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REPORT OF THE EXECUTIVE SECRETARY
ON THE ACTIVITIES OF THE COMMISSION

PROGRESS MADE IN THE IMPLEMENTATION OF THE
PROGRAMME OF WORK FOR THE BIENNIUM 1992-1993

Report on the
progress achieved in the implementation of the
Mar Del Plata Action Plan

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ABBREVIATIONS

BCM	Billion cubic metres
ESCWA	Economic and Social Commission for Western Asia
FAO	Food and Agriculture Organization of the United Nations
GCC	Gulf Cooperation Council
HKJ	Hashemite Kingdom of Jordan
JVA	Jordan Valley Authority
Km ³	Cubic kilometres
Km ²	Square kilometres
MAP	Mar del Plata Action Plan
m	Metres
m ³ /s	Cubic metres per second
mm	Millimetres
mm/a	Millimetres per annum
MCM	Million cubic metres
MCM/a	Million cubic metres per annum
mgd	Million gallons per day
ppm	Parts per million
RO	Reverse osmosis
SA	Saudi Arabia
SAR	Syrian Arab Republic
TDS	Total dissolved solids
UAE	United Arab Emirates
UNDP	United Nations Development Programme
UNWC	United Nations Water Conference
WAJ	Water Authority of Jordan
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

1. It is well known that most of the ESCWA region is comprised of arid or semi-arid zones. When present and projected water requirements for all purposes are compared with the available water resources, serious questions arise concerning the long-term economic, environmental and political sustainability of existing water resources development and water use patterns. Under existing patterns of water use, it is unlikely that the expansion of irrigated agriculture can proceed without water shortages. Additionally, increasing water scarcity in the region is likely to impose significant constraints upon growing domestic and industrial demands.

2. Many member countries of ESCWA have recognized the need for concurrent development, conservation and management of their vital water resources. Among the objectives and targets considered during the last decade in some member countries of the ESCWA region were: water assessment and planning to determine the most appropriate allocation of resources to various water users; and formulating medium- and long-term policies and guidelines for the exploitation, utilization and subsequent management of water resources.

3. The estimated available water resources, based on the various hydrological and hydrogeological investigations carried out in the region, are summarized in table 1 below, which provides an idea of the importance of the close relationship that exists between the availability of water resources and present and future water demand. Many member States of the region will reach their development limits by the year 2000, due to acute water shortages which are even now a reality in places such as the GCC countries, Jordan and Yemen. In other cases, the estimated demand for agricultural water will not be met at all, preventing some countries from achieving food self-sufficiency, if present regional water use practices continue.

4. However, the figures on available surface-water resources shown in table 1 for both the Syrian Arab Republic and Iraq, and to a certain extent for Egypt and Jordan, may not apply in future, due to activities to develop water resources which are being practised in neighbouring upstream countries and the absence of registered riparian rights.

5. The amounts of available groundwater resources shown in table 1 are based mostly on reconnaissance investigations. Over exploitation of groundwater in the form of excessive and uncontrolled pumping, and deterioration of water quality, are common features observed in many regional basins such as those in Jordan, the Syrian Arab Republic, Saudi Arabia and Yemen. Groundwater quality is deteriorating due to sea-water intrusion into the coastal plains aquifers in Yemen, Oman, Bahrain, the United Arab Emirates and Qatar. All these factors have resulted in a progressive reduction in available groundwater resources in the ESCWA region, to the extent that sustainable agricultural development may be hindered in the future. Expensive nonconventional water resources are being produced via desalination plants so as to meet the increasing water demands in the region, particularly in the GCC States. Likewise, surface-water resources are increasingly vulnerable to pollution from agricultural practices or waste disposal.

6. A lack of regional cooperation for managing and developing the major shared water resources has been common. Despite years of efforts, no formal protocols yet exist among riparians of the Nile, Yarmouk, Orentes, Al-Kabir, Tigris and Euphrates rivers. If current circumstances continue, most of the downstream riparians will experience a severe quantity and/or quality deficit in water resources. Under even the best circumstances, most of the end-user countries will be unable to generate sufficient capital to finance technically feasible and critically needed water-storage and management projects without massive assistance from donor nations and lending institutions.

7. The existing shared-water commissions in the region (the UNDUGO Group for the Nile, the Technical Committee for the Yarmouk, the Trilateral Commission for the Euphrates and Tigris rivers) have proved unable to meet periodically or to defuse the water conflicts among the riparians. Such conflict resolution cannot be attained without the formulation of joint comprehensive plans for water resources management. Such plans should include explicit agreements on water allocation among the concerned riparian for each river basin and/or exploitation rights for the major aquifers within the region.

