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PROGRESS MADE IN THE IMPLEMENTATION OF THE WORK PROGRAMME
THE ACTIVITIES OF GOVERNMENTS AND INTERNATIONAL AGENCIES
IN THE FIELD OF
WATER RESOURCES WITHIN THE ESCWA REGION

Note by the Secretariat

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ABBREVIATIONS

a. s. l	Above sea level
C	Construction
d	day
D	Design
E	Ended
F	Feasibility
Gov'tal	Governmental
gpm	Gallon per minute
gpd	Gallon per day
he	hectare
km	Kilometre
km ²	Square kilometre
km ³	Cubic kilometre
I	Institutional support
l/s	Litres per second
l/s.m	Litres per second per metre
m	Metres
m ³ /d	Cubic metre per day
m/d	Metres per day
m ³ /s	Cubic metres per second
mm	Millimetres
mm/annum	Millimetres per annum
Mm ³ , mcm	Million cubic metres
MSF	Multi-stage flash
MCM/annum	Million cubic metres per annum
M	Million
MGD	Million imperial gallons per day
N.A.	Not available
W.S.	Water supply

I. INTRODUCTION

The ESCWA Natural Resources, Science and Technology Division has developed this programme element in the work programme for the biennium 1984-1985 to follow up progress reached by the members of the Commission in achieving goals of water resources development. This is in compliance with the Mar del Plata Action Plan ^{1/}, whereby many resolutions were adopted in this area.

The current programme element, entitled "Survey of recent activities in the field of water resources development in the ESCWA region", has been implemented as one of the programme elements first approved by ESCWA member States at the tenth session. The current report "The activities of Governments and international agencies in the field of water resources within the ESCWA region", (E/ESCWA/NR/86/4) is the final output of this programme element. It aims at, as stated in the work programme for the biennium 1984-1985, at reviewing major water resources development projects with overall socio-economic impacts which were executed or under execution in the period 1980 to 1985. Results obtained from the survey will be used in establishing a data base. Accordingly, it is expected that information and experiences will be shared by the members in the region. Among other requests, some representatives at the twelfth session of ESCWA, held in April 1985, had requested that such a survey be conducted. In fact this survey is considered the base for the existing water resources situation aiming at establishing an integrated plan for a data and information base concerned with the water sector in the region. It is expected that the report will be used to provide guidance to member States in implementation of their water resources development plans by dissemination and exchange of information of various aspects of water sectors among member countries.

^{1/} Report of the United Nations Water Conference, Mar del Plata, 14-25 March 1977 United Nations publication (E/CONF. 70/29) chap. VI, pp. 76-78.

II. SURVEY OF WATER RESOURCE DEVELOPMENT PROJECTS IN THE ESCWA REGION DURING 1980-1985

A. Country by country

On a country -by country basis, the main report contains a summary of the progress achieved in water resources development in the ESCWA region. In each country, the presentation of information is introduced following the same pattern. The main aspects encountered for each country are:

1. Country profiles including some basic economic, demographic, geographic (physiographic) and climatic indicators in each country;
2. Major water sector institutions in the country, sometimes with clarifications as to the mandate of the institutions;
3. Country water resources including brief descriptions of conventional and nonconventional water resources available in each country;
4. Descriptions of country water resources development projects (1980-1985) to include briefly, but not too briefly, the main water resources projects during the period 1980 to 1985. Projects started before 1980 and extended after 1980 were also considered under this survey. Constraints on the development of the water sector were indicated whenever possible. Experiences gained, technologies and methodologies applied were also mentioned. In addition the water projects were presented and classified on a sectorial basis. Emphasis was placed on these water activities which have a direct impact on national and/or regional socio-economic development.

One should bear in mind that the water resource projects introduced in this report are not the only water activities executed in the concerned countries. Certainly, there are other projects executed in the region in addition to those listed in the original text. If some projects are not mentioned in the text, it is due to the lack of adequate information on such projects, or contradictory information from different sources, or to the fact that no information on these projects was given to the Commission.

Some member countries were not fully covered in the report due to the special political situations prevailing in their countries, as is the case in Lebanon and the West Bank and Gaza Strip.

B. Regional water resource development projects

In spite of the success observed in the field of regional water resources in many other places in the world, regional water resource development projects are limited in the ESCWA region. It is necessary to develop co-operation, co-ordination and management; the shared water resources

which should be promoted between the ESCWA countries; as well as agreements should be established among them so that all would benefit from available water resources. Technically speaking unilateral development of common water resources will never reach its full usefulness and totality without full knowledge of the shared main water parameters, i.e., geomorphology, hydrology, hydrogeology, hydrometeorology, agrometeorology, climate, soil and socio-economic conditions prevailing in the project area. Co-operation among countries will facilitate studies of such parameters required and the outcome will benefit all.

The ESCWA region has the potential for regional projects. This is confirmed by the existence of major surface and ground-water basins such as the following: the sandstone aquifer from the Paleozoic - Mesozoic geological eras, which extends through Jordan, Saudi Arabia, Qatar, Kuwait, Bahrain, the United Arab Emirates, Omani and Democratic Yemen; the Um-Al-Radhuma - Damnam limestone aquifer which occurs in Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates, Oman and Democratic Yemen; the Euphrates river basin which is shared by Syria, Iraq and Turkey; the Yarmook river basin which is shared by Syria and Jordan; the AL-Asi-Al-Kabir river basin shared by Syria and Lebanon; and the Wadi Tuban, Wadi Bana and Wadi Beihan watersheds in both Democratic Yemen and Yemen. In addition there are non-conventional desalination problems common to the Gulf Co-operation Council countries.

The most active agencies in executing and funding the regional projects are the United Nations agencies and the Arab Centre for the Study of Arid Zones and Dry Lands (ACSAD). During the period between 1980 to 1985 many projects were executed, and here below are some of these projects:

1. The Hammad Basin project

The project was initiated in 1975. The four countries sharing the basin - Iraq, Jordan, Saudi Arabia and the Syrian Arab Republic - have undertaken co-operation action within a plan aimed at an integrated study of available natural resources in the basin. Special attention was given to development of water resources.

2. Shared water resources in the Gulf States and the Arabian Peninsula (Damnam aquifer):

The project was executed by the Food and Agriculture Organization of the United Nations (FAO). The project area covers 1.7 MKm². The main objective of the project is to develop a hydrogeological model for the eastern Arabian basin.

3. International Drinking Water Supply and Sanitation Decade

The project was executed by ESCWA and funded by the United Nations Development Programme (UNDP). Cost estimate of the project was \$0.04 million. The objectives of the project are mainly to review the national plans in ESCWA member countries for the International Drinking Water Supply and Sanitation Decade and to draw up a regional plan of action on the Decade's activities to be undertaken by the Commission during that period.

4. Study and development of traditional waterworks

The project is to optimize the utilization of the rural water resources through development of the existing conventional waterworks in the Arab countries; it is executed and funded by ACSAD.

5. ACSAD water resources data bank in Arab countries

Phase I of the project has been executed.

6. Regional development and application of components of a hydrological operational multipurpose (HOMS).

The project is executed and funded by ACSAD, UNDP and Arab countries to improve hydrological data and utilize rationally the available water resources.

7. Water resources mapping of the Arab countries

The project is executed and funded by ACSAD and Arab countries.

8. Yemeni joint project for natural resources

The United Nations Department of Technical Co-operation for Development (DTCD) is the executing agency for the project. It is funded by UNDP and the Arab Fund for Economic and Social Development (AFSED). Funding amounted to until 1985 \$5.2 million. Project objectives are:

(a) National exploration and management of mineral and water resources;

(b) Geological and hydrogeological survey of mineral and water resources in both Yemens.

III. UNITED NATIONS AND OTHER FUNDING AGENCIES CONTRIBUTION TO WATER RESOURCE DEVELOPMENT PROJECTS IN THE ESCWA REGION

It is needless to say that the United Nations agencies are playing a major role in developing the water sector in the ESCWA region either by executing or funding water and sanitation projects. Chapter II of the report presents, inter alia, the United Nations agencies' activities in the region in different aspects of water resources development as well as in sanitation. It is obvious that the least developed countries (Democratic Yemen and the Yemen Arab Republic) receive most of the assistance offered by the United Nations agencies; Egypt, Jordan and Syria come after in terms of benefits received from funding assistance in supplying water and sanitation projects in their countries.

Oil-producing countries receive assistance from United Nations agencies principally for strengthening of manpower and of their water institutions. Also, there are various donor agencies, banks, funds, international organizations and voluntary services which are funding activities in the water sector in different parts of the world including some parts of the ESCWA region.

Water-related programmes have always been an integrated part of the United Nations agencies overall development effort and in particular of UNDP, which is represented in more than 150 developing countries by a Resident Representative to co-ordinate all United Nations programmes in the country. Other agencies such as the World Health Organization (WHO), the World Meteorological Organization (WMO), FAO, the World Bank and the International Development Association (IDA) were active in funding, supervising and executing many of the projects in many ESCWA member countries.

Bilateral donors such as the Netherlands, the Federal Republic of Germany, France, the United States of America and the United Kingdom were active in assisting the developing countries in the ESCWA region technically or financially to promote the water sector. Also, there are several development banks and funds whose contribution in the last five years had benefited the water sector in the region: they include AFESD, the Islamic Bank, the Kuwaiti Fund and the Abu Dhabi Fund. The report contains details on assistance to different countries.

IV. CONCLUSIONS AND RECOMMENDATIONS

Over the past decade, the ESCWA region has witnessed unusually rapid socio-economic development, and remarkable progress has been achieved through national economic development plans in each member country. Particular problems have been created by the need to satisfy the excessive water demand caused by an improved standard of living. To solve these problems water resources development should be improved and advanced, and water resources management should be based on a comprehensive water resources master plan.

The following summary, conclusions and recommendations concerning water resource development projects are presented on a country-by-country basis, as drawn from the main report.

1. Bahrain

In the last decade, Bahrain has witnessed a rapidly declining hydraulic head of its ground-water resources associated with a water-quality deterioration. Sea-water intrusion can be observed around the island's perimeter and an invasion from waters deep within the aquifer system has been identified. Accordingly, owing to the limited ground-water resources Bahrain, as an alternative and rapid solution, has decided to depend intensively on desalinated sea-water for domestic and industrial uses. Therefore, Bahrain's water resources projects executed in the last five years (1980-1985) were focused on desalination and sewage treated effluent. Bahrain's water sector received bilateral assistance from Saudi Arabia and Abu Dhabi to construct a huge desalination plant at Sitra and a sewage treatment plant at Tubli to reuse water for agricultural purposes.

A specific Drinking Water Supply and Sanitation Decade programme does not exist but water supply and sanitation projects are integrated within the national development plans. From the above, the following recommendations can be made.

(a) Bahrain currently depends on the exploitation of its artesian ground-water aquifers. There are fears that ground-water reserves could be damaged by such heavy loads, and that salinity would rise despite strict measures to control the use of water by both domestic and industrial users. Therefore, it is recommended that ground-water withdrawal be controlled strictly and that the Alat-Khobar aquifer be studied in detail in an endeavour to clarify the situation and to quantify the resources.

(b) A National Water Plan would help in coping with the water situation and a strategy should be formulated with special emphasis on the rational utilization of scarce water resources and the expensive non-conventional desalination of sea-water; this would include conservation measures, strict regional water management, establishment of priorities in water use, and closer co-ordination of agricultural, industrial and water development plans.

(c) Development of a water training programme to close the gap in skilled manpower deficiency at all levels.

2. Democratic Yemen

The exploitation of ground-water resources will be excessively increased to meet the growing water demand for all types of uses. Surface water from the Wadi Tiban flood recharges the aquifer; the amount of surface water is estimated at 60 Mm³/annum of which around 55 Mm³/annum are withdrawn for drinking and irrigation purposes. There is a continuous drop in the water level associated with water-quality deterioration due to sea-water encroachment up-delta of Wadi Tiban. No factual data on surface water are available concerning Wadi Bana and other wadis in Democratic Yemen, which receives technical and financial assistance from the United Nations agencies (FAO, WHO, UNDP, the World Bank, etc.), and bilateral assistance from the Soviet Union and different Arab and governmental funds (see table).

In order to improve the water sector and make a contribution to the Drinking Water Supply and Sanitation Decade, it is recommended that:

(a) A national water plan be established, and water programmes generated to attract donor agencies to provide financial and technical assistance in the water sector.

(b) A comprehensive study be conducted on the Wadi Tiban aquifer recharge, as well as other wadis, to define the relationship of sea-water encroachment to critical ground-water extraction from the delta; in addition artificial recharge through injection of coastal aquifers should be considered if sea-water encroachment endangers drinking water at Bir Naser.

(c) A water resources development programme be initiated to provide realistic knowledge of the country's water resources.

(d) A programme be established to close the gap in manpower deficiencies at all levels.

3. Egypt

Egypt's water resources are limited and confined to its share of Nile water (55,000 Mm³/annum), drainage water utilized for irrigation (5,000 Mm³/annum) and ground-water (500 Mm³/annum). Rapid growth of the population and its concentration (90 per cent) in the urban areas make it necessary for Egypt's water sector to increase the speed of execution of projects for water supply, irrigation and sanitation. This was reflected in the Master Water Plan adopted by the Government. The Government's contribution to the water and sanitation sector is large (see table). In addition United Nations agencies (World Bank, UNDP) and bilateral donors such as the United States Agency for International Development (USAID), the United Kingdom and the Federal Republic of Germany have provided assistance in this sector. With regard to the Drinking Water Supply and Sanitation Decade, the water supply and sanitation services have increased significantly since 1980.

While the achievements described above confirm the substantial progress made in satisfying the water needs of Egypt's population, the rapid increase in water consumption due to rapid socio-economic progress raises some key policy issues for the future development of the water sector through the Water Master Plan adopted by the Ministry of Irrigation. Therefore, the following recommendations have been made:

(a) The basic strategic principle for planning in the water sector is to develop appropriate administrative organizations to serve the new needs of the community. Accordingly, a need has arisen to reassess the institutional framework of water administration in Egypt.

(b) While great progress is being made in the urban areas in providing adequate water supplies to most of the population, many people living in small towns, isolated villages and rural areas are still facing water shortages. The government has to redress this imbalance in meeting the basic water needs of the population to encourage the rural inhabitants to stay where they are.

(c) A programme of surface water development including maintenance of a reliable data base on surface water resources based on hydrological and hydrogeological studies has been initiated and it should be assisted.

(d) A programme to close the gap in the lack of skilled manpower at all levels should be developed.

(e) Programmes and water plans concerning water supply and sanitation such as the programme mentioned in subparagraph (c) above should be developed to attract donor agencies providing financial and technical assistance.

(f) Research programmes concerning low cost and appropriate technology in water reuse and other relevant subjects should be developed.

4. Iraq

Iraq's major water resources are the Tigris and the Euphrates rivers. Ground-water exploration activities are limited and the quantity of ground-water is still unknown. In spite of war conditions, Iraq is concerned with developing the water sector and this is reflected in its tremendous expenditures on projects for water supply, irrigation and drainage during 1980 to 1985 (see table).

Iraq's concern in the past five years with the Drinking Water Supply and Sanitation Decade is confirmed by the many water supply projects, dam construction and sewage treatment plants and expansion networks completed or under construction in different parts of the country.

Although surface water is the main source of water supply in the country, ground-water is an essential source of supply in the desert areas and some parts of Jazira and the foothills. Therefore, the following recommendations have been made:

(a) An improvement in operation and maintenance performance is necessary to reduce costs of water supply and sewerage networks, wells, dams, pipelines,

and water treatment plants. On-the-job training of Iraqi manpower at all levels will be very important.

(b) A detailed hydrogeological study should be conducted to cover the whole country to develop the renewable and non-renewable ground-water supplies by studying the hydrogeological characteristics of the various aquifers.

5. Jordan

Jordan's major water resources are relatively scarce and limited to ground and surface water. The projects executed during 1980-1985 have focused on utilization of surface and ground water for municipal, industrial and agricultural uses.

Projects are funded by the World Bank, AFESD, USAID, the Kuwaiti Fund, the United Nations agencies and bilateral assistance. Jordan's water supply and sanitation plans during the last five years include, inter alia, compliance with the objectives of the Drinking Water Supply and Sanitation Decade, whereby many sanitary and water supply projects were executed.

Over the last five years, all water activities were concentrated in one co-ordinated water body, the Water Authority of Jordan. Projects executed were focused on providing additional water resources by the following measures: construction of dams such as Wadi Al Arab and the raising of existing ones (King Talal Dam); intensification of ground-water exploration to meet various needs within the framework of development priorities and to provide more water to over 140 villages; increasing the area of irrigable land and providing adequate technical staff for the planning, execution and operation of irrigation, water and wastewater projects. In the light of the above, the following recommendations have been made:

(a) Implementation of projects which would supply enough water to relieve water shortages in all parts of Jordan should be continued.

(b) Water resource development programmes should be established to attract donor agencies to provide technical and financial assistance.

(c) The existing National Water Plan should be enforced to ensure the provision of services and expanded to meet current and foreseeable requirements.

(d) The utilization of existing water resources should be enhanced through the construction of more dams for storage and the recharging of aquifers: methods for collection, treatment and utilization of sewage water should be improved.

6. Kuwait

Kuwait's 220 MGD water requirement was met by the construction of additional desalinated water plants: the water therefrom was blended with brackish ground-water to meet WHO drinking water standards. Potable ground-water, which does not exceed 6,800 m³/day, is limited and already utilized.

Sewage-treated effluent is utilized in irrigation and estimated at 7 Mm³/annum. Needless to say Kuwait's concern to meet the International Drinking Water Supply and Sanitation Decade programmes is obvious by the tremendous expenditures on water supply and sanitation projects executed from 1980 to 1985 (see table).

Plans for optimization of ground-water development from the point of view of quality, quantity and economics are under way; it should be noted that brackish ground-water blended with desalinated water is an expensive operation. Therefore, the following recommendations have been made:

(a) Strict water conservation policies should be applied and the critical balance between supply and demand should be maintained by the development of appropriate administrative organizations to serve the new needs of the community.

(b) Throughout the country, water, including desalinated water, has been supplied free of charge; while this policy has benefited all in the country, it is conducive to waste. The most effective way to conserve water is the system of progressive tariffs.

(c) A programme should be established to remedy the shortage of skilled manpower at all levels; this would help in establishing a qualified cadre of experts in water resources planning, management and operations.

7. Lebanon

The country has a relatively considerable amount of water resources: surface and ground waters have not been fully utilized yet and there are still possibilities for water resources development in the country. However, owing to civil war conditions, water projects have ceased operations for the past few years, except for the plans and feasibility studies funded by the United Nations agencies or limited bilateral donors. UNDP has financed the preparation of a "National Waste Management Plan". For the time being, Lebanon's main problem in the water and sanitation sector stems from the lack of investment and maintenance caused by the prevailing civil war conditions over the last decade.

8. Oman

Oman's major water resource is ground-water and its availability affects to a certain extent many sectors of the country's economy. The discharge of springs into the mountainous areas is fully utilized in drinking and irrigation. Surface water flows to the sea or to the desert. Desalinated sea-water is used to meet excessive water demand. Sewerage treatment plants and networks are under construction. In the last five years the Government spent a great deal on the water sector and sanitation services, and received financial and technical assistance from the United Nations agencies and bilateral donors (see table).

Under the prevailing conditions, the following recommendations have been made:

(a) Since Oman currently exploits its ground-water resources on a large scale, there are fears of sea-water encroachment and rising salinity. Recharge through the construction of dams would minimize surface water losses to the sea or the desert and the new equilibrium would be maintained by recharging the fans' aquifers.

(b) A national water plan would assist in ensuring the provision of water and sanitation services and their expansion according to current and foreseeable requirements.

(c) Owing to the rapidly growing imbalance between water use and available water resources, there is now a need to organize and co-ordinate all activities in the field of water by establishing control regulations and optimization of water use.

(d) A long-term programme should be established to develop skilled manpower in the water sector at all levels.

9. Palestine Liberation Organization

Water resources, surface and ground waters, are abundant all over the West Bank and Gaza Strip. Owing to the Israeli occupation, no data are available concerning water resources development or sanitation projects.

10. Qatar

Qatar's water resources depend mainly on ground-water extraction, estimated at 80 Mm³/annum, augmented by supplies of desalinated sea-water blended with brackish ground-water. In the last five years, Qatar has spent a great deal on the water sector to avoid possibly serious future problems in the ensurance of an adequate water supply and sanitation projects.

The following recommendations have therefore been made:

(a) A national water plan should be established and enforced to ensure the provision of services and their expansion according to current and foreseeable requirements.

(b) The utilization of the existing water resources should be enhanced through aquifer recharging, and through improved methods of collection, treatment and utilization of sewage water.

(c) A long-term programme to develop skilled manpower in the water sector at all levels should be undertaken.

(d) Throughout the country, water, including desalinated sea-water and fresh ground water, has been supplied free of charge. While this policy has benefited all in the country, it is conducive to waste. The most effective way to encourage water conservation is the system of progressive tariffs.

11. Saudi Arabia

Water resources in Saudi Arabia consist of ground water (500,000 M reserves), surface water (900 Mm³/annum), desalinated water and renovated wastewater (100 Mm³). Desalinated water is blended with brackish water and supplies 50 per cent of the water demand of domestic users; the recycled water is utilized for irrigation and industrial use if possible. Extensive water supply, sewage and rainwater drainage systems in the cities throughout the country were completed during the last five years to comply with the objectives of the Drinking Water Supply and Sanitation Decade.

The following recommendations concerning the water sector and sanitation have been made:

(a) Because of the growing imbalance between water use and available water resources, there is now a need to organize and co-ordinate all activities in the field of water use by establishing regulations to control and ensure the best use of water.

(b) The enforcement of the existing National Water Plan will ensure the provision of services and their expansion according to current and foreseeable requirements.

(c) The enhancement of the utilization of existing water resources will be ensured through the construction of dams for storage and recharging of aquifers, and through improved methods of collection, treatment and utilization of sewage water.

(d) Projects which supply water from local resources, or from alternative resources, such as desalinated water, where the local ground-water supply is insufficient in quantity or quality should be continued; at the same time the highest priority should be given to the water requirements of the population.

(e) An improvement in operation and maintenance performance is a necessary condition for the reduction of costs in water supply and sewage networks, wells, dams, pipelines, water treatment plants and desalination plants. An important element of all activities will be on-the-job training of Saudi manpower at all levels.

12. Syrian Arab Republic

The availability of water resources depends equally on surface and ground water. Ground water is being extracted through pumpage wells in Damascus, the Orontes and the Aleppo ground-water basins. Many large springs' baseflows along limestone terrain can be used. Surface water is estimated at 32 Km³/annum, of which the Euphrates alone supplies 26 Km³/annum the water has been conserved by many dams constructed across the Euphrates, as well as by the many rivers and wadis spread over the country. Sewerage treatment plants and network projects are under construction, especially in the urban areas. Projects executed during 1980 - 1985 were mainly funded by the Government, supported by United Nations agencies (World Bank, FAO, WHO) and bilateral assistance (AFESD, Abu Dhabi Fund, Kuwaiti Fund, Soviet Union, USAID, etc.) (see table).

Syria is willing to meet the objectives of the International Drinking Water Supply and Sanitation Decade; this is evidenced in the projects which have been executed in the last five years.

The following recommendations based on the above water sector situation have been made:

(a) There are now some critical areas in Syria in terms of the rapidly growing imbalance between water use and available water resources. Therefore, there is now a need to organize and co-ordinate all activities in the field of water use, and in particular to establish controls to regulate and ration water use.

(b) Water is a critical resource and its conservation must be encouraged by using the system of progressive tariffs. Existing water tariffs are based on charging a symbolic cost. Reducing the government subsidy will encourage a more rational use of water. Low-income customers can be protected through the application of only a small tariff for basic minimum needs.

(c) Water resources development programmes should be established to encourage donor agencies to provide technical and financial assistance.

(d) The utilization of existing water resources should be enhanced through the construction of more dams for storage and recharging of aquifers and by improved methods of collection, treatment and utilization of sewage water.

(e) A training programme should be developed to close the gap in the manpower deficiencies at all levels in the water sector.

13. United Arab Emirates

Owing to a disastrous lowering of ground-water levels caused by huge increases in water withdrawal and steadily rising water consumption, the country is resigned to long-term dependence on desalinated sea water. Available ground-water reserves are estimated as 9,700 Mm³ and water conservation programmes are being undertaken through construction of dams, and desalination plants and the use of recycled water for irrigation. Sewerage systems and water supply projects executed or under construction are the Government's main concern in pursuing the goals of the Drinking Water Supply and Sanitation Decade.

The following recommendations based on the findings above have been made:

(a) A national water plan should be established and enforced to ensure the provision of future required services and their expansion in the water sector.

(b) The imbalance between water use and available water resources necessitates the co-ordination of all activities in the water sector through the best use of water available.

(c) Strict water conservation policies should be applied and optimal use of water would maintain the critical balance between supply and demand; appropriate administrative organizations should be developed to serve the new needs of the community.

(d) A programme should be established to develop skilled manpower in the water sector at all levels.

14. Yemen Arab Republic

The quantity of ground-water, the major resource of Yemen is unknown: its throughput across the Tihama coast is 1.4 Mm³/annum/km width of alluvial aquifer. Surface water is available from a limited number of springs and ephemeral wadis. In the last five years, the water sector in Yemen benefited from activities at all levels supported by the Government, the United Nations agencies and bilateral technical and financial assistance.

Among the constraints on the water sector are: insufficient knowledge of available water resources owing to absence of water assessment; lack of skilled manpower; the multitude of governmental organizations responsible for the water sector which leads to fragmentation of responsibilities; and the lack of a national water plan.

Based on the above findings, the following recommendations have been made:

(a) The development and utilization of all water resources should be co-ordinated through a national water plan.

(b) A reliable data base should be maintained on water resources and demand; it should include information on aquifer characteristics, ground-water storage, water quality, change in water levels, rainfall, infiltration and evaporation, based on hydrological and hydrogeological studies.

(c) Administrative units for the enforcement of laws, regulations and water rights, in accordance with established priorities for water use, should be established.

(d) The consumption of all water users and the quality of water used should be monitored through the installation of water meters and the preparation of a progressive tariff system in all sectors of water use.

(e) Pumping should be restricted in areas experiencing serious depletion of ground-water resources and deterioration in water quality below levels needed to sustain future water supplies; the definitions of short, medium and long-term pumping rates for all aquifers should be made clear.

(f) Water-saving techniques should be introduced through the establishment of national specifications and standards for water quality, treatment and usage of sewage water, irrigation equipment, water supply and distribution works, plumbing in houses, factories and other buildings.

(g) A national water plan should be prepared.

(h) Water and agricultural policies should be regularly assessed.

(i) A programme for developing skilled manpower in the water sector at all levels should be established.

Table 1. Water resource development projects: distribution in the ESCWA region and funding during 1980-1985(*)

Country	NO. of Projects (total)	Conventional Water Resources						Non-Conventional			Funding in \$ (million)		
		No. of W.S. Proj.	No. of Irrig.& W.S. Proj.	No. of Irrig.& drainage Proj.	No. of Irrig.& Elec. Proj.	No. of Manpower length. Proj.	No. of Sewage Proj.	No. of Desal. Proj.	No. of Water Reuse Proj.	Gov'tal (Rounded)	UN (Rounded)	Bilateral or Multilateral (Rounded)	
Bahrain	5	-	-	-	-	1	-	2	2	465.4	-	-	
Democratic Yemen	11	6	3	-	-	-	1	1	-	29.0	33.7	76.7	
Egypt	15	2	-	5	-	3	1	1	4	149.4	70.0	1357.1	
Iraq	26	11	-	9	4	-	1	1	1	11167.7	-	-	
Jordan	36	22	-	7	-	-	-	7	7	414.6	85	412.9	
Kuwait	11	2	-	-	-	-	-	7	1	1023.6	-	-	
Lebanon	6	2	-	2	-	-	2	-	-	8.5	2.17	-	
Oman	12	7	-	1	-	-	2	1	1	162.0	-	-	
Palestine Liberation Organization	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	-	-	
Qatar	8	4	-	-	-	-	-	-	4	90.5	-	-	
Saudi Arabia	18	-	2	3	-	-	1	10	2	6773.7	0.95	-	
Syrian Arab Republic	34	3	7	17	3	2	-	-	2	3700.8	115.2	95	
United Arab Emirates	10	4	-	-	-	1	-	4	1	682	0.96	-	
Yemen	16	6	-	4	-	5	-	-	1	4.5	108.5	161	

(*) Table contents are limited to the obtainable data only.

(**) Feasibility studies, sanitation connection projects only.