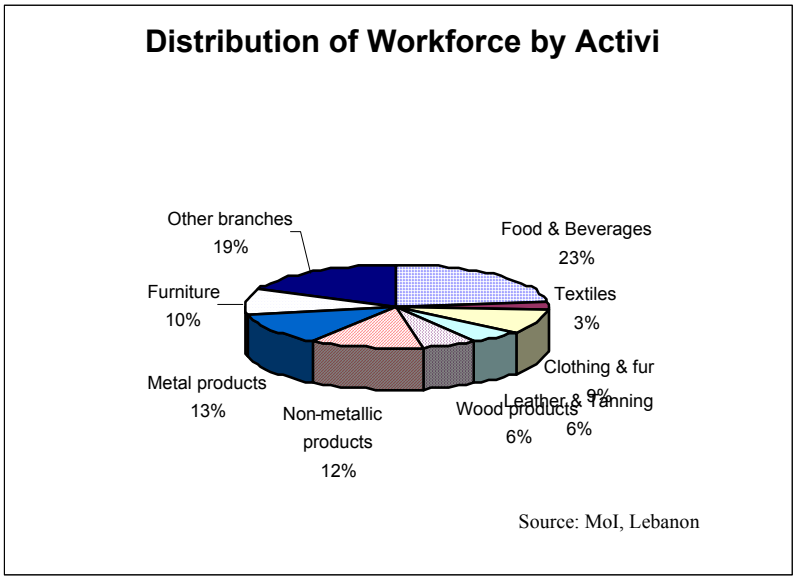
- Small size of the industrial firms
- Labor intensive production/investment
- Salaries represent a big share of the total expenditures
- No diversity in production
- Family business predominance, with monopolized decision makings

**Figure 9**



The industrial sector in Lebanon faces general problems and challenges, which are internally: Recession, Lack of industrial investments High costs of production (raw material, power, etc.), Low quality of products making them more difficult to penetrate foreign markets, High transaction cost, leading to increase in opportunity cost (time, money), Lack of resources at the MoI essential for proper management of the sector; and externally: Strong international markets' competition (absence of quality, conformity and standards), High competition in the FDI markets (due to lack of appropriate environment to attract FDI), Increase in regulations, resolutions and standards codes after signing trade agreements with Arab countries and the WTO (ensure required standards).

**Figure 10**




Industrial development proposed by the MoI would consist of general measures such as:

- Improvement of the industrial information and technical consulting services;
- Creation of legal and organizational frameworks triggering incentives for industrial development;
- Improvement of the industrial infrastructure;
- Reduction of the production cost;
- Provision of sources of finance with attractive conditions;
- Modernization of the sector;
- Expansion of local markets for local commodities and fight dumping;
- Development of exports;
- Organization and administration of WTO negotiations from a strategic perspective.

Figure -11- is an export profile chart for selected key products in Lebanon. It shows the growth of export of certain products and the decline of export of others. For example, products having relatively high export and high growth rate are:

- Aluminum bars, roof rods
- Furniture
- Printed materials
- Wine of fresh grapes
- Electrical transformers and other electrical component
- Cloths like T-shirt and vests

Examples of declining sectors from the export point of view are:

- Minerals and chemical fertilizers
- Got and stomach of animals
- Faeroese waste and scrap

Examples of products having high volume of export but negative export growth rate are:

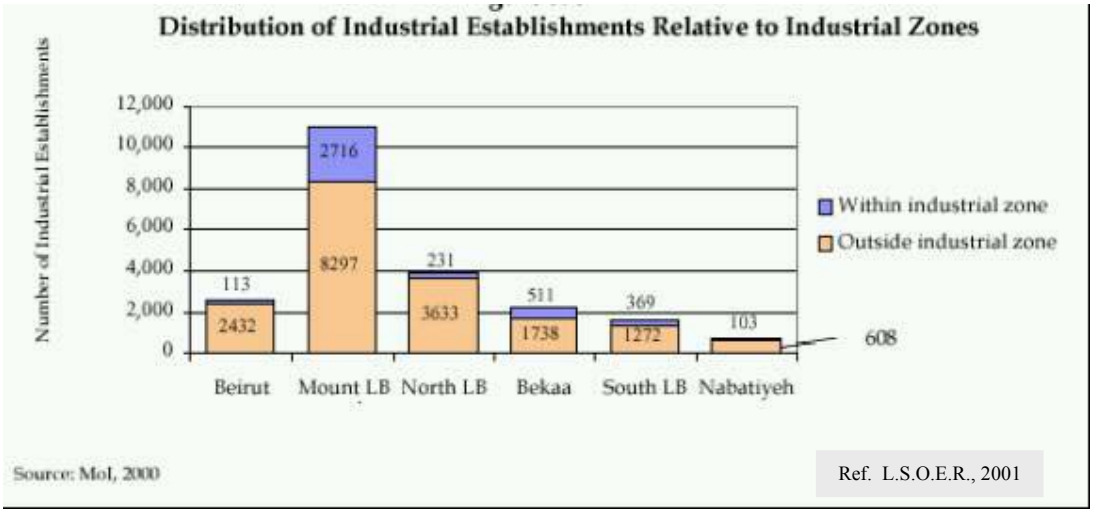
- Diphosphorus pentaoxide, phosphoric acid, etc
- Tobacco

Finally examples of products having low export volume but high export growth rate are:

- Aluminum waste and scrap
- Grape fresh and dried
- Men and boys suits…

These examples show that there is a potential for the Lebanese industrial sector to be developed. It shows also that high and medium technology industries have better chance for such development. There is a huge need and potential for the development of the industrial sector. The MoI has argued that the output of the industrial sector should be of the order of 8 billion US dollar instead of about 3 billion US dollar now.

**Figure 11**



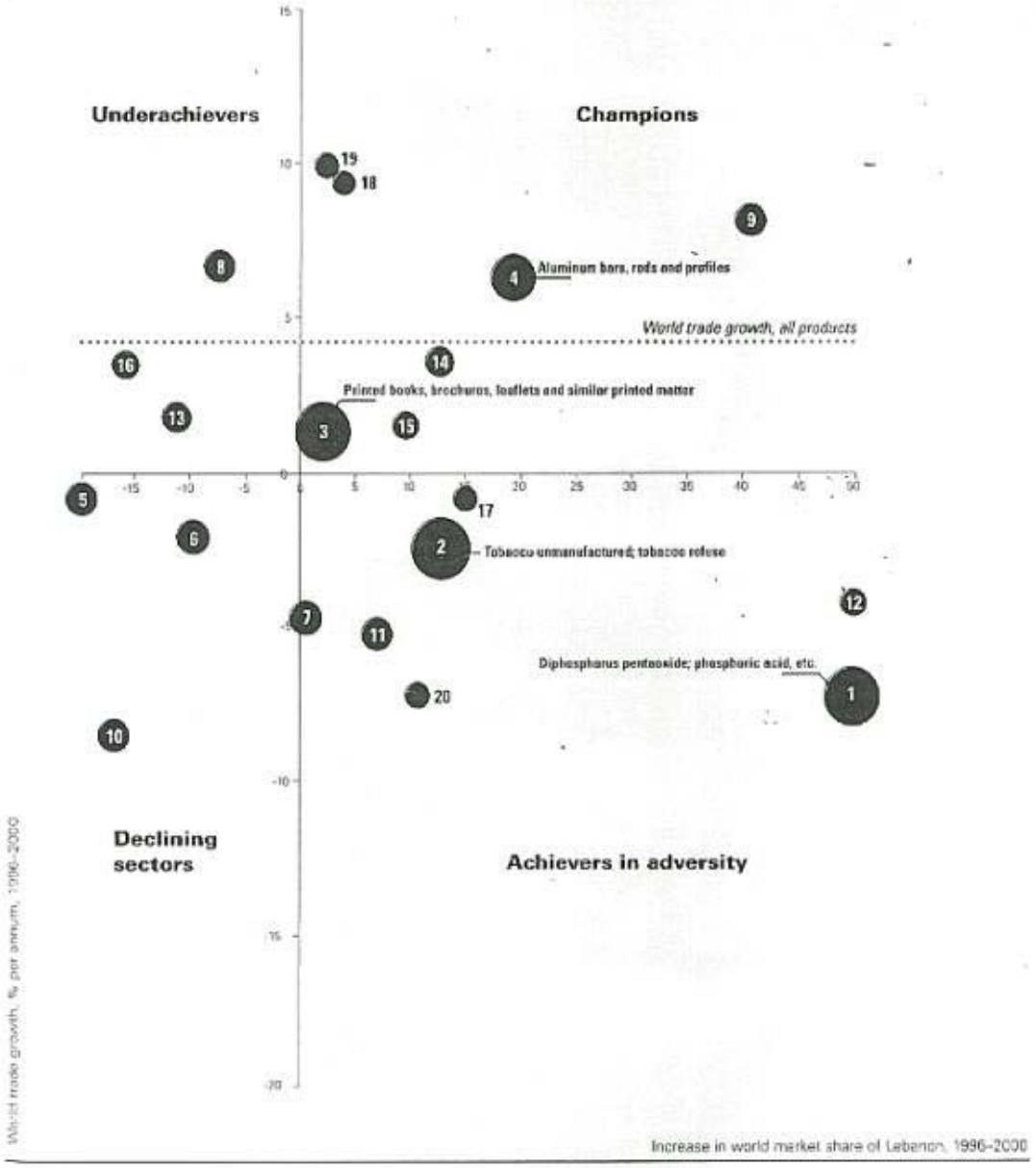

Revitalizing the industrial sector is a major socio-economic need. Establishing a more favorable environment for this sector is a vital measure to take. Promoting S & T, fostering innovation, building an absorptive capacity for technology transfer, improving the total quality management, expanding the information technology infrastructure particularly industrial information, and establishing S&T parks and incubators are all essential measures to be taken by the public and private sectors in Lebanon.

**Figure 12**

## Export Profile Chart for Selected Key Products

Lebanon

Ref.: AWCR (2002-03)




Key

1. 2809 Diphosphorus pentaoxide; phosphoric acid, etc.
2. 2401 Tobacco unmanufactured; tobacco refuse
3. 4901 Printed books, brochures, leaflets and similar printed matter
4. 7604 Aluminum bars, rods and profiles
5. 7204 Ferrous waste and scrap; remelting scrap ingots of iron or steel
6. 0504 Guts, bladders and stomachs of animals
7. 7404 Copper waste and scrap
8. 7602 Aluminum waste and scrap
9. 9403 Other furniture and parts thereof
10. 3103 Mineral or chemical fertilizers, phosphatic
11. 0808 Apples, pears and quinces, fresh
12. 4101 Raw hides and skins of bovine or equine animals
13. 0806 Grapes, fresh or dried
14. 2204 Wine of fresh grapes
15. 1704 Sugar confectionery
16. 6203 Men's or boys' suits, jackets, trousers, etc.
17. 2008 Fruits, nuts prepared or preserved
18. 8504 Electric transformers, static converters, etc.
19. 6109 T-shirts, singlets and other vests, etc.
20. 8438 Other machinery, to manufacture food or drink

Note: The area of the circles is proportional to the export turnover.
Source: ITC calculations based on COMTRADE statistics.

The public and private sectors are still adopting the concept of industrial zones. These zones are based on assembly under license, or import-substitute manufacturing. While, what is needed is technology parks, technology incubators and centers of excellence, where R&D and innovation are the primary activities. Figure -12- shows the distribution of industrial establishment relative to industrial zones, and annex –2- shows the situation of present industrial zones in Lebanon indicating that the number of "informal" zones is extremely large. Figures -13,14- schematizes the difference between the existing industrial zones and the needed Science parks.

**Table 8**

**Number of ISO-Certified Establishments**

| *Year* | *ISO 9000* | *ISO 14000* | *Total* |
|---|---|---|---|
| 1994 | 12 | 0 | 12 |
| 1995 | 0 | 0 | 0 |
| 1996 | 4 | 1 | 5 |
| 1997 | 10 | 0 | 10 |
| 1998 | 8 | 0 | 8 |
| 1999 | 43 | 3 | 46 |
| **Total** | **77** | **4** | **81** |

Source: MoI, Annual Bulletin

Ref. L.S.O.E.R., 2001

Finally table -8- shows that the number of ISO-certified Establishments is still very low. It is also an important need for the Lebanese economy to improve its efforts in total quality management.

**Figure 13**

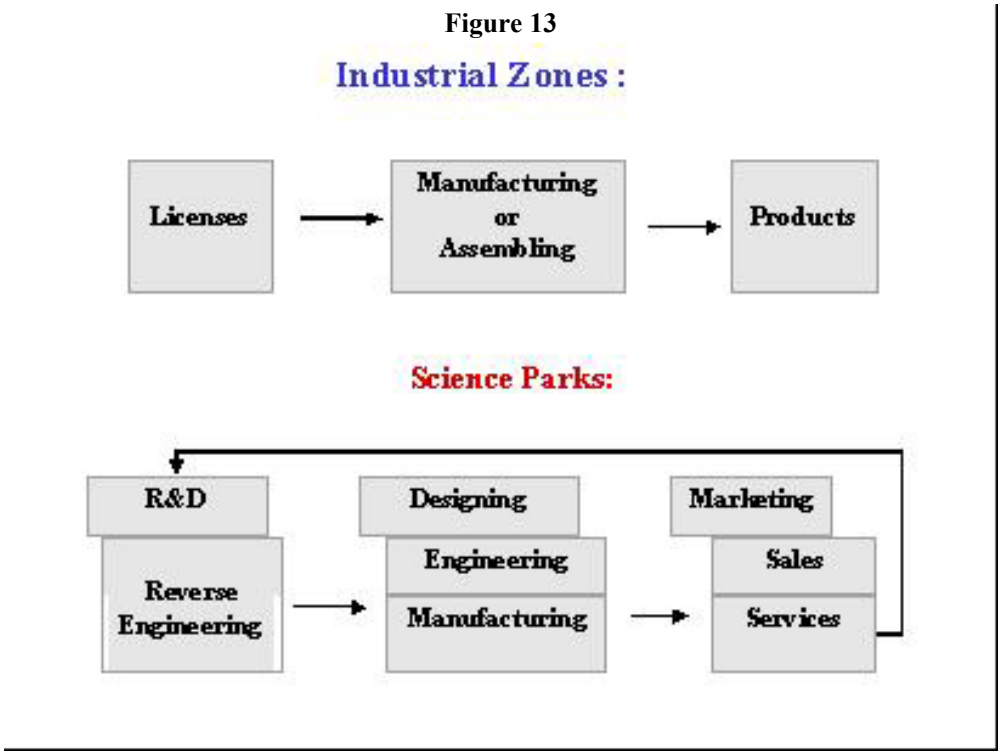
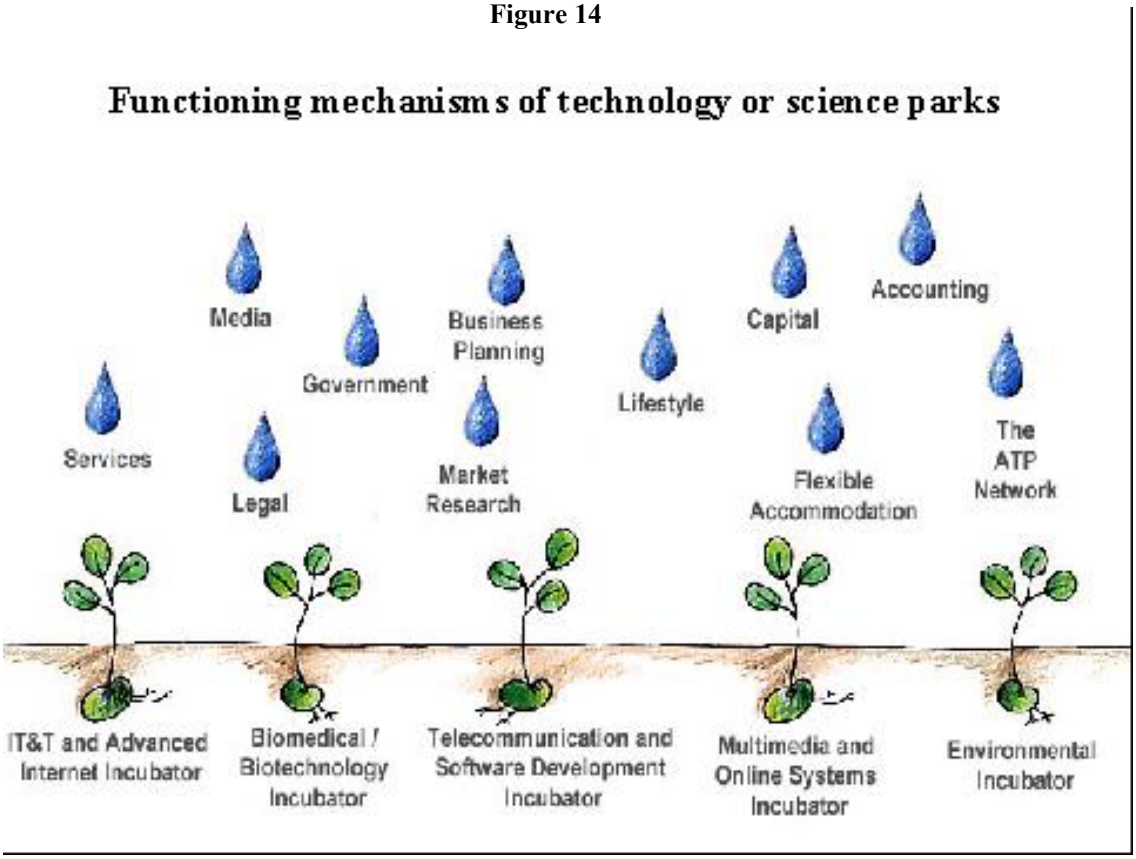


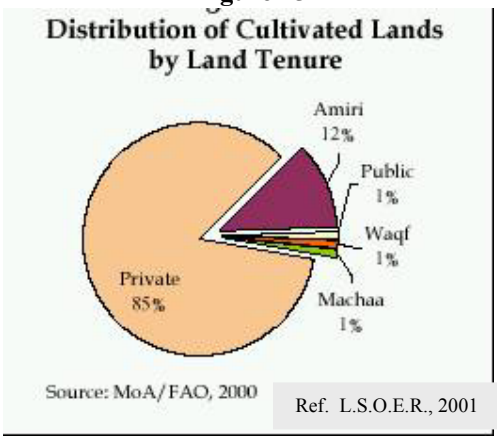
**Figure 14**




## C. CURRENT SITUATION OF THE AGRICULTURAL SECTOR

The agricultural sector represents 13% of GDP (see Table -6-).

**Figure 15**




Lebanon enjoys plentiful sunshine, enough water supply and fertile soil. Lebanese agricultural sector has the potential to be one of the most productive in the region. Instead, it is underdeveloped and poorly managed. Most holdings are small, not irrigated and use outdated, inefficient production technologies. Farmers are poorly educated and are not well advised in choosing their crops, for example, to grow low-yielding staples such as potatoes, which can be sold and consumed locally, rather than more lucrative cash crops for export. Output is also often of questionable quality.

According to the UN Economic and Social Commission for Western Asia (ESCWA), Lebanon has some 207,060 ha of arable land, with 60,047 ha of that irrigated. Another 360,000 ha are suitable only for grazing, while 79,560 ha comprise forests and woodland. The most important agricultural areas are on the high Beqaa valley, which accounts for 35% of farmable land, and the fertile coastal plain, accounting for a similar area. The Beqaa is mostly sown with root vegetables, some cereals and tobacco, which together account for about 30% of total production. Coastal areas generally grow fruits as bananas, melons, and apples. The government subsidies the production of some crops, such as tobacco, to provide indirect support for rural populations in the south and in the Beqaa.

Overall, the agricultural sector accounts for an estimated 13% of GDP, and employs a similar percentage of the labor force. Most output is consumed locally, although some is exported, primarily to the UA and Saudi Arabia. Limited funding, receiving just 0.33% of the state budget in 2002, or US$ 22m also

**Table 9**

**Area Cultivated by Major Crop Type**

| *Crop Type* | *Area cultivated (dunum)* | | *Percent change* |
|---|---|---|---|
| | Period 1980-1995 [a] | 1999 [b] | |
| Cereals | (1989) 1,020,000 | 518,420 | - 49% |
| Fruit trees | (1989) 560,000 | 595,147 | + 6% |
| Olives | 350,000 | 524,213 | + 50% |
| Industrial crops | n/a | 247,265 | n/a |
| Vegetables | (1988) 230,000 | 452,320 | + 97% |
| Other | n/a | 142,000 | n/a |
| **Total** | **(1980) 2,850,000** | **2,479,365** | **- 13 %** |
| | **(1986) 2,740,000** | | **- 9.5 %** |

[a] Source: METAP/ERM, 1995 (reported values cover different years)
[b] Source: MoA/FAO, 2000

Ref. L.S.O.E.R., 2001

curtails the sector. Private-sector finances are equally limited, with bank loans to agriculture accounting for only 2% of bank credits. The net result has been a lack of investment and old technologies, undermining productivity and competitiveness. In international markets Lebanese agricultural goods trade alongside output from the EU and regional countries, which is often sold below cost-price because of production

**Table 10**

**Land use, 1996[a]**

| | Ha | % of total |
|---|---|---|
| Arable land | 260,000 | 25.6 |
| **Forest** | | |
| More or less degraded (with cover of less than 10%) | 70,000 | 6.9 |
| Sparse (less than 10% cover) | 65,000 | 6.4 |
| Abandoned lands, mostly old terraces | 70,000 | 6.9 |
| Rocky, non-cultivable lands, degraded range lands | 515,000 | 50.6 |
| Urban & constructed areas | 27,000 | 2.7 |
| **Total area** | **1,017,000** | **100.0** |

[a] Total does not add in source.

Sources: UNDP; UN Food and Agriculture Organization.

Ref: EIU, CP-2002, Lebanon

subsidies. Unable to match subsidies offered elsewhere, successive governments have chosen to protect the industry by restricting food imports.

Table -9- shows land use in Lebanon. About 50% of the land is arable and forest, which is a large percentage compared to other countries in the region. Figure -15- indicates that 85% of cultivated land is owned by the private sector .

Area cultivated by major crop types and its evolution between the 80s and 90s is shown in table -10-. A net increasing in area cultivated by vegetables and olives is clear, while an important decrease in area cultivated by cereals is also noticeable.

**Table 11**

**Evolution of Livestock Production (1980 1999)**

| *Category* | *1980* | *1999* | *Variation (%)* |
|---|---|---|---|
| Cows | 55,612 | 75,874 | + 36 |
| Sheep | 145,068 | 378,050 | + 160 |
| Goats | 444,448 | 435,965 | - 2 |
| **Total** | **645,128** | **889,889** | **+ 38** |

Source: MoA/FAO, 2000

Ref. L.S.O.E.R.,

On the other hand, evolution of livestock production between 1980 and 1999, given in table –11-, indicates a percentage increase of 160% of sheep and 36% of cow.

The productivity of the land and the workforce is not high; R&D in agricultural domain and in biotechnology, to increase this productivity and to promote agricultural export is an essential economical need in Lebanon. Agro-industry could play an important role in the Lebanese economy provided new technologies are introduced for higher quality and higher productivity and competitiveness. Livestock production is gaining steps, and is a potential sector if new technologies are absorbed to promote its productivity.

## D. CURRENT SITUATION OF THE HEALTH AND MEDICAL SECTOR

The health-care system in Lebanon is well developed, with high-quality care available, though it is expensive. For those born in 1995-2000, the average life expectancy is one of the highest in the region, at 72.6 years, compared with 61 in Egypt. Infant mortality is relatively low at around 28 per 1000 life births, which is much lower than the Middle East average of 51. There was one doctor for every 476 people in Lebanon in year 2000, compared with 1320 in Egypt. Table -12- shows certain health-care indicators that are relatively positively high compared with most of the countries in the region.

**Table 12**

| **Healthcare indicators, 2001** | |
|---|---|
| Life expectancy at birth (years, 1995-2000) | 72.6 |
| Infant mortality rate (per 1,000 births) | 28 |
| **% of population with access to:** | |
| Health services | 95 |
| Safe water | 100 |
| Sanitation | 99 |
| One-year-olds immunised against measles (%) | 88.0 |
| % population over 15 years old who smoke (1997) | 53.6 |
| Health expenditure, public (as % of GDP) | 2.2 |
| Health expenditure per capita (US$), 1998 | 469 |
| Births attended by skilled health staff (%) | 88.0 |
| Physicians (per 100,000 people, 1990-99) | 210 |
| Daily calorie intake per head (1996) | 3,319 |

Sources: UNDP; Ministry of Health.

Ref: EIU, CP-2002, Lebanon

Before the civil war, medical services used to represent an important sector economically on the regional level. It is now a potential sector.

Medical R&D enjoys the highest expenditure compared with other R&D fields in Lebanon. If this R&D is market-oriented, it will promote the growth of this sector.

Pharmaceutical industry is another potential sub sector. An evaluation of this sub sector and its market nationally and regionally could help directing R&D in this field. Biotechnological research is a promising source of innovation. Lebanon could specialize in selected activities in this field that is market oriented.

"Medical tourism" is another economic activity that Lebanon could venture into. The Malaysian experience in this field is rich to look into.

## E. CURRENT SITUATION OF THE NATURAL RESOURCES SECTOR

### *1. Energy*

Lebanon imports all of its fuel. Primary energy consumption is steadily increasing over the past years. It was about 4129 Ktonnes in 1995, and was raised to about 4963 Ktonnes in 1999, which is equivalent to an increase of 18.5 %. Currently, the petroleum and gas sector is the responsibility of the Ministry of Energy and Water. The government bill for petroleum products was about 805 million US dollar in 1999. Immediately after the war with most the areas receiving only a few hours of state electricity a day, restoring the network and increasing the supply was a priority. Power generation from hydroelectric plants has fluctuated in recent years, peaking in 1998 at 786 KWh, and then declining to 331 KWh in 1999. The total power generation (hydroelectric and thermal) totaled to 8356 in 1998 and 8186 KWh in 1999. Table -13- shows electricity production evolution.

**Table 13**

**Electricity production**[a]

| | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| m kwh | 8,325 | 9,030 | 9,030 | 9,233 | 9,436 |

Source: Central Statistics Administration.

Ref: EIU, CP-2002, Lebanon

Use of solar energy to heat water continues to be very limited in Lebanon compared with other neighboring countries such as Cyprus, Greece, and Jordan. According to one study (ALMEE,2000 "le Solaire au Liban"), the installation of 400,000 solar heater in Lebanon, over a 10-years period, would entail electricity energy saving of about 8 %, and consequently avoid the need to expand the power production capacity by 100MW, saving more than 100 million US dollar yearly as capital cost. On the other hand, it would lower the energy bill by about 30 million US dollar over 10-years, and would also reduce the atmospheric pollution from thermal power plants.

R&D on renewable energy, and on energy conservation, are essential needs for the Lebanese economy. The establishment of the Lebanese Center for Energy Conservation and Planning is a step ahead in this direction.

## *2. Water*

Lebanon enjoys a relatively good hydrological position. Yearly precipitation is estimated to result in an average yearly flow of 8600 million cubic meters (Mm3). This precipitation gives rise to about 40 major rivers and steams and more than 2000 springs. Although water seems to be abundant now, shortage could happen in 10 to 15 years, if sound and radical water management strategies are not developed and implemented. It is generally accepted that approximately 50% of the average yearly precipitation is lost through evaporation, 8% as surface water flow the neighboring countries, and 12% as ground water seepage. The rest 30% (2600 Mm3) of the precipitation is available for exploitation as surface and ground water. Most of the exploited water in Lebanon is used for irrigation. Figure -16- shows the distribution of the irrigated lands by water source and irrigation methods. The Ministry of Energy and Water (MoEW) has a 10-year plan for water projects, with a budget of 850 million dollar over 10 years (see Table -14-).

R&D on water management, water recycling, and efficient irrigation technologies is very much needed in the coming 10 years. Potable natural water could be an industrial sector in Lebanon, if competitive technologies are used for its production and packaging, particularly in the market of the Arab Gulf countries.

**Figure 16**

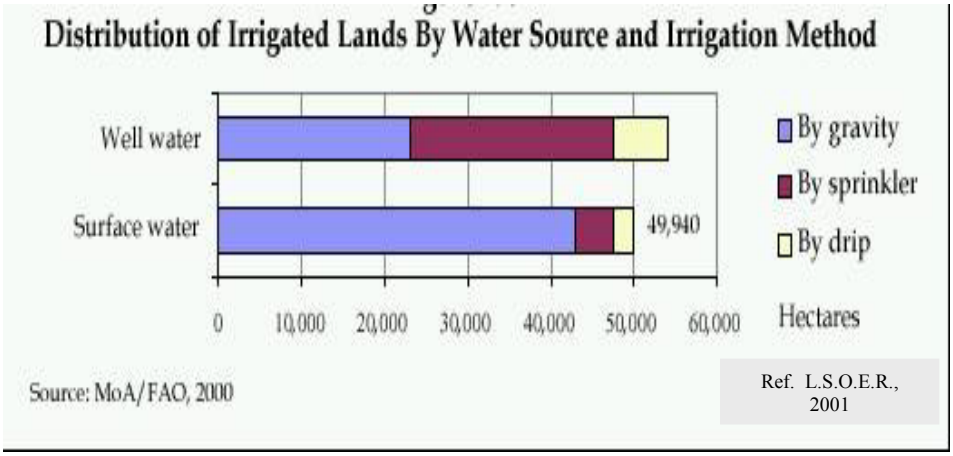



**Table 14**

**Budget Appropriation for 10-Year Plan.**

| *Component of 10-Year Plan* | *Budget Allocation (%)* |
|---|---|
| Procurement of additional exploitable water resources | 66.7 |
| Potable water supply projects | 15.7 |
| Irrigation schemes and wastewater plans | 9.8 |
| Assessment of river basins & their protection from pollution and flooding | 5.1 |
| Electric infrastructure | 2.7 |
| **Total budget**<br>Per capita equivalent total budget (assuming a population of 4 million) | **US$ 850 Million**<br>212.5 |

Source: MoEW, 10-Year Plan

Ref. L.S.O.E.R., 2001

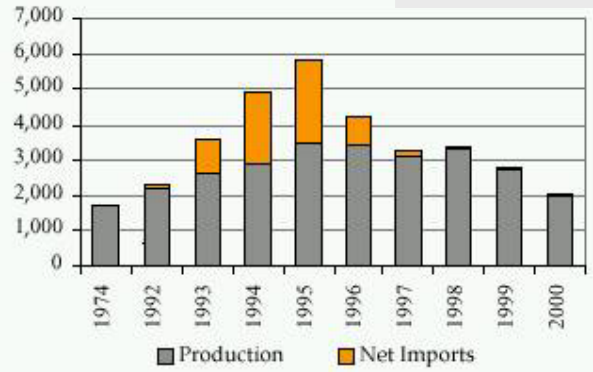
### *3. Quarries and Cement*

According to the Country Profile-2002 published by EIU, Lebanon has no commercially exploitable mineral deposit. The post-war construction boom has encouraged open-cast quarrying for marble, as well as sand and limestone for cement production. Most of this is domestically consumed, although a modest quantity is exported. However, the industry is facing growing opposition because of its effect on the environment.

Figure -17- shows cement production and imports. Production has been increasing until 1996 when it started to decrease. An export of cement industry is possible if the cost of production is reduced. Introducing new technologies is one of the measures to achieve this goal. Table –15- shows the cement industry statistics of selected countries. Lebanon has the highest price. Innovations in: manufacturing, packaging, and shipment are primordial for this industry to be competitive.

**Figure 17**

Ref. L.S.O.E.R., 2001




Source: Compain et al., 1997 and CAS Bulletins, 1996-2001

**Table 15**

**Cement Industry Statistics for Select Countries**

| *Country* | *Number of cement production plants* | *Total Production Capacity (million tonnes)* | *Total consumption in 1995 (million tonnes)* | *Per capita consumption in 1995 (kg/person)* | *Average price (US$ per tonne)* |
|---|---|---|---|---|---|
| Cyprus | 6 | 1.6 | 1.0 | 1330 | 60 |
| Egypt | 10 | 18.7 | 18.5 | 313 | 52 |
| Jordan | 2 | 4.0 | 2.7 | 620 | 48 |
| **Lebanon** | **4** | **3.5** | **5.8** | **1,650** | **62** |
| Saudi Arabia | 8 | 15.2 | 16.7 | 900 | 53 |
| Syria | 8 | 3.2 | 6.5 | 455 | 52 |

Note: Lebanon data corrected by CERMOC to reflect actual consumption and using a population of 3.5 million

Source: Flemings, 1996

Ref. L.S.O.E.R., 2001

## F. CURRENT SITUATION OF THE TOURISM SECTOR

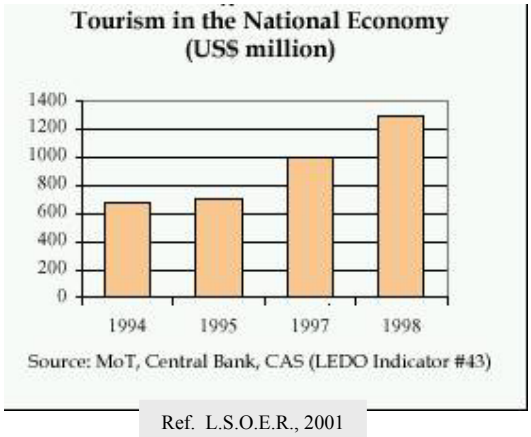
Tourism has traditionally been a significant economic activity in Lebanon. Figure -18- shows the evolution of tourism in the national economy. It is seen to be increasing exponentially. Tourism is classified in three major categories:

1. The recreation tourism including: beach holydays, summer holidays in mountain, cultural tourism, adventurer tourism, and youth activities.
2. Business tourism including: exhibitions, congresses, and individuals
3. Other types of tourism including: medical, educational, and training tourism

Cultural tourism for example could be developed tremendously in Lebanon, due to historic attraction such as: Baalbeck, Beit el Dine, Byblos, Tripoli, Tyre and Saida. Figure -19- gives number of visitors to eight heritage sites. When compared with number of visitors to other similar sites in Egypt or Spain, it is evident that these numbers could be improved tremendously.

Innovation in the tourism sector is a socio-economic need in Lebanon. R&D for the rehabilitation and management of the historic sites, environmentally managing the costal plain, developing new tourism products, diversifying services and promoting new marketing technology are all needed axis of intervention. E-tourism is also an activity that Lebanon could promote, and could have a competitive advantage all over the region.

**Figure 18**




Ref. L.S.O.E.R., 2001

**Figure 19**


Ref. L.S.O.E.R., 2001

### *G. Current Situation of the Financial Sector*

Financial services in Lebanon constitute an important sector. Banking services used to be the first in the region. This sector is witnessing a high competition from other countries in the region such as Bahrain, Dubai. This sector is also witnessing great technological changes, particularly in e-banking and in new communication technologies such as GPRS. Absorbing these new technologies by the Lebanese financial sector is an urging need.

On the other hand, billions of dollars are being invested by Lebanese banks outside Lebanon. This is the case because return on investment (ROI) is not high in the Lebanese market, due to the lack of high added value activities. It is well known that high added value economical activities are the result of production and services sector based on new technologies and innovation. It is estimated that more than one trillion dollar of Arabic capital is invested outside the Arab world. R&DI is a prerequisite for promoting the trend towards KBE and consequently for attracting investment to Lebanon. This is a long-term process that should be implemented according to a proactive science and technology strategy.

Concerning the financial situation of Lebanon, it is well known that the government has a high debt. Table -16- shows the evolution of this debt, and figure -20- gives the composition of this debt in the year 2001. Figure -21- and Table -17- assures that the current account balance as a percentage of GDP is improving.

Finally, Table -18- gives a forecast summary of the financial situation.

Improving this financial situation needs a high-sustained economic growth rate. The technological level of the economy, and the growth rate of this level are the key to attain this needed growth according to the "new growth theory" (see Solow and Romer).

Inflation averaged around 4% in 2002, according to new data. The gain was largely a result of the introduction of VAT early in 2002, compounded by the higher price of imported goods following the weakening of the US dollar against the Euro. As the one-off impact of VAT passes we expect consumer price growth to ease to an average of under 2.5% in 2003-2004.

**Figure 20**

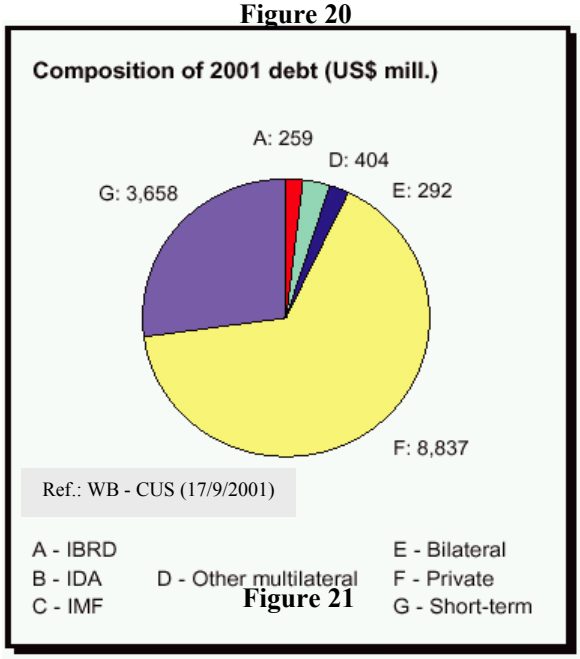



**Figure 21**

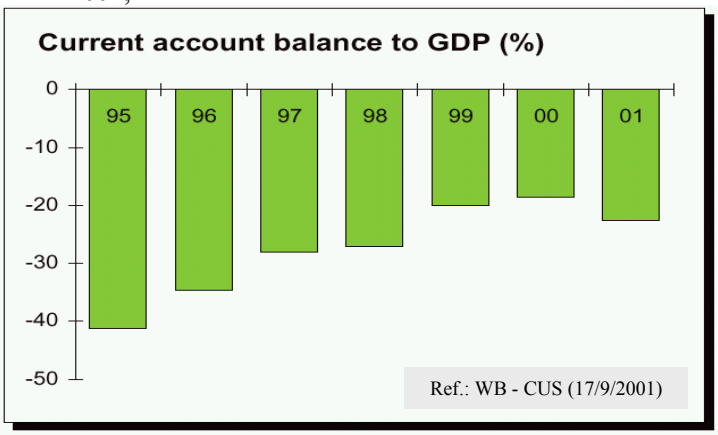


**Table 16**

Ref: EIU, CP-2002, Lebanon

**Government foreign bond debt**
(US$ m; end-period)

| | 1997 | 1998 | 1999 | 2000 | 2001 | Jun 2002 |
|---|---|---|---|---|---|---|
| Total issues | 639 | 1,450 | 1,200 | 1,850 | 3,100 | 1,850 |
| Maturing issues | 400 | 0 | 0 | 400 | 500 | 132 |
| Net issues | 239 | 1,450 | 1,200 | 1,450 | 2,600 | 1,718 |
| Outstanding bond debt | 1,039 | 2,489 | 3,689 | 5,139 | 7,739 | 9,457 |

Source: Ministry of Finance.

**Table 17**

**Balance of payments, national series**
(US$ m)

| | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| Exports fob | 642 | 716 | 677 | 714 | 896 |
| Imports cif | -7,457 | -7,060 | -6,206 | -6,228 | -7,291 |
| **Trade balance** | **-6,815** | **-6,344** | **-5,529** | **-5,514** | **-6,395** |
| Net invisibles, transfers & capital inflows (incl bonds) | 7,235 | 5,856 | 5,795 | 5,225 | 5,227 |
| **Balance of payments** | **420** | **-488** | **266** | **-289** | **-1,168** |

Source: Banque du Liban.

Ref: EIU, CP-2002, Lebanon

**Table 18**

Ref. EIU, CR, 2003

**Forecast summary**
(% unless otherwise indicated)

| | 2001[a] | 2002[a] | 2003[b] | 2004[b] |
|---|---|---|---|---|
| Real GDP growth | 0.8 | 1.5 | 2.0 | 2.5 |
| Consumer price inflation (av) | 0.5 | 4.0 | 2.5 | 2.0 |
| Consumer price inflation (year-end) | 1.0 | 3.5 | 2.0 | 2.0 |
| 2-year Treasury bill rate | 14.6[c] | 9.4[c] | 8.9 | 8.5 |
| Government balance (% of GDP) | -17.3 | -16.8 | -12.9 | -10.1 |
| Exports of goods fob (US$ bn) | 0.9[c] | 1.0[c] | 1.2 | 1.3 |
| Imports of goods fob (US$ bn) | 6.7 | 6.0 | 6.1 | 6.3 |
| Current-account balance (US$ bn) | -4.0 | -3.0 | -3.0 | -3.0 |
| Current-account balance (% of GDP) | -24.9 | -17.8 | -16.7 | -15.8 |
| External debt (year-end; US$ bn) | 15.0 | 19.6 | 22.5 | 25.0 |
| Exchange rate L£:US$ (av) | 1,507.5[c] | 1,507.5[c] | 1,507.5 | 1,507.5 |
| Exchange rate L£:¥100 (av) | 1,240.4[c] | 1,202.6[c] | 1,287.4 | 1,305.2 |
| Exchange rate L£:€ (year-end) | 1,328.6[c] | 1,580.9[c] | 1,771.3 | 1,748.7 |
| Exchange rate L£:SDR (year-end) | 1,894.5[c] | 2,049.5[c] | 2,146.3 | 2,132.9 |

[a] Economist Intelligence Unit estimates. [b] Economist Intelligence Unit forecasts. [c] Actual.

## II. SOCIO-ECONOMICAL NEEDS (PRIORITIES)

Analysis of major Lebanese socio-economic issues shows certain general needs and challenges that the Lebanese National Innovation System (NIS) should consider. These needs should be classified according to priorities based on national, regional and international requirements. Such urgent needs are:

- High and sustained economic growth to reduce national debt;
- Job creation to reduce brain drain and unemployment;
- High added value economic activities to improve economic growth rate and high standard of living and attract FDI;
- Exports increase to improve balance of exports-imports;
- Better competitiveness of economic sectors to respond to changes due to WTO, AFTA, EU partnership;
- Diversification of economic activities and the move towards knowledge-based economy. Creation of new high-tech industries and services;
- Better management of natural resources, particularly water, costal beaches, and land;
- Protection of the environment to improve tourism, life quality and to get into emerging environmental industries;
- Optimize energy consumption, to reduce cost of energy particularly for the production and services sectors in order to raise their competitiveness;

## III. NIS OBJECTIVES AND MEANS IN RESPONDING TO NEEDS

A simplified conceptual model of NIS is that it is composed of the following components and of effective linkages between these components: education and training, R&D, technology transfer, product innovation and development, regional and international cooperation, technical services, information and knowledge dissemination, and the production and services sectors.

A long-term vision for the Lebanese NIS is that it should play an important role in dealing with the recognized major SE needs. The richness in human resources should lead the Lebanese economy successfully towards a stable and strong KBE.

The general objectives of the Lebanese S&T policy that will create a NIS responding to the SE needs are:

1) Adopt a holistic approach in the reform of the Lebanese NIS. Missing linkages between HE, R&D and "production and services" activities should be established, both in the public and private sectors. This objective could be achieved through:

   - Coordinating national sectoral policies with the S&T policy;
   - Promoting partnerships, networking and clustering between the different components of the NIS;
   - Encouraging the creation of NIS linking mechanisms and institutions, such as: science parks, technology incubators, centers of excellence, cooperative research centers, venture capital funds;
   - Helping the private sector to participate in national R&D and S&T activities.

2) Improve the participation of the national educational system in the Lebanese SE activities. The objective is to have a HRD which should lead to less brain drain and better employment of graduates. This is achievable through:

   - Ensuring an education curricula more relevant to Lebanese market demand;
   - Establishing contact with expatriates abroad in order to solicit their participation in the reconstruction and development of the country;
   - Establishing effective private and public employment agencies, and a national programme aiming specifically at employment of graduates;

- Elaborating a manpower plan that identifies the skill and specialization needs of the Lebanese labour market in the next five to ten years. Such a plan would permit proper counseling of students as to career opportunities;
- Introducing incentives for students to move into the type of training most needed by the Lebanese economy;
- Promoting a better distribution of education institutions between Mohafazats, to reduce migration of working age population from villages and towns towards the city or towards other countries;
- Promoting R&D in Lebanese universities and adopt a proactive Masters and PhD programmes in cooperation with the private sector.

3) Improve the national capacity in R&DI to respond to the Lebanese SE needs; and to contribute to a sustained economic growth. This objective is realized through the following policies:

- Adopt a national programme to support the private sector demand of R&DI, and to support the cooperation of this sector with national HE and R&D institutions;
- Create new R&D units, related to Lebanese SE needs, and render more support to existing ones;
- Create intermediate institutions to link R&D and HE to the market, such as: science parks, incubators, centers of excellence, venture capital funds, cooperative R&D centers and laboratories between the private sector and R&D institutions;
- Promote Lebanese capacity in product development: reverse engineering, technology transfer, CAD/CAM, physical design;
- Increase the number of R&D staff in Lebanon.
- Increase expenditure on R&D (GERD)

4) Focus on three major R&D axis: (1) basic sciences, industrial technologies and engineering sciences; (2) environmental sciences, agriculture and biological sciences; (3) medical sciences and public health.

- Adopt national R&D programmes in the major three axis that would:
  - Improve the technologies of already existing sectors;
  - Create new sectors based on new technologies;
  - Anticipate for the transfer and adoption of emerging technologies.

- R&D in the first axis would focus on
  - Application of TQM in Lebanese industries; and adoption of international industrial standards, to ensure that Lebanese products and services will be in conformity with these standards;
  - Creation or linkages of industrial and technological databases or information systems related particularly to Lebanese production and services sectors;
  - Automation technologies for production lines, particularly for major Lebanese industrial sub-sectors, namely: textiles, metal, and agro-industries;
  - ICT applications in the Lebanese financial sector, particularly new technologies such as GPRS telecommunication which is expected to introduce major drastic changes in this sector. This important sector in the Lebanese economy is now not as competitive as it used to be;
  - Building Lebanese absorptive capacity of new technologies and new industrial sector such as ICT, electronics, advanced and new materials, and mechatronics;
  - Renewable energies, energy management, and energy conservation.

- R&D in the second axis would focus on:
  - Water management both surface and underground, and the use of ICT in this field;
  - Waste, water and air recycling technologies and industries;
  - New technologies for agro-industries including new packaging techniques;
  - Biotechnology for agricultural applications;
  - Application of ICT in Lebanese tourism.

- The 3rd axis would include R&D on:
  - Selected pharmaceutical fields. The selection should be drive by the Middle East market, and based on the high technical human resources available in Lebanon;

- Capacity building in medical services. Lebanon had a comparative advantage in the Arab world in this respect. This status could be restored. "Medical Tourism" could be a successful field of this sector in Lebanon;
- Selected biomedical fields and industries;
- Devices particular to the region;
- E-healthcare on the regional level.

5) Diversify and increase funding of R&DI by means of the following measures:
   - Raise funds from public, private, regional and international resources to augment the GERD to a higher percentage of the Lebanese GDP;
   - Promote legislative incentives for the private sector to encourage its demand of R&DI;
   - Adopt national programmes to encourage industry-university cooperation in R&DI;
   - Encourage the creation of venture capital funds and banks;
   - Increase the Lebanese efforts to profit from regional and international aids for R&DI.

6) Intensify Technology Transfer (TT) efforts by:
   - Improve local TT between universities, R&D institutes and the production and services sectors;
   - Improve local negotiation capacity of Lebanese companies for TT;
   - Improve local capacity in selecting new technologies;
   - Ameliorate local absorptive capacity for TT, revere engineering, and product development;
   - Regulate TT by avoiding unsuitable technologies for the Lebanese market.

7) Create a favorable environment for S&T (R&DI) from the legislative, administrative, fiscal and informational point of view (see Section IV).

## IV. INSTITUTIONAL OBJECTIVES OF LEBANESE S&T POLICY: NEEDED LINKAGES WITHIN THE NIS

For the Lebanese S&T policy to be effective, the NIS should be activated. This can be achieved by establishing strong links between the components of this system. These links are now either weak or non-existent in the Lebanese NIS. These needed links can be classified in six categories, which are:

a. Favorable environment: Legislative, Administrative, Social and Informational;
b. Missing Aspects in Human Resources Development;
c. Needed Institutional Cooperation and Partnership;
d. Missing Financial Links:
e. Contractual Partnership Programmes;
f. Needed S&T Planning and Monitoring Mechanisms.

Box –1- shows a summary of these needed linkages which would make the S&T strategy effective and implementable and would create and stimulate entrepreneurship environment.

**Box –1-a**

## Needed Institutional Cooperation and Partnership

1- **Cooperative Research Centres (CRC).**
2- **Incubators (BI, TI).**
3- **Science, Research and Technology Parks.**
4- **Virtual Parks.**
5- **Centres of Excellence (specialized).**
6- **Expertise Centres (specialized).**
7- **Collaboration with industry through:**
   * **Technology Consortia**
   * **R&D Syndication**
8- **Service Centres:**
   * **Information Services Public and Private Establishments;**
   * **Technical Services Public and Private Establishments;**
   * **Technical Consultancy Public and Private Establishments.**
9- **Technology Centres (specialized).**
10- **NSB National Standards Bodies.**

## Missing Aspects in Human Resources Development

- Reorient University objectives: entrepreneurial universities
- Partnerships between universities, R&D institutions and the private sector in:
  - Design of curricula
  - Higher education R&D: Master and PhD programs
  - Market oriented specialties
  - Training programs
- Translation to Arabic of S&T sources, and Arabisation of education for the work force,
- Build effective school-to-work system
- Product Development courses in higher education,
  - Manufacturable prototyping, Physical design of products, Technologies, CAD/CAM, ..
  - Technical Doc.( Procedures,..)
  - QM Specifications
  - Technologies and equipment
  - Supply Chain (Components, Materials,.)
  - On-Line testing equipment&fixtures
  - Production line design
  - Plant engineering design
- Promote Techno-commercial education: Industrial financing and accounting, Marketing studies (Pre-production,..), Fund raising , …

**Box –1-b**

## Missing financial links :

**1- Increase investment in the creation R&D based SMEs :**

* Venture capital funds and banks
* Angel capital
* Seed capital
* Matching capital

**2- Public fiscal measures (fiscal incentives)**

* Depreciation allowance for R&D capital
* Tax concession for R&D expenditure
* Reduce import tariff on R&D equipments

**3- Public financial measures**

* R&D revolving fund
* Soft loans، Graduates Recruitment Fund
* R&D grants. Innovation Fund

**4- Increase GERD both public and private.**

## Contractual Partnership Programs:

**Missing Partnership Programs Through National Initiatives such as:**

- **Commissioned research**
- **Collaborative projects – Development Agreements - Cooperative Research**
- **Joint Research grants**
- **Sharing of research facilities public/private**
- **Transfer or license the patents of publicly funded technologies to the private sector.**
- **Consultancy.**

**Box –1-c**

## Needed S&T Planning and Monitoring Mechanisms

- S&T foresighting and forecasting centers
- National S&T initiatives
- Institutionalized S&T indicators monitoring
- Technology management in each sector ( public and Private)
- Targeted and proactive international cooperation in S&T
- Knowledge management structures
- Coordinated visions and strategies for the major Lebanese sectors
- Studies on implementation mechanisms of S&T strategies for Lebanon

## Favorable environment: Legislative, Administrative, Social and Informational

- Networking (promoting ICT tools)
- S&T databases and Information Systems
- Legislations: Antitrust law for technology transfer, Laws to support negotiation for technology transfer (Chinese case), ..
- Monitoring NIS: benchmarking, best practices, annual reporting, ..
- Laws for IPR protection and its enforcement,
- Stimulate spin-offs from public institution,
- Raise social awareness of the importance of NIS and its missing links
- Employing public investment for the promotion of national production and services sectors

## V. ICT TO SUPPORT NIS PERFORMANCE

### A. ACADEMIC NETWORKS - A MAJOR COMPONENT OF S&T STRATEGY IN LEBANON

Over the past two decades, academic communities all over the world, whether higher education institutions, national research institutes, centers of excellence, or industrial research centers strived towards establishing computer networks that link them together, given the high rate of information exchange within each community and amongst the various communities. Broadband local area networks (LANs) were constructed in buildings and campuses to satisfy the growing need for communication between researchers, professors, students and administrative staff in a given institution, while wide area networks (WANs) linked the various research and teaching institutions in a country. This led to the establishment of national academic networks, such RENATER in France, that enhance the communications capabilities among national academic communities and help advancing teaching and research capabilities while simplifying administrative tasks and procedures. These academic networks were also connected to regional backbones and to the Internet with very high throughput to allow for exchange of information with academic communities at the regional and global levels.

Five years ago efforts have been deployed by the UNESCO Cairo Office in the Arab region to build pilot academic networks linking universities and research centers at the national level, following a model that was widespread in European academic communities. Academic networks were planned for Lebanon, Palestinian Territories, Syria, and Yemen. The main objective of these projects was the creation of essential infrastructure facilities needed to upgrade higher education programmes, facilitate research and reduce administrative tasks.

The establishment of similar academic networks in countries of the region should lead to the creation of a wider regional academic network that will facilitate exchanges between Arab universities and more collaboration between researchers. It constitutes a step in the right direction towards the networked knowledge-based economy.

### B. THE LEBANESE UNIVERSITY NETWORK

At the request of the Lebanese Government and due to the fact that the Lebanese University1 (LU) lacked any networking infrastructure while other private universities had already some networking facilities in their campuses, the Lebanese project focused on establishing a Lebanese University Network (LUN) to connect about 20 campuses and sites, mostly in the Beirut area, forming an intranet, with gateways to the Internet. Funding was mainly provided by UNDP and OMSAR, through its administrative reform project, with some cost sharing by UNESCO and the Lebanese University. It was understood though that LUN was one component of the Lebanese academic network that needs to be established soon afterwards.

The infrastructure consists of LANs in the various campuses based on structured wiring in buildings (with optical fiber links between buildings) and a WAN linking these campuses. The WAN is based on ring topology, and links the major campuses through routers, leased lines and/or wireless connections, with star connections for satellite buildings/campuses. A gateway to the Internet exists at the main connection point. Following the intranet model, network servers (i.e. Web, Mail, DNS and Firewall servers) are installed at main locations. The network infrastructure is scalable and flexible in order to grow and develop over time underpinning all the development and operation of data network services and applications in all LU sites

[1] The Lebanese University is the official national institution responsible for Higher Education in Lebanon. Scattered around the country are 48 sites, 3,000 full-time faculty members, 2,000 part-time faculty members, 2,000 staff members and a student body counting over 65,000 individuals. This number is expected to grow quickly due to the economic conditions and to high fees in private universities (where fees/year are between US$ 6,000 and US$ 14,000 exceeding by far the average GNP of the country).

and branches, scattered throughout Lebanon, for the foreseeable future. The main objectives of this network are presented in box 1.

Box 1- Objectives of the Lebanese University Network

The long-term objective of the Lebanese academic network is to assist in achieving sustainable human resource development by helping the country accelerate development of Information and Communication Technology (ICT) facilities, skills, and use. The short-term objective is the creation of essential infrastructure facilities at the Lebanese University to use and adapt ICT for upgrading their programmes of teaching, research and administration through:

- Improving services at the University;
- Making LU more accessible through accessing its services electronically, anywhere and anytime;
- Improving the quality, timeliness, and accessibility of information in order to support decision-making processes at all levels;
- Improving efficiency and effectiveness at the operational level;
- Re-envision the academic services in order to move the organization toward the future;
- Achieve sustainable human resource development through the use of Informatics and Communications facilities;
- Allow all LU human resources (faculty, technical and administrative staff, students) to develop and to share knowledge in order to enhance their performance appraisal and their skills.

*Source: Al-Abbas, F. et al, "Academic networks in Syria and Lebanon: Objectives, structure and collaboration potential", in Proceedings of the First Syrian-Lebanese Symposium on Information & Communication Technology Development, 25-29 April 2000.*

## C. BENEFITS OF AN ACADEMIC NETWORK IN LEBANON

An academic network for Lebanon will facilitate exchange and sharing of information between the different academic institutions, thus increasing availability of applications covering teaching and research needs. Electronic information resources having increased in quantity, quality and overall importance over the last decade, there online library catalogues, networked CD-ROM's, bibliographical reference works and electronic journals can be made available by each academic institution to all others, reducing cost and increasing availability. Instant publishing becomes a reality as well as instant availability of local information about courses, facilities, plans and achievements. This network could also be the basis of e-learning activities, virtual universities, collaborative research and sharing of best practices in teaching and research.

Furthermore, research in many disciplines is increasingly dependent on national and international collaboration to the point that "virtual colleges" of scholars who cross university and country boundaries becomes a reality. A Lebanese academic network will facilitate such cooperation between scholars in the country and, once a regional academic network is established, in the region.

In the administrative arena, the network will help universities and the Ministry of Education exchange information regarding faculty members, employees, student admission and academic life in general.

## D. FUTURE PROSPECTS

Information Technology will redraw the map of education in the next few years. With the ever faster pace of change, the academic institutions are facing new challenges to bring their people up to speed – and very quickly. Knowledge navigation becomes more important than knowledge retention. This cannot be done without a sound infrastructure linking together all these institutions, which reduces traffic through the Internet outside of the country. The LUN is only the first step on the road to a Lebanese academic network followed by a regional academic network. Other steps will have to follow such as linking all universities in Lebanon to form a higher education network for at the Lebanese level, then connecting research and development institutions to complete the Lebanese Academic Network. Linkages with other (similar) academic networks on the regional and international levels should follow gradually.

# PART II

## VI. NEW SCIENCE AND TECHNOLOGY INDICATORS

Reliable information on science, technology and innovation (STI) capabilities in Lebanon provide essential inputs for relevant policy-making aimed at enhancing national competitiveness and productivity. Additionally, sound implementation of STI policies must rest upon reliable information concerning the state of the Lebanese science and technology (S and T) systems as well as regional and international trends likely to impact national competitiveness and productivity.

Traditional S and T indicators, emphasizing supply-side aspects, and inputs to national S and T "systems,"2 are collected and used by a relatively wide range of governmental and academic institutions in many developing countries, including Lebanon. Innovation indicators, on the other hand, constitute novelties to almost all developing countries. While the traditional variety of S and T indicators currently used are certainly of great value in policy and decision-making, they may only be of limited utility when dealing with the challenges and opportunities that Lebanon will need to tackle in an increasingly knowledge-based economy with intense global competition across all sectors.

Recognition of the value of scientific and technological innovations as basis for economic competitiveness, and through it, sustainable development is well established and widespread in Lebanon. However, the present state of understanding of the complex processes involved in transforming scientific and technological knowledge into commercially viable innovative inputs is still somewhat deficient. As a result, innovations based on scientific and technological knowledge and their socio-economic impact are still dealt with implicitly by planners and decision makers with little if any coordination or cooperation.

Special note must be made here of ESCWA intentions plans, in cooperation with concerned regional and international organizations, to act as hub for a regional network of national units or "observatories" to monitor STI activity and act as focal points for establishment of national databases on STI indicators. As a member country, Lebanon is encouraged by ESCWA to establish its own national STI observatory preferably in conjunction with a national network of investment and is encouraged as well to participate in the exchange of data, information and experiences on the implementation of relevant policies and strategies. Training related to the collection and analysis of STI indicators and their incorporation in policy and strategy formulation will clearly be required. In this, as in other areas of activity so crucial to sustainable development, ESCWA is quite keen to commit time and substantive resources.

## VII. CATEGORIES OF STI INDICATORS

STI indicators may be grouped into many categories or classes and according to a variety of conceptual frameworks. One class of indicators that is used in Lebanon concerns STI human resources and related development activities, such as the number of researchers, universities, their graduates, and the projects they engage in. Another class of indicators designed to appraise research and development (R and D) activity include such indicators as national expenditure on R and D, output produced by national R and D institutions and the effectiveness of linkages between such institutions and others concerned with the utilization of R and D output.

Classification of indicators should consider their position within Lebanon's STI system, as indicators of input, output or processes and linkages. Example of input indicators include the number of researchers and financial expenditure on R and D. Indicators used as STI output comprise the number of patents and papers published in refereed journals. As for processes and linkages indicators, they may consist of joint research activity, joint publications, and research contracts. On the other hand, indicators addressing the impact of STI

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2 For a detailed treatment of these notions see the ESCWA Study on Science and Technology Indicators – Basic concepts, definitions and prospects for development (Document Symbol: E/ESCWA/TECH/1997/6).

activity on economic performance include revenues generated by high technology enterprises or the export of high technology products in comparison to total exports.

Another system for classifying STI indicators depends on the nature of national activities undertaken relating to whether that activity targets the creation, dissemination, transfer or utilization of STI knowledge. This classification system may be more suitable for adoption in Lebanon considering the present state of its STI development, which is characterized by considerable separation of the aforementioned activities at the level of institutions and resource allocations.

Immense technological change is currently transforming the global economy with respect to a number of disciplines in science and technology. More specifically, new Information and Communications Technologies (ICTs) have introduced a multitude of changes in the innovation of countries and institutions to achieve a competitive edge. Therefore, it is essential to utilize indicators that describe national and enterprise performance in ICTs as users and developers.

Any sector in Lebanon's economy is capable of innovating, yet, innovation taking place at the enterprise level is considered the most valuable for direct benefits targeting national growth and competitiveness. Hence, attention has recently focused on evaluating innovation at the level of the individual enterprise. Some possible innovation indicators include the proportion of "innovating" firms, as opposed to the "non-innovating" ones, the impact of innovation or the percentage of sales derived from innovative products, as well as other indicators relevant to the measurement of innovation, such as resources devoted to R and D.

The following sections address a number of traditional science and technology (S and T) indicators. Section III explains indicators related to research and development indicators, bibliometrics, intellectual property indicators, and higher education indicators. The focus of Section IV is innovation indicators, namely, technological product and process innovation as well as international trade in high technology. Finally, Section V addresses information, communication technology (ICT) indicators.

The annexes to this summary contain a comprehensive list of indicators of STI capacity in selected domains tackled within subsequent sections, along with definitions. However, these indicators should be taken up in Lebanon's STI policy formulation and implementation in a manner that reflects immediate and long-term national needs. The selection of indicators should possibly be synchronized with phases of policy implementation at the national and sectoral level.

## VIII. SCIENCE AND TECHNOLOGY INDICATORS

### A. RESEARCH AND DEVELOPMENT INDICATORS

The capacity to undertake innovation activities is directly related to national R and D activity in Lebanon. The general tendency in R and D assessment has been to emphasize quantitative input indicators over output indicators. The complexity of estimating R and D output has incited wider use of indicators such as expenditure on R and D, number of R and D personnel, and the number of R and D projects in a particular area.3 Related indicators have also been assembled on the basis of the former two indicators, e.g. number of researchers per project in a particular area, annual expenditure per researcher and per project, etc. Frame 1 presents indicators providing information on a country's support for and performance in R and D, while Annex V presents further R and D indicators.

[3] One of the limitations of the data collected for estimating resources devoted to R&D is the fact that being an input, it does not measure technical change, and as such, falls short of including factors such as learning-by-doing.

**Frame 1. Indicators providing information on a country's support for, and performance in R and D**

- **Business Enterprise R and D Expenditure (BERD):** Accounts for contributions to R and D activity made by firms, organizations and institutes that primarily produce goods and services[4] for sale to the general public, as well as the non-profit private institutions that service them. Contributions to R and D by public sector enterprises are also included within this category.
- **Government R and D Expenditure (GOVERD):** Incorporates R and D expenditure by agencies, offices, and other entities that offer public goods and services[5], as well as those that oversee governmental, economic, and social policies of the country or community in question. This indicator also includes expenditure by non-profit institutions funded and directed by the government.
- **Higher Education R and D Expenditure (HERD):** Accounts for R and D expenditure by higher education institutions, such as universities and colleges, irrespective of their source of funding, degree of dependence on public policies or legal profile. This is also inclusive of expenditure by research centres, experimental stations and clinics that operate under the wing of higher education institutions or are affiliated with such institutions.
- **Private Non-profit R and D Expenditure (PNPERD):** Includes expenditure by non-profit institutions that serve the public sector, as well as those by individual donors to R and D activity.
- **Extra-national contributions:** Refers to contributions by organizations and individuals resident abroad[6]. This would include international organizations and any physical assets and activities they may deploy within national borders.

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

It may be possible to develop more intricate indicator systems and conduct more detailed analyses with regards to R and D contributions by the business and governmental sectors in Lebanon. Obviously more recent data would need to be available especially those related to the type of research expenditure, and area of scientific or technological activity.

From a quantitative point of view, R and D output can be measured through an assessment of the knowledge embodied in published scientific discoveries and technological innovations, as well as from sources of information that detail published research reports and patents. However, the creation of knowledge that stems from R and D activities is more difficult to measure. Annex III includes illustrative examples of international comparisons based on selected R and D indicators, essentially those for which data on Lebanon is available. Note, however that the numerical values for indicators listed in the annexes to this summary draft will need to be updated on the basis of more recent survey studies.

## B. BIBLIOMETRICS

Mathematical and statistical analysis of scientific publications may be conducted to study the extent and distribution of scientific output in a given field in Lebanon as well as the contributions of specific institutions or individuals. Bibliometric indicators generally focus on the output of research activity undertaken primarily in universities and public research institutes. They address both the quantity and the quality of such activity. In common with other indicators, they are significant only in a comparative sense.

The use of bibliometric data is based on the premise that the ultimate objective of scientific effort is knowledge production and that this is reflected in relevant literature. This is one of the basic weaknesses of using bibliometrics as an indicator. Despite their extensive use for evaluating scientific output, bibliometric indicators possess some additional shortcomings, [24]:

4 Excluding higher education

5 Excluding higher education

6 With the exception of the cars, ships, airplanes and space satellites that are operated by domestic organizations and the experimental locations of these organizations [24].

- Different scientific fields publish and cite prior work differently. Variations are also present between countries.
- Language biases may arise due to working with selected journals and periodicals. This is especially true in the developing countries, particularly those in which the working language of instruction and scientific communication is not English. Naturally the Arab countries fall in this category.
- Certain valuable scientific output that has become part of the "obvious" may no longer be cited.
- Extended periods of time often elapse between reporting a given result and adequate recognition of its value.
- Principal periodicals refer only to productive experimental or laboratory work, leaving out innovations in important including computation or software development.

Bibliometric indicators usually use a full-counting scheme of publications grouped by countries or regions. Otherwise, they may consider the distribution of periodicals across different scientific fields. It is also possible to combine several citation impact indicators into more complex indices, which could be accomplished by the following techniques:

- Relative specialization index: indicates the country's share of global publications in specific scientific fields relative to its share across all fields;
- Co-authorship: determines the link between different geographical regions by the association of several authors on the same publication;
- Scientific productivity: measures the productivity of individual organizations;
- Citation-based indicators: quantifies the citations or references made to an article from other articles over a certain period of time.

Frame 2 presents statistics on papers published in the ESCWA member countries.

**Frame 2. Science and Technology Papers Published in the ESCWA Member Countries**

The number of science and technology papers published in refereed international journals have increased in the last twenty years from a total 5,865 in the period 1970-1975, to 34,594 during 1990-1995. Egypt and Saudi Arabia are the most prolific in absolute terms; together they produced almost 74 per cent of all papers published in the Arab region between 1990 and 1995. Lebanon is the only county in the region whose publishing output decreased from 743 during 1970-1975, to 500 during 1990-1995. See Figure 22. Nevertheless, the number of citations received by these published articles is very small. The latest figures published by the Arab Human Development Report 2002 indicate that only four papers from the region are cited more than 40 times, almost negligible compared to the thousands of articles from the United States of America cited the same number of times.

**Figure 22. Number of Papers Published in ESCWA Member Countries**

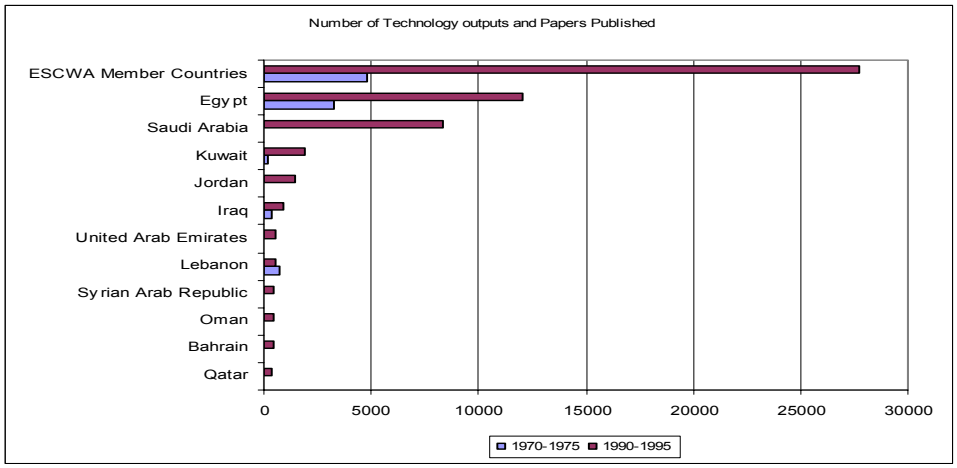


*Figure Source: UNDP, Arab Human Development Report 2002.*
*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

## C. INTELLECTUAL PROPERTY INDICATORS

Patenting is used as a primary tool by firms and individuals to protect their production and receive royalties on production and services activities based on an innovative concept. The number of patents granted in a given sector to a particular institution, or to researchers in a given discipline within a given country, is useful as an indicator of institutional and national contributions to innovation in that sector or discipline.

Limitations from resorting to patents as a measure of STI output include the following:

- Variations in patent systems across countries;
- Discrepancies as a result of differing tendencies to patent between sectors and organizations;
- Difficulties in assigning patents to a specific country or geographical location as some firms tend to patent centrally, i.e. applying from headquarters irrespective of the geographical location of the invention;
- Most patents never reach commercialisation, and as such their true contribution to competitiveness and productivity is not made.
- Some worthwhile inventions, primarily of cultural nature, but also including software items and certain biotechnology/genomic products such as new forms of life, are not protected with patents.

Based on data collected through patent offices, it is possible to extract several variables pointing to the extent and level of patenting activity:

- Summarized description of the invention;
- Various patent counts according to country, industry or technological field, time period, assignee type[7];
- Geographical distribution of assignees;
- Percentage shares of patent renewals;
- Number and type of contested patents.

These variables are relatively straightforward and provide valuable information that can primarily be used in economic, business, and policy analyses. Such analyses may be further enriched by incorporating economic and social variables leading to indicators that address [24]:

- **Productivity** of companies due to the impact of technology. Patents have been extensively studied in witnessing company economic growth;
- **Determinants of technological advance** relating to the production/import of new technology;
- **Spillovers/knowledge flows** implying the extent of technological exchange and knowledge accumulation;
- **Technology foresight** inferring the evolution of technological advance, and the impact of certain technologies on productivity.

## D. HIGHER EDUCATION INDICATORS

A set of widely used S and T input indicators are utilized in Lebanon to evaluate the performance of higher education institutions and their contribution to the accumulation of skilled human resources and intellectual capital. Gender segregated statistics are available but not necessarily up-to-date. Data collected for these indicators should (and generally are) encompass the field of specialization, degree or diploma, year of graduation, geographic location of the educational institution, and nationality of the graduate. Factors such as enrolment in the different levels of the national system of higher education are also available.

Both input and output elements should be used to analyse information on higher education and vocational training. Indicators less frequently used are those that refer to the quality of higher education, although they are exceptionally important and deserve a greater amount of attention. Assessing the quality of higher education requires considering a broad perspective of life-long learning, rather than restrict focus to the current labour market.

Some input indicators that may be useful to assess higher education in Lebanon comprise: expenditure on higher education, the number of students enrolled in the various stages and areas of specialization, and the

[7] Could be an individual, a company, university, etc.

ratio of students to professorial and assistant staff. Other indicators, such as spending on higher education in relation to gross domestic product and per student are also used. Moreover, the amount and type of equipment, science facilities, and number of computers available in institutions are important.

On the other hand, output indicators in higher education frequently refer to the number of graduates in different areas of specialization. The quality of the higher education system in Lebanon is measured by course completion rates across disciplines and areas of specialization, and the success rates in acquiring jobs at the end of the higher education courses. Note that the latter is an indicator of the prevailing general economic conditions and of the supply and demand of specialized professionals of a particular economy. Table A. 2 presents a comprehensive list of higher education indicators whereas Annex IV provides available statistics on Lebanon in relation to selected indicators.

## IX. INNOVATION INDICATORS

The development and diffusion of new technologies in Lebanon play a central role in securing improved productivity and competitiveness. Indeed, the global economy is being reshaped by new information technologies and by radical technological changes in a number of other disciplines in science and technology. However, despite the importance of scientific and technological innovation, understanding the processes that lead to innovations and to their dissemination is still deficient. As a result, the impact of technological changes is dealt with implicitly by planners and decision makers and is not normally reflected in reporting on Lebanese total factor productivity and in output growth rates.

While innovations can occur in any sector of the economy, those that take place at the enterprise level have been credited with enormous benefits for national economic growth. Therefore, attention is usually focused on evaluating innovation in the business enterprise sector and at the level of individual firms as well as activities related to enterprise creation, incubation and promotion activities undertaken in Lebanon's universities and research centres.

Success in refining the analysis of innovation is essential in improving understanding of the link between technological change and economic performance. More importantly, in the case of Lebanon, such success will help in formulating strategies for the collection and analysis of information on innovation flows and the promotion of national capacity building in innovation.

### A. TECHNOLOGICAL PRODUCT AND PROCESS (TPP) INNOVATION

In general, introducing TPP innovation involves activities on a wide front; aimed at securing inputs of scientific, technological, organisational, financial and commercial origins. It is often that a whole collection of such inputs will play an important part in producing conditions that eventually allow implementation of technologically new or improved products or processes.

A given entity, firm or institution, may engage in successful innovation leading to the creation and commercialisation of a new or improved product or process. However, innovation may be aborted due to difficulties encountered during various stages of the process of introducing innovative inputs in the product or process targeted. TPP innovations may also be aborted due to changes in market conditions and also due to regulatory or legislative changes, either national or international.

TPP innovation may be regarded as such only if it has been implemented; i.e. if it has actually been introduced into commercial application, in the case of product innovation, or used within a production process, in the case of process innovation. On the other hand, innovative firms may be engaged in "ongoing innovation" where innovative activities are in progress but have not yet reached a stage of commercial implementation.

### B. INTERNATIONAL TRADE IN HIGH TECHNOLOGY

A country's trade activity in high technology provides insight into its competitiveness. One indicator that may be used in Lebanon is the percentage of trade in high technology goods with respect to Lebanon's total exports. This indicator can be evaluated at the sectoral level or the product level.

The main problem facing this indicator is that data collected on high technology is often too general for reliable analysis. Using the data in conjunction with other data on R and D would perhaps help attain a more comprehensive view. Even so, it is not possible to clearly determine high technology content in a product. Moreover, the lack of standards by which to measure technological intensity, leads firms to classify products with similar technology content differently. It is with a view to resolving this difficulty that OECD and Eurostat have produced a list of products stipulating their technology content.

In its 2001 Human Development Report, the United Nations Development Program classifies exports as "low", "medium" or "high" technology. See Table A. 4. According to these definitions, data shows that a majority of ESCWA member countries do not export any high-technology content. The two exceptions are Egypt and Oman where high-technology exports account for a mere 2 per cent of their total goods exports, each. Medium-technology exports, such as various types of manufacturing equipment, are only slightly more common in ESCWA member countries.

## X. INFORMATION, COMMUNICATION, AND TECHNOLOGY (ICT) INDICATORS

The importance of information and communication technology (ICT) infrastructure and ICT capabilities in general is hard to over emphasize. In particular, indicators are required to point out progress achieved in ICT dissemination through higher educational and vocational training as well as capabilities being established for ICT research and development activities in addition to the extent of dissemination of selected ICT applications. Frame 3 lists relevant indicators in addition to selected statistics on Lebanon's ICTs.

**Frame 3. Information and communication technologies indicators: Definitions and Statistics**

The World Bank defines ICTs as " the set of activities which facilitate by electronic means the processing, transmission and display of information" [16]. By improving communication, ICTs promote information sharing and the accumulation of knowledge. They have also become essential in organizing and restructuring working methods. However, there are barriers that hinder the effective diffusion and implementation of ICTs in Lebanon as well as many other countries, such as general and computer illiteracy. The uneven diffusion of technology, which includes even conventional telephony, marks a failure in the developing world to participate in the new digital world [16].

Indicators allow for comparison of ICT capacity building among countries in reference to defined criteria. This would naturally allow decision and policy makers to devise appropriate policies and future action plans. However, in order to fully appreciate the significance of values associated with particular indicators, it is necessary to consider a number of related social and economic parameters. This is essentially the case since the value of an indicator does not always relate to socio-economic conditions and can seldom be used in isolation from underlying conditions that may facilitate or constrain ICT utilization. Nevertheless, an important starting point is to collect data on indicators at the national level as a prelude to their analysis in relation to socio-economic and other factors.

Several recent attempts at crafting measures of ICT capacity that are sensitive to specific socio-economic and national situations will need to be considered in more detail when devising a set of indicators, both simple and composite, that relate as closely as possible to current conditions in Lebanon. Table shows a list of the adopted ICT indicators whereas Table presents some statistics on ICTs in Lebanon.

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

**TABLE 15. ICT INDICATORS**

| Index/ Dimension | Indicators | Sources |
|---|---|---|
| 1. Connectivity | Internet hosts per capita | ITU |
| | Number of PCs per capita | |
| | Telephone mainlines per capita | |
| | Cellular subscribers per capita | |
| 2. Access | Internet users per capita | ITU |
| | GDP per capita | World Bank |
| 3. Policy | Presence of Internet exchange | UNCTAD research |
| | Competition in local loop telecom | ITU |
| | Competition in domestic long-distance | ITU |
| | Competition in ISP market. | ITU |
| 4. Other | Network Readiness Index | Harvard University |
| | ICTs in education | |

*Source: Adapted from United Nations Conference On Trade and Development (UNCTAD). Information and Communication Technology Development Indices. 2003*

**TABLE 16. SELECTED ICT DATA IN LEBANON**

| Country/ Region | Main Telephone Lines per 100 Inhabitants | Cellular Subscribers per 100 inhabitants | Personal Computers per 100 inhabitants | Internet Users per 100 inhabitants | Top-Level Domain names per 10,000 inhabitants |
|---|---|---|---|---|---|
| | **2002** | **2002** | **2002** | **2002** | **2002** |
| Lebanon | 19.88 | 22.7 | 8.05 | 11.713 | 21.08 |
| ESCWA member countries | 19.45 | 25.27 | 10.93 | 6.67 | 10.71 |
| Arab World | 13.47 | 17.69 | 6.72 | 4.57 | 7.04 |
| World | 18.04 | 18.77 | 9.22 | 9.72 | 238.26 |

*Sources: ITU World Telecommunication Indicators Database, 6th edition, 2002; ITU Arab States Telecommunication Indicators, 2000*

## XI. CONCLUSION

Over the past few decades, significant progress has been made in monitoring national STI capabilities. New and more complex indicator systems were developed through improved understanding of the paths taken by scientific and technological development, their impact on innovation, and through it, on national competitiveness and productivity. Indicators that enable monitoring of some of the more complicated aspects of the relationship between STI capacity, national growth, and competitiveness are now in use in all developed and most industrializing countries around the world.

Mastering the ability to use such indicators will be crucial for Lebanon's socio-economic policy and decision-making. National development strategies will be in greater need than ever before for these improved tools to evaluate the status of Lebanon's STI capabilities, forecast future prospects and institute appropriate measures to achieve desired changes. Attempts are being made in Lebanon to devise strategies aimed at enhancing national STI capabilities. These strategies should allocate top priority to overcoming obstacles to effective STI monitoring and evaluation. Two of the main difficulties often encountered in Lebanon in this regard are:

(a) lack of institutional arrangements dedicated to STI monitoring and evaluation;
(b) the limited degree of agreement among institutions on common definitions for some of the main entities addressed in STI performance evaluation exercises.

There is a pressing need to set up national STI observatories in Lebanon dedicated to monitoring STI capabilities. These observatories should be an integral part of the design of a national STI policy and the implementation of strategies. Additionally, it would be essential to form modalities that promote demand for information produced by these observatories. In particular, it will be of the utmost importance to set up national STI policy research units, capable of analysing national observatory outputs for the benefit of policy and decision-making. Designs aimed at implementing national STI strategies should include pilot activities aimed towards these ends. It is suggested that these observatories and consequent steps be hosted by NCSRL.

Monitoring the evolution of STI capabilities may certainly be facilitated by developments in ICTs. It should thus be possible to set up specialist statistical units, within universities and departments of education, at the national and district levels to carry out collection and initial analysis of information relevant to their scope of activities which then could be used in implementing policy and institutional change. Similar arrangements should be possible with regard to entities engaged in monitoring and licensing industrial enterprises related to issues of technology transfer and utilization activities, product and process innovations, etc., with minimal expenditure of costs and manpower efforts. Similar activities may be undertaken by agricultural extension services in monitoring STI related activities.

It is necessary for local efforts in Lebanon to move towards internationally adopted systems of indicators and analysis methodologies. Annex III and Annex IV list indicators categorized according to their specific function in national STI systems. Implementing some of the indicator systems listed in the annexes, especially those relating to innovation and to the utilization of STI knowledge which will not be a straightforward affair in Lebanon. Many aspects of such implementation will require a great deal of research activity, which reinforces the necessity for linking national STI observatories to policy research facilities.

In summary, greater efforts need to be exerted in Lebanon to collect and analyse statistics and other information on the evolution of its STI capabilities. Further manpower, financial and institutional resources will be required to:

- Develop a national system of indicators that reflects national aspirations and particularities, while maintaining emphasis on compatibility with regional and international metrics;
- Establish units dedicated to the development and implementation of STI indicators as part of efforts to review and update national STI policies;
- Allocate resources for training activities, capacity building, development of software packages, etc. that would standardize the use of STI indicators.

# ANNEXES

## Annex I. Key Indicators

| | |
|---|---|
| Surface area (thousand sq. km) | 10.4 |
| Population (millions), 2001 | 3.6 |
| Population (average annual percent growth), 1990-2000 | 1.8% |
| Life Expectancy at birth, 2000 | |
| Male (years) | 69 |
| Female (years) | 72 |
| Adult illiteracy rate (percent), 2000 | |
| Male | 8% |
| Female | 20% |
| Gross tertiary enrollment ratio, 1998 or most recent year | 38% |
| Gross domestic product (US$ billion), 2001 | 16.7 |
| Gross domestic product (average annual percent growth), 1990-2000 | 6.0% |
| Gross national income per capita (US$, PPP), 2000 | 4,550 |
| Growth of output (average annual percent growth), 1990-2000 | |
| Agriculture | 1.8% |
| Industry | -1.6% |
| Manufacturing | -4.3% |
| Services | 4.1% |
| Inflation (annual percentage change), 2001 | 0 |
| Unemployment (percent of total labor force), 1997 | 8.6% |
| Gross national savings rate (percent growth), 1990-2000 | -2.7% |
| Gross capital formation (percent of GDP), 2000 | 18.0% |
| Household final consumption (percent of GDP), 2000 | 87.8% |
| Current government revenue (ex grants, percent of GDP), 2001 | 18.6% |
| Total government expenditure (percent of GDP), 2001 | 35.5% |
| Overall budget deficit/surplus (percent of GDP), 2001 | -16.9% |
| Highest marginal tax rate, 2001 | |
| Individual | 20% |
| Corporate | 15% |
| Money and quasi money (annual percent growth), 20002 | 9.8% |
| Domestic credit provided by the banking sector (percent of GDP), 2000 | 183.4% |
| Stock market capitalization (US$ million), end 2001 | 1.228 |
| Exports of goods (US$ million), 2001 | 889 |
| Imports of goods (US$ million), 2001 | 7291 |
| Net energy imports (percent of commercial energy use), 1999 | 97% |
| Current account balance (percent of GDP), 2001 | -27.1% |
| Foreign direct investment inward stock (US$ million), 2000 | 998 |
| Foreign direct investment (percent of gross capital formation), 2000 | 10.0 |
| Total international reserves minus gold (US$ million), end 2001 | 5,013.8 |
| Total international reserves minus gold (months of import coverage), 2001 | 8.3 |
| Total foreign debt (US$ million), 2001 | 15,143 |
| Long-term debt (US$ million), 2001 | 12,167 |
| Total debt service (percent of GDP), 2001 | 10.5% |
| Total foreign debt service paid (percent of exports of goods), 2001 | 196.2% |
| Sovereign Long-term foreign debt ratings, July 2002 | |
| Moody's | B2 |
| Standard and Poors | B- |
| Real effective exchange rate (1997=100) 2001 | 106.9 |

*Sources: the Heritage Foundation 2002 Index of Economic Freedom; World Development Indicators 2002; IMF International Financial Statistics 2002; IMF World Economic Outlook Database, April 2002: Economist Intelligence Unit; UNCTAD FDI Statistics.*
*Values greater (less) than 100 indicate appreciation (depreciation).* *Ref.: AWCR (2002-03)*

## Annex II. Status of Industrial Zones in Lebanon

| Zones Decreed | Zones approved by Council of Ministers | Zones approved by the GDUP | Others (Informal) |
|---|---|---|---|
| 1. Aajaltoun | 1. Baalbeck | 1. El hirre* | 1. Naameh-Damour |
| 2. Aley | 2. Halba | 2. Amechit* | 2. Haouch Sneid |
| 3. Baabda | 3. Qalamoun | 3. Bahsas | 3. El Mansourieh |
| 4. Bauchrieh | 4. Sibline | 4. Beit Mery | 4. Halat |
| 5. Dbaye | 5. Sin el fil | 5. Broumana | 5. Qraiaa |
| 6. Fanar-roumieh | 6. Taalabaya | 6. Dekwaneh | 6. Toul (Nabatiye) |
| 7. Ghazir* | 7. Saadnayel | 7. Ghazieh | 7. Deir Nbouh (Zghorta) |
| 8. Hosrayel | 8. Zouq* | 8. Hadeth-Baalbeck | 8. Hermel (al Mansoura) |
| 9. Majdel-anjar | | 9. Kfarchima | 9. Qleiaat (Al Roumoul) |
| 10. Mkalles* | | 10. Choueifat | 10. Mazraat Bsafour |
| 11. Nabatiye | | 11. Baabdate-Sfeila | 11. El Qaa (ras baalbeck) |
| 12. Taanayel* | | 12. Hsoun (Jbeil) | 12. Semqaniye |
| 13. Bablieh | | 13. Al Safra (Kab-Elias) | 13. Majdel (amioun zonet) |
| 14. Ain anoub | | | 14. Jouar (Metn) |
| 15. Insariye | | | 15. Choueir (Metn) |
| 16. Bablieh | | | 16. Hammana (Metn) |
| 17. Mina | | | 17. Selaata |
| 18. Makse | | | 18. Edde (Jbeil) |
| 19. Nahr Ibrahim* | | | 19. Sarba (Jounieh) |
| 20. Chekka-Enfe* | | | 20. Ain Akrine (Batroun) |
| 21. Mazraat Yachoua* | | | 21. Basbine (Chouman) |
| 22. Choueifat | | | 22. Baaouerta (Aley) |
| 23. Bchamoun | | | 23. Baaqline |
| | | | 24. Beddawi |
| | | | 25. Bouj Hammoud |
| | | | 26. Saida |
| | | | 27. Tyr |
| | | | 28. Zahleh |

*Source: Data was compiled by URBI (January 1999)*

** The limits of these coastal zones were modified.*

## Annex III. Selected Science, Technology and Innovation Indicators

**TABLE A. 1. INDICATORS RELATED TO STI CREATION**

| RESEARCH AND DEVELOPMENT | |
|---|---|
| **Indicator** | **Definition** |
| Gross Domestic Expenditure on R&D (GERD) | Gross Domestic Expenditure on Research and Development (GERD) is total intramural expenditure on R&D performed on the national territory during a given period. [10] |
| GERD as a percentage of GDP | The Gross Domestic Expenditure on R&D expressed as a percentage of the Gross Domestic Product. |
| GERD per capita | The Gross Domestic Expenditure on R&D divided by the total population. |
| Percentage of GERD allocated to different sectors | The percentage of Gross Domestic Expenditure on R&D in the following different sectors (Business enterprise, Government, Private non-profit, Higher education, Abroad). *Adapted from* [10] |
| Percentage of GERD financed by organizations abroad | The percentage of Gross Domestic Expenditure on R and D financed by organization abroad out of the total GERD. The abroad section includes:<br>• All institutions and individuals located outside the political borders of a country, except vehicles, ships, aircraft and space satellites operated by domestic entities and testing grounds acquired by such entities.<br>• All international organizations (except business enterprises), including facilities and operations within the country's borders. *Adapted from* [10] |
| Full-Time Equivalent (FTE) researchers per capita | Full-time equivalent staff is a true measure of the volume of R&D. One FTE may be thought of as one person-year. Personnel should be measured as the number of person-years on R&D over the same period as the expenditure series. [10] |
| Number of R and D support personnel | Other R and D supporting staff include skilled and unskilled craftsmen, secretarial and clerical staff participating in R&D projects or directly associated with such projects. [10] |
| Number of national institutions involved in R&D | All National institutions including Universities and other organizations involved in R and D. According to the Frascati Manual, research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications. R&D must be distinguished from a wide range of related activities with a scientific and technological basis which should be excluded when measuring R&D.– Education and training.– Other related scientific and technological activities.– Other industrial activities.– Administration and other supporting activities. *Adapted from* [10] |
| National/regional prizes dedicated as incentives to researchers and inventors | The number of all national and regional prizes dedicated as incentives to researchers and inventors. |
| Number of registered patents | A patent is defined by the Oslo Manual as a legal property right over an invention, which is granted by national patent offices. Patent statistics are increasingly used in various ways by technology students as indicators of the output of invention activities. [11] |
| Publications in refereed journals | A refereed journal has a structured reviewing system in which at least two reviewers, excluding in-house editors, evaluate each unsolicited manuscript and advise the editor as to acceptance or rejection. [23] |
| Co-authorship and other forms of STI cooperation with developed countries. | Co-authored publications involve authors from at least two different countries and are defined by research papers in which there are addresses of at least two authors in different countries. Note that the method of counting co-authored publications involves including all countries participating in the publication. [6] |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

**TABLE A. 2. INDICATORS RELATED TO STI DISSEMINATION**

| EDUCATION AND LITERACY | |
|---|---|
| **Indicator** | **Definition** |
| Literacy Rate (percentage) | Percentage of persons aged 15 and over who can read and write a short, simple statement on their everyday life. [25] |
| Growth in Literacy Rate | Percentage of increase of literacy rate over several years. [25] |
| Primary School Enrolment | Ratio of children of all ages enrolled in primary school to the country's population of school-age children (ages 6-11). [25] |
| Secondary School Enrolment | Ratio of children of all ages enrolled in secondary school to the country's population of school-age children (12-17). [25] |
| Secondary Technical Enrolment Average | Average over several years of the ratio of pupils preparing directly for a trade or occupation other than teaching, to total secondary school enrolment. [25] |
| **HIGHER EDUCATION** | |
| **Indicator** | **Definition** |
| Number of Universities and other Institutions of Higher Education | The total number of national Universities and Institutions of Higher Education. |
| Tertiary School Enrolment | Ratio of the number of pupils enrolled in all post-secondary schools and institutions by the population in the 18-24 age group. [25] |
| Number of students enrolled in STI fields (Bachelors, Masters, PhD) | Students currently enrolled in the natural and applied sciences, including medicine, as a percent of total enrolled students. [25] |
| Number of graduates in STI fields (Bachelors, Masters, PhD) | Tertiary graduates in the natural and applied sciences, including medicine, as a percent of total graduates. [25] |
| Higher education expenditure | Capital Expenditure on education is expenditure for assets that last longer than one year. It includes expenditure for construction, renovation and major repairs of buildings and the purchase of heavy equipment or vehicles.<br>The current Expenditure on Education is the expenditure for goods and services consumed within the current year and which would need to be renewed if there were a need for prolongation the following year. It includes expenditure on: staff salaries and benefits; contracted or purchased services; other resources including books and teaching materials; and other current expenditure such as furniture and equipment. [19] |
| Higher education expenditure as a percentage of GDP | Total expenditure on higher education expressed as a percentage of the Gross Domestic Product. |
| Higher education expenditure per capita | The Higher Education Expenditure divided by the total population. |
| Number of S&T colleges in universities | The number of Science and Technology colleges that provide studies in the following fields: engineering, natural sciences, mathematics and computers. *Adapted from* [6]. |
| Number of H&SS colleges in universities | The number of Humanities and Social Sciences colleges that offer studies in the following fields: social and behavioural sciences, journalism and information, business and administration, and law. *Adapted from* [6] |
| Distribution of S&T colleges in universities by area | The ratio of the different areas of Science and Technology colleges (Basic Sciences, Computer, Engineering, Medicine, Pharmacy, Dentistry, Nursing, Para Medicine, Agriculture, Veterinary Science, Others) in universities to the total number of Science and Technology colleges. |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

**TABLE A. 3. INDICATORS RELATED TO STI TRANSFER**

| CONTRACTS | |
|---|---|
| **Indicator** | **Definition** |
| Number of contracts dedicated to consultancies and acquisition to know-how across sectors and countries | The number of consultancy contracts concluded in the following sectors: Agriculture and Fishing, Defence, Industry, Infrastructure, Services, Tourism and Transport. |
| Value of contracts dedicated to consultancies and acquisition to know-how across sectors and countries | The value of consultancy contracts concluded in the following sectors: Agriculture and Fishing, Defence, Industry, Infrastructure, Services, Tourism and Transport. |
| Number of industrial contracts concluded by sector | The number of industrial contracts concluded in the following fields: cement and glass, metallurgical, oil and gas, petrochemicals, pharmaceutical, power, waste management, water and others. |
| Number of infrastructure contracts concluded by sector | The number of infrastructure contracts concluded in the following fields: electrical, housing and offices, port, power, telecommunications, and water. |
| Value of industrial contracts concluded by sector | The value of industrial contracts concluded in the following fields: cement and glass, metallurgical, oil and gas, petrochemicals, pharmaceutical, power, waste management, water and others. |
| Value of infrastructure contracts concluded by sector | The value of infrastructure contracts concluded in the following fields: electrical, housing and offices, port, power, telecommunications, and water. |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

**TABLE A. 4. INDICATORS RELATED TO STI UTILISATION**

| EMPLOYMENT[8] | |
|---|---|
| **Indicator** | **Definition** |
| Employment in industry (% of total employment) | The industry sector includes mining and quarrying (including oil production), manufacturing, construction, electricity, gas, and water. [27] |
| Employment in services (% of total employment) | Services include wholesale and retail trade and restaurants and hotels; transport, storage, and communications; financing, insurance, real estate, and business services; and community, social, and personal services. [27] |
| Employment in industry, female (% of total employment) | The number of females employed in industry expressed as a percentage of the total number of people employed in industry. |
| Employment in services, male (% of total employment) | The number of males employed in services expressed as a percentage of the total number of people employed in industry. |
| **TECHNOLOGY TRANSFER** | |
| **Indicator** | **Definition** |
| Exports of high technology | High-technology exports are products with high R&D intensity. They include high-technology products such as in aerospace, computers, pharmaceuticals, scientific instruments, and electrical machinery. [17] |
| Exports of medium technology | Automotive products, manufacturing equipment (such as agricultural, textile and food processing machinery), some forms of steel (tubes and primary forms) and chemical products such as polymers, fertilizers and explosives. [17] |
| Exports of low technology | Low technology exports include textiles, paper, glassware, and basic steel and iron products (such as sheets, wires and un-worked casting) [17] |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

[8] The concept of employment generally refers to people above a certain age who worked, or who held a job, during a reference period. Employment data include both full-time and part-time workers. [27]

**TABLE A. 5. INDICATORS RELATED TO PRODUCT AND PROCESS INNOVATION**

| PRODUCT INNOVATION | |
|---|---|
| **Indicator** | **Definition** |
| New technology products introduced | A quantitative indicator supported by qualitative information on the number of new products introduced by a given sector or segment embodying new technology inputs. |
| Expenditure on new technology products | Presents information on expenditure allocated to the acquisition or development of new products embodying new technology inputs by sector or segment. |
| Export of technologically new products (as percentage of total exports) | Indicates the percentage of technologically new products exported in relation to total exports. |
| Market penetration of products incorporating new technology inputs | Presents information on the extent of dissemination of products incorporating new technology inputs. This indicator may have to target specific segments and sectors at the outset. |
| **PROCESS INNOVATION** | |
| **Indicator** | **Definition** |
| Process improvements introduced | Presents information on the number of processes introduced that are based on new technology inputs or that utilize new technology in production or service activities in a segment or sector under consideration. |
| Investment in new process equipment | Provides numerical information on expenditure dedicated to the purchase, maintenance and servicing of processes incorporating new technology inputs in a given segment or sector. |
| Extent of process automation in the segment/sector/industry. | This indicator is directly to the one listed above, but with reference to technology inputs targeting automation in particular. |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

## Annex IV. Selected Information and Communication Technology Indicators[9]

**TABLE A. 6. ICT INFRASTRUCTURE AND ACCESS INDICATORS**

| Indicator | Definition |
|---|---|
| Telephone main lines in operation (per 100 inhabitants) | Refers to a telephone line connecting the subscriber's terminal equipment to the public switched network and which has a dedicated port in the telephone exchange equipment. Note that one main line could serve several subscribers. [8] |
| Main lines for residential use | The number of main lines serving households (i.e. lines which are not used for business government or other professional purposes or as public telephone stations). [8] |
| Main lines in urban areas | The number of main lines in urban areas by the total number of main lines in the country. [8] |
| Waiting List | Shows the number of applications for a connection to a mainline that have been held up by a lack of technical capacity. [26] |
| Waiting Time | Shows the approximate number of years applicants must wait for a telephone line [26] |
| Revenue per Line ($) | Refers to the revenue received by firms per mainline for providing telecommunications services. [26] |
| Cost of local Call ($ per 3 minutes) | The cost of a three-minute peak rate fixed-line call within the same exchange area using the subscriber's equipment (that is, not from a public phone). [26] |
| Cost of Call within Region ($ per 3 minutes) | The cost of a three-minute peak rate fixed-line call within the region |
| Cost of call to US ($ per 3 minutes) | The cost of a three-minute peak rate call from the country to the United States. [26] |
| Number of fixed lines operators | A telephone operator or a switchboard operator is a person who helps callers reach the person they are calling. [2] |
| ISDN subscribers | The number of subscribers to the Integrated Services Digital Network. This can be separated by basic rate interface service and primary rate. [8] |
| Leased Lines subscribers | Leased circuits refer to a two-way link for the exclusive use of a subscriber regardless of the way it is used by the subscriber (e.g., switched subscriber or non-switched, or voice or data). Leased lines can be either national or international in scope. In reporting this indicator, only the number of lines should be included, not the number of network termination points. [8] |
| Initial Cost ($) | The cost in dollar of the initial installation charge |
| Monthly Charge ($) | The monthly rental charge of a telecommunication subscription. |
| Outgoing Traffic (minutes per subscriber) | Refers to the total telephone traffic measured in minutes and that originated in the specified country with a destination outside the country [26] |
| Mobile Phones subscribers (per 100 inhabitants) | Cellular telephone subscribers refers to users of portable telephones subscribing to an automatic public mobile telephone service which provides access to the Public Switched Telephone Network (PSTN) using analogue of digital cellular technology. [8] |
| TV receivers | The total number of television sets in use. Some countries have a licensing scheme where television sets must be registered. Since households may have more than one television receiver or may not register, the number of licensed receivers may understate the true number. [8] |
| Cable subscribers | Refers to the number of cable television subscribers. [8] |
| Newspaper circulation | Average circulation of a "daily, general interest newspaper" (defined as a news periodical published at least four times a week) per 1,000 people. [25] |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

[9] This draft collection of indicators has been compiled by the ESCWA ICT Division.

**TABLE A. 7. COMPUTERS AND INTERNET INDICATORS**

| Indicator | Definition |
|---|---|
| Personal Computers | Number of computers designed for single person use (though they may be used by many users and/or run unattended). [7] |
| Personal Computers in Education | The number of PCs installed in educational establishments, whether primary or secondary schools or universities. [26] |
| Networked PCs | Refers to the proportion of the total installed base of personal computers that are connected to a local area network. [26] |
| Internet Subscribers | The number of persons and organizations paying for access to the Internet. [9] |
| Internet Users | The total number of persons with access to the worldwide network. [26] |
| Dial-up Internet tariff | Consists of two components: telephone usage charges (monthly subscription, line rental and call charge paid to the telephone company), and Internet access charges (paid to the ISP). [9] |
| Dial-up Internet traffic | The volume of Internet dial-up traffic in minutes. [9] |
| Access to Internet | Number of inhabitants that have access to the Internet (at home, work or school) but who may not necessarily use it. [9] |
| Awareness of Internet | Number of inhabitants that are aware of the Internet. [9] |
| Internet Hosts | A host is a domain name that has an IP address record associated with it. This would be any computer system connected to the Internet (via full- or part-time, direct or dialup connections). [9] |
| ISPs | Number of companies that provide end-user access to the Internet. When necessary, a distinction should be made between "licensed" and "operational" ISPs. [9] |
| Internet monthly access charges, ISP monthly charges ($) | The monthly dial-up access charge for 20 hours of use. It excludes the initial ISP connection charge. Peak and off-peak prices are averaged. [26] |
| Available National Bandwidth | Bandwidth has a general meaning of how much information can be carried in a given time period (usually a second) over a wired or wireless communications link. For example, a link with a broad bandwidth - that is, a broadband link - is one that may be able to carry enough information to sustain the succession of images in a video presentation. [13] |
| Secure Servers availability | Secure servers are servers using encryption technology in Internet transactions. [26] |
| Local online content | The local online content includes web pages related to the following fields: news, enterprises, education, entertainment, portals, discussion groups and general information. |
| Top-Level Domain Names (TLDNs per 10,000 inhabitants) | A top-level domain (TLD) identifies the most general part of the domain name in an Internet address. A TLD is either a generic top-level domain (gTLD), such as "com" for "commercial," "edu" for "educational," and so forth, or a country code top-level domain (ccTLD), such as "fr" for France or "is" for Iceland. [15] |
| Academic Domain Names (percentage) | The .edu academic domain is one of the seven original top-level subdivisions of the Internet Domain Name System (DNS). The .edu domain is intended for regionally accredited degree-granting institutions of higher education. The percentage of academic domain names is the number of universities owning a website to total number of universities. [3] |
| e-government Index | An index that tends to reflect a country's economic, social and democratic level of development. [22] |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

**TABLE A.8. ICT EXPENDITURE INDICATORS**

| Indicator | Definition |
|---|---|
| Telecom expenditures | Current expenditure means expenditure other than investments; it consequently refers to the running of telecommunication services on an annual basis. [8] |
| ICT expenditures | Include external spending on information technology (spending on products purchased by businesses, households, governments, and education institutions from vendors or organizations outside the purchasing entity), internal spending on information technology (spending on internally customized software, capital depreciation, and the like). [26] |
| ICT expenditures as a percent of GDP | The percentage of ICT expenditures out of the Gross Domestic Product. [26] |
| ICT expenditures per Capita | The value of ICT expenditure divided by the number of the population. |

**TABLE A.9. ICT CAPACITY BUILDING INDICATORS**

| Indicator | Definition |
|---|---|
| Scientists and Engineers in R and D in ICTs | Scientists and Engineers engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the planning and management of R&D projects. [18] |
| R and D expenditures in ICTs | R and D expenditures are current and capital expenditures on creative, systematic activity that increases the stock of knowledge. Included are fundamental and applied research and experimental development work leading to new devices, products, or processes. [26] |
| R and D expenditures in ICTs as a percent of GNI | The value of R and D expenditure in ICTs expressed as a percentage of the Gross National Income. |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

**TABLE A.10. ICT LAWS AND REGULATIONS INDICATORS**

| Indicator | Definition |
|---|---|
| Laws relating to ICT use | Measures the efficacy of laws relating to electronic commerce, digital signatures, and consumer protection. Ratings range from 1 to 7; the higher the rating the better. [26] |
| Patent Law | A patent is defined by the Oslo Manual as an exclusive right granted for an invention, which is a product or a process that provides a new way of doing something, or offers a new technical solution to a problem. A patent provides to its owner a monopoly (with limited duration) for exploiting the patented invention, as a counterpart for disclosure (which is intended to allow a broader social use of the discovery). [11] |
| e-Commerce Law | e-commerce (electronic commerce or EC) is the buying and selling of goods and services on the Internet, especially the World Wide Web. In practice, this term and a newer term, e-business, are often used interchangeably. [12] |
| e-signature | e-signature is an electronic signature that can be used to authenticate the identity of the sender of a message or the signer of a document, and possibly to ensure that the original content of the message or document that has been sent is unchanged. Digital signatures are easily transportable, cannot be imitated by someone else, and can be automatically time-stamped. The ability to ensure that the original signed message arrived means that the sender cannot easily repudiate it later. [14] |
| Piracy Rate (%) | Software piracy is defined as the illegal copying, distribution, or use of software. Software piracy causes significant lost revenue for publishers, which in turn results in higher prices for the consumer. Some software publishers go out of business because of software piracy. Others are discouraged from entering markets where software piracy rates are high. [14] |
| IPR enforcement | Is defined as the rights awarded by a society to individuals or organizations over inventions, literary and artistic works, and symbols, names, images, and designs used in commerce. They are said to give the titleholder the right to prevent others from making unauthorized use of their property for a limited period. |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

**TABLE A.11. ICT POLICY INDICATORS**

| Indicator | Definition |
|---|---|
| National ICT strategy | The existence and development of an ICT national plan. |
| ICT Plan of action | The existence and development of an ICT plan of action. |
| National Initiatives | The presence of national introductory steps related to ICT. |
| Existence of Technology incubator | In the business world, an incubator is an enterprise that is set up to provide office space, equipment, and sometimes mentoring assistance and capital to new businesses that are just getting started. [15] |
| Planned Technology Incubator | Number and existence of planned technology incubators. |
| Operational Technopole Initiative | "Technology park" is used to describe a variety of efforts to stimulate the development of "entrepreneurial, knowledge-based small and medium-sized enterprises" (or SMEs) within a country. The term has at least 16 synonyms, with the most common being "science park," "research park," and "technopole." 0 |
| Plan of Technopole Initiative | The presence of a plan of technopole initiative. |

*Source: Economic and Social Commission for Western Asia (ESCWA). New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/...)*

## Annex V. Selected R and D Indicators and Data [10]

Some of the most commonly used indicators of R and D activity cover quantitative inputs, namely the number of scientists employed in R and D departments, expenditure per project and per researcher, overall investment in the purchase of new equipment and in building new facilities, and time allocated for a project completion. On the output side, the preference for indicator usage varies among countries.

In ESCWA member countries, the prevailing tendency is to evaluate results of R and D in terms of expected savings achieved through improved products and processes. Some efforts have been devoted to grade the R and D output in terms of conformity with planning parameters and initial expenditure, and time-to-delivery estimates. Nevertheless, the limitation of these methods has been the lack of indicators to measure the quality of the final product.

Information on National S and T policy or strategic plans and related institutions:

- Major components, themes and areas of focus, short- and medium-term objectives;
- Numerical targets and dates set in relation to resource allocations from GDP;
- National legislative and regulatory framework for R and D institutions/activities;
- Methodologies worked out for securing resources and following up on progress;
- Existence and orientations of bodies engaged in technology scanning and assessment at national\sectoral levels; date established and details of their linkages and operating methodologies.

- Number of R and D institutional units, their missions, affiliations and distribution over principal areas of R and D activity;
- Number of FTE (full-time equivalent) researchers and their distribution across R and D fields, by qualifications and type of institution (governmental, semi-governmental, private, etc.);
- Information on the existence, and extent of coverage and participation, in national information networks, as well as expenditure allocated to securing information as well as establishing linkages to other information networks/sources;

- Volume of total computing capabilities available to all R and D institutions and related activities across fields of activity and institution with information on generations and compatibility;
- Number of total support staff and their distribution across R and D institutions/units, R and D fields, as well as by qualification levels;
- Number of special R and D initiatives undertaken at the national level: aims, financial and other resources, cooperating bodies from industry, agriculture and the service sectors, as well as targets achieved;
- Initiatives and modes of assistance extended to businesses, concerning technology assessment and acquisition, with emphasis on the needs of small and medium enterprises;
- Number of R and D publications across institution types, R and D fields, as well as publication/dissemination media, i.e. local and international journals, as well as national, regional and international seminars, conferences and symposia;
- Availability, number and fields of activity of national technical facilities for R and D support, scientific equipment building and maintenance centres, laboratory equipment and materials manufacture/packaging facilities;
- Information on the activities of patent examination and patenting bodies and their linkages to R and D and higher educational institutions;
- Information on specialized R and D networks and special agreements for R and D collaboration and information/expert exchange within the country and with other countries/institutions.

Statistics for selected R and D indicators are briefly presented below11. Note, however that the numerical values for indicators listed in this and other annexes need to be updated on the basis on more recent surveys.

[10] This section draws mainly on [20]

**Full Time Equivalent (FTE) Researchers:** The distribution of full time researchers in the Arab countries for 1996 shows that the majority, around 44 per cent, converges on agricultural research. This is mainly due to the fact that most Arab countries have an important agricultural economy. Lebanon, for example, allocated almost 31% of its FTE workforce in this field. Engineering researchers in 1996 were most prevalent in the Syrian Arab Republic, at 32 per cent of total researchers. Meanwhile, Lebanon had 24 per cent of its FTE researchers dedicated to the basic sciences.

**R and D expenditure:** The R and D expenditure in the majority of the ESCWA member countries were in the range of $3 million to $70 million. Lebanon falls at $7.5 million in that range. An obvious exception is Egypt that had R and D expenditure value of $227.5 million. See Table A.13. The R and D expenditure per FTE researcher is a more valuable indicator that allows suitable comparisons among countries. The highest value of R and D expenditure per FTE researcher was that of Saudi Arabia with a value of $231,800.

**TABLE A. 12. NUMBER AND PERCENTAGE OF FTE RESEARCHERS BY R AND D AREA, AND THEIR DISTRIBUTION FOR EACH OF THE ARAB COUNTRIES IN 1996**

| Country | Agriculture | | Health | | Industry | | Basic Sc. | | Education | | Engineering | | Energy | | Petroleum | | Econ. | | Res. Mngmt. | | **Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | Nr. | Pct. | |
| **Egypt** | 5221 | 48.6 | 1827 | 17.0 | 871 | 8.1 | 751 | 7.0 | 523 | 4.9 | 471 | 4.4 | 509 | 4.7 | 236 | 2.2 | 102 | 0.9 | 233 | 2.2 | **10,744** |
| **Syria** | 124 | 34.8 | 30 | 8.4 | 13 | 3.7 | 15 | 4.2 | 39 | 11.0 | 112 | 31.5 | 20 | 5.6 | 0 | 0.0 | 3 | 0.8 | 0 | 0.0 | **356** |
| **Lebanon** | 63 | 30.7 | 32 | 15.6 | 4 | 2.0 | 45 | 22.0 | 22 | 10.7 | 14 | 6.8 | 12 | 5.9 | 0 | 0.0 | 8 | 3.9 | 5 | 2.4 | **205** |
| **Qatar** | 0 | 0.0 | 0 | 0.0 | 2 | 5.9 | 8 | 23.5 | 13 | 38.2 | 4 | 11.8 | 0 | 0.0 | 0 | 0.0 | 5 | 14.7 | 2 | 5.9 | **34** |

*Source: ESCWA-UNESCO. Research and Development Systems in the Arab States: Development of Science and Technology Indicators, 1998. (E/ESCWA/TECH/1998/3)*

**TABLE A. 13. R & D EXPENDITURE AND NUMBER OF FULL-TIME EQUIVALENT RESEARCHERS AND SUPPORT STAFF IN 1996**

| State | R and D expenditure (Millions of US dollars) | Number of FTE researchers | Number of FTE researchers per 100 000 population | Number of R and D support personnel | Number of R and D support personnel per 100,000 population | Ratio of R and D expenditure to the number of FTE researchers (thousands of US dollars) |
|---|---|---|---|---|---|---|
| Lebanon | 7.45 | 205 | 6.6 | 239 | 7.7 | 36.4 |
| Saudi Arabia | 196.1 | 846 | 4.5 | 1,575 | 8.4 | 231.8 |
| Yemen | 10.3 | 270 | 2 | 771 | 4.8 | 38.1 |
| Total in ESCWA member countries | 611.67 | 14 962 | 10.3 | 34 475 | 23.7 | 40.9 |

*Source*: Adapted from ESCWA-UNESCO, *Research and Development Systems in the Arab States: Development of Science and Technology Indicators* (E/ESCWA/TECH/1998/3).

[11] The material in this section is taken from: *ESCWA*. New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/…)

## Annex VI. Selected Data on Higher Education in Lebanon[12]

**Higher Education Infrastructure:** Most ESCWA Member Countries, including Lebanon, show an even distribution between the number of S and T, and H and SS colleges. The most recent statistics on the number of students and staff in Lebanon and other countries do not all belong to the same year as shown in Table A. 14. For comparison purposes, the student/staff ratio is of more significance than the actual numbers; that of Lebanon was 12 students per staff member in 1999.

**TABLE A. 14. HIGHER EDUCATION STUDENT TO STAFF RATIO IN LEBANON AND SELECTED ARAB COUNTRIES**

| | Academic Year | Student to Staff Ratio |
|---|---|---|
| Lebanon | 1999 | 12 |
| Oman | 2001 | 10 |
| United Arab Emirates | 1998 | 14 |
| Yemen | 2000 | 43 |

*Source: Adapted from ESCWA, Statistical Abstract of the ESCWA Region (E/ESCWSTAT/2002/6).*

**Higher Education Expenditure[13]:** One of the most significant input factors is expenditure on higher education, usually reported per capita or as a percentage of the country's GDP. Total higher education expenditure in the Arab countries amounted to US$ 6,976.7 million in 1996. Table A. 15 shows higher education expenditure in the Arab countries as a percentage of GDP for 1996. As a whole, Arab countries allocated an average of 1.25 per cent of their GDP to higher education expenditure in 1996 [4]. A majority of ESCWA member countries allocate a "medium" to "high" portion of their GDPs to higher education expenditure, Lebanon falls within "high" higher education expenditure as a percentage of GDP at 2.0%.

Higher education expenditure per student is another indicator that is useful to assess a country's investment in higher education. The values for Lebanon and other selected Arab countries in 1996 are shown in TABLE A. 16. The expenditure in higher education per student in Lebanon was about $3,100 whereas that of Saudi Arabia was at a value slightly lower than $10,000. The higher education expenditure per student in Yemen, on the other hand had a much lower value at about $500 indicating a low investment in higher education.

**TABLE A. 15. HIGHER EDUCATION EXPENDITURE AS PERCENTAGE OF GDP IN ARAB COUNTRIES, 1996**

| High: Above 1. 5 % | | Medium: 1.0 – 1.5 % | | Low: Below 1.0 % | |
|---|---|---|---|---|---|
| Jordan | 3.1 % | Sudan | 1.4 % | Qatar | 0.8 % |
| Palestine | 2.3 % | Algeria | 1.4 % | Iraq | 0.5 % |
| Lebanon | 2.0 % | Syrian Arab Republic | 1.3 % | Djibouti | 0.4 % |
| Saudi Arabia | 1.8 % | Yemen | 1.3 % | Libya | 0.4 % |
| Egypt | 1.6 % | Morocco | 1.2 % | United Arab Emirates | 0.3 % |
| | | Bahrain | 1.1 % | Somalia | 0.2 % |
| | | Kuwait | 1.1 % | | |
| | | Oman | 1.1 % | | |
| | | Tunisia | 1.1 % | | |
| | | Mauritania | 1.0 % | | |

[12] The material in this section is taken from: *ESCWA*. New Indicators for Science, Technology, and Innovation in the Knowledge-Based Society, 2003. (E/ESCWA/TECH/2003/…)

[13] Unfortunately, not all statistics on higher education systems in the Arab countries are available after 1996, further illustrating the obvious inadequacies in statistical resources in the region.

*Note: ESCWA member countries are shaded.*

*Source: Adapted from ESCWA-UNESCO, Higher Education Systems in the Arab States: Development of Science and Technology Indicators (E/ESCWA/TECH/1998/3).*

**TABLE A. 16. HIGHER EDUCATION EXPENDITURE PER STUDENT IN LEBANON AND SELECTED ARAB COUTNRIES (1996)**

| | Higher Education Expenditure per Student (US$) |
|---|---|
| Lebanon | 3087.3 |
| Oman | 9539.0 |
| Saudi Arabia | 9946.2 |
| Yemen | 515.0 |

*Source: Adapted from ESCWA-UNESCO, Higher Education Systems in the Arab States: Development of Science and Technology Indicators (E/ESCWA/TECH/1998/3).*

**Student Enrolment and Graduates:** Student enrolment, particularly at the Bachelor level, in the Arab region has been on the rise over the last decade. Masters and Ph.D. students have also increased but are still quite low, partly because not all universities in the region possess the necessary capabilities, in terms of qualified faculty members, course material and equipment. TABLE A. 17 presents the number of university students in Lebanon and selected Arab countries in 1996 whereas Table A. 18 gives the number of higher education students in more recent years.

**TABLE A. 17. UNIVERSITY STUDENTS AND GRADUATES IN LEBANON AND SELECTED ARAB COUNTRIES, 1996**

| | Bachelor | | Masters | | Ph.D. | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Students | Graduates | Students | Graduates | Students | Graduates | Students | Graduates |
| Egypt | 836,055 | 91,511 | 43,204 | 5,984 | 20,522 | 3,421 | 899,781 | 100,916 |
| Lebanon | 71,220 | 9,501 | 2,506 | 666 | 590 | 116 | 74,316 | 10,283 |
| Qatar | 7,477 | 1,289 | 78 | 23 | 57 | 10 | 7,612 | 1,322 |
| United Arab Emirates | 14,691 | 1,691 | 213 | 57 | 294 | 53 | 15,198 | 1,801 |

*Source: Adapted from ESCWA-UNESCO, Higher Education Systems in the Arab States: Development of Science and Technology Indicators (E/ESCWA/TECH/1998/3).*

**TABLE A. 18. NUMBER OF HIGHER EDUCATION STUDENTS AND UNIVERSITY GRADUATES IN LEBANON [14]**

| | 1997 | 1998 | 1999 | 2000 | 2001 |
|---|---|---|---|---|---|
| University Graduates | 11,422 | 11,298 | 12,895 | 14,742 | - |
| Higher Education Students | 87,957 | 87,330 | 101,440 | 103,869 | 119,487 |

*Source: ESCWA. Statistical Abstract of the ESCWA Region. 2002. (E/ESCWA/STAT/2002/6)*

[14] Higher education institutions include university and other higher education institutions

*Abbreviations*

| | |
|---|---|
| AFTA | Arab Free-Trade Agreement |
| CAD | Computer Aided Design |
| CAM | Computer Aided Manufacturing |
| EU | European Union |
| FDI | Foreign Direct Investment |
| GDP | Gross Domestic Product |
| HE | Higher Education |
| HRD | Human Resources Development |
| ICT | Information and Communication Technology |
| IS | Industrial Sector |
| KBE | Knowledge-Based Economy |
| MoI | Ministry of Industry |
| NIS | National Innovation System |
| R&D | Research and Development |
| R&DI | Research and Development and Innovation |
| S&T | Science and Technology |
| SE | Socio-Economic |
| WTO | World Trade Organization |
| AWCR | Arab World Competitiveness Report |
| WB | World Bank, CUS: Country Unit Staff |
| LEDO | Lebanese Environment Development Observatory |
| L.S.O.E.R. | Lebanese State Of Environment Report |
| Ref | Reference |

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