8. The continuously increasing demand for water and rapidly diminishing water supplies emphasize the need for more rational planning in the water sector. Such planning should be carried out within the context of national development goals and objectives. The planning process must recognize that development in the water sector and in other sectors is interdependent and mutually supporting.

9. The planning process should proceed with a good understanding of the national development goals, sectoral objectives, and planning horizon. A sectoral review should be carried out with the specific objective of generating information and data needed for the planning exercise. Alternative strategies should be formulated and tested to determine the best option for attaining the sectoral objectives. The selected strategy should clearly spell out policies, programmes and projects. The financial requirements for implementing the plan should be assessed to test the viability of the plan within the context of macroeconomic budgetary constraints.

10. Planning in the water sector requires an enormous amount of data that can be translated into terms of demand and supply. The scarcity of reliable data about supply/demand variables in the ESCWA region may not facilitate efficient water sector planning.

I. INTRODUCTION

A. Overview

11. During the last decade, water resources management, planning and administration has established itself as a relatively self-contained activity concerned with finding solutions to problems resulting from increasing water demand on the one hand and the availability of water as a natural resource on the other. These two components comprise the basics of water resources management and planning.

12. In the past, in the ESCWA region and in other areas, water resources managers and developers applied ad hoc solutions to major water supply/demand problems as they emerged by initiating engineering projects related to irrigation, road construction, town planning, health care, etc.; the problem was generally viewed as being remediable by engineering measures. With the increased scope and number of water conservation projects in the region, conflict resulting from supply/demand problems began to occur. Now that the complexity of water issues is recognized, the old view of water resources management and planning has been changed from one which seeks only engineering solutions to one with a more comprehensive and integrated view of water problems, in order to provide optimal solutions and to satisfy, as far as possible, the various water demands which will most benefit society, in line with overall socio-economic national development plans.

13. This broader concept of water resources management and planning has resulted in significant efforts at the national level within the region to establish efficient water institutions and training centres, execute major water projects, and adopt and apply modern techniques and methodologies such as systems analysis using high-speed computers, simulation modelling, statistical hydrology, isotope analysis, remote sensing and detailed hydrogeological mapping.

14. Population growth, agricultural and industrial development and improved living standards in most countries of the region have resulted in increasing demand for water, and subsequent increased amounts of waste water, causing a degradation of water quality. This increase in demand has produced problems related to the availability of water resources and the progressive reduction of national resources due to the deterioration of water quality and/or depletion. The failure to strike a balance between the availability of water resources and demand through efficient water resources management will likely limit socio-economic development in most of these countries.

B. Scope and objective of the report

15. The United Nations Water Conference (UNWC) held in Mar del Plata, Argentina, March 1977, recognized that a proper assessment of water resources and planning at national levels should be undertaken in all countries of the world, particularly in developing countries. The Conference considered that this assessment could be achieved only if all countries strengthened and

coordinated arrangements for collecting data and disseminating information in the field of water resources development, conservation and management.^{1/}

16. The Mar del Plata Action Plan called upon the United Nations regional commissions to play a major role in implementing its recommendations; they were therefore asked to be involved in an inter-agency activity to assess the progress made in the implementation of the Mar del Plata Action Plan and to formulate a strategy for its implementation in the 1990s.

17. This report has been prepared as a follow-up to the report on the previous activity carried out during the 1990/1991 work programme of ESCWA and which dealt mainly with the institutional and legislative aspects of water resources management in the ESCWA region. The present report describes the progress achieved in the implementation of Mar del Plata Action Plan relevant to water resources assessment and planning in the region.

18. Both reports were prepared at the request of the Inter-Agency Working Group Preparatory Meeting on Water and Sustainable Agricultural Development held at the Food and Agriculture Organization of the United Nations (FAO) in Rome from 21 to 23 February 1990. The meeting was convened as per the resolution of the Committee on Natural Resources (CNR) 1987/7 operative paragraph 5, which requested the Secretary-General, in consultation with the regional commissions and organizations of the United Nations system, to report to the CNR on progress made in formulating proposals for a comprehensive strategy to implement the Mar del Plata Action Plan during the decade 1991-2000, and to include an assessment of these proposals as they related to the activities of the United Nations system.

19. In order to implement the activity as per the 1992/1993 work programme of ESCWA, the concerned staff have toured the region and collected and analysed relevant information on planning and management of water resources. A regional assessment based on available data was then carried out, describing the progress achieved and constraints existing with regard to the assessment and availability of water resources and with regard to the management of water resources, including policy formulation and planning. It also addressed issues related to the efficient utilization of water and its various aspects, including water supply, water demand and waste-water reuse in some countries of the region. Progress made in the implementation of the Action Plan in some member States is outlined in this report, which concludes with the major priority areas in the ESCWA region to be considered in the formulation of national water-sector planning and strategy formulation.

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

II. WATER RESOURCES ASSESSMENT

A. Overview

20. The first resolution of the United Nations Water Conference (UNWC) stressed the need for assessing water resources at the national level. It recommended that member States give high priority to the initiation of programmes for the collection, processing, storage and dissemination of hydrological and hydrogeological data and to the formulation of long-term monitoring and follow-up programmes in order to realistically assess the available water resources and the means of developing them.^{2/}

21. Since the UNWC, comprehensive water resources assessment programmes have been substantially practised in the ESCWA region. The objectives of these programmes were to determine the availability, extent, dependability and quality of water resources in order to develop a base for evaluating the possibilities for their utilization and control. Efficient water resources planning may not be possible without realistic water resources assessment at the national level. Hence water resources assessment studies have assumed special significance in the region. Semi-detailed and detailed studies in this field have been carried out in the last decade in most member countries of ESCWA. Although many (more than 60) groundwater surveys have been implemented, total groundwater potential has not yet been identified; there is still a need for more detailed and accurate information on the quantity and quality of available and potential regional groundwater resources.

22. It is noteworthy that most of the hydrogeological investigations completed in many countries of the region were carried out by foreign consulting firms. There have also been other projects carried out by the specialized United Nations agencies. National experts in some countries undertook case-studies or cooperated with consulting firms as official government counterparts, either for supervision and guidance or for on-the-job training aimed at allowing local staff to take over at later stages. Foreign consultants are probably needed for two main reasons: compliance with the financial and/or technical conditions of the donating agencies (governmental or non-governmental); and the lack of local competent manpower to undertake such investigations in some member countries.

23. A review of available literature revealed that many of the studies carried out were redundant. In many countries, the same area was often studied by more than one investigator. In some instances, the same conclusion was often reached without any substantive amendments resulting, such as those carried out in the Tihama Plain of Yemen, Batinah Plain of Oman, Azraq and Disi basins of Jordan, the Eastern Province of Saudi Arabia and others.

24. A few national hydrogeological surveys were undertaken (Jordan, Qatar, Bahrain and the Syrian Arab Republic); other studies dealt with one particular basin (Yemen and Oman). Some of these studies are very detailed, while others are superficial. Surface-water resources investigations and development have

^{2/} Report of the United Nations Water Conference, Mar del Plata, 14-25 March 1977 (E/CONF.70/29), Res. I, p. 66.

focused on some important river systems in the region, such as the Nile, Euphrates, Tigris, Jordan, Yarmouk, Litani and others. Water resources have been developed to some extent in some of these river basins (Tigris, Euphrates and Nile), but the potential for development for various purposes is still great.

25. Based on the studies of water resources carried out at the national and subregional levels, the condition of regional water resources can be briefly described as follows:^{3/}

1. The Arabian Peninsula subregion encompassing the Gulf States and Yemen

26. Rainfall in this subregion is generally low and scarce, and is of a Mediterranean type in the north and monsoonal in the south. The subregion itself is more arid than semi-arid. Rainfall volume over the Arabian peninsula is estimated at 214 billion cubic metres (BCM)/year.^{4/} Zones of high rainfall exist over the mountains along the Red Sea coast, the Gulf of Aden, the Arabian Sea and the Gulf of Oman. The climate is generally hot, tropical and dry in summer and moderate to cold in the inland areas in winter, with high daily temperature variations throughout most of the subregion.

27. In the Arabian peninsula, surface-water resources are limited and rely on irregular, sporadic and unpredictable flood occurrences. The potential for making use of these floods is high in areas such as Tehama and the Batinah coastal plains in Oman and the United Arab Emirates.

28. Groundwater and non-conventional water resources (desalinated water and treated sewage effluent) are the major components of the water supply in the subregion. The main producing aquifers are composed of: Paleozoic sands; Mesozoic sands and carbonate rocks; and Tertiary carbonate rocks and the Quaternary alluvium. Groundwater quality generally deteriorates as one moves from the mountain ranges towards the inland basins or sea coasts.

2. The northern and north-east subregion encompassing Jordan, Palestine, Lebanon, the Syrian Arab Republic, Iraq and Egypt

29. In this subregion, surface-water resources predominate, though groundwater resources do occur and are well developed in Jordan, the Syrian Arab Republic, and to a lesser extent, in Lebanon and Egypt. In Iraq, the development of surface-water resources is well under way, while groundwater resources have been neither identified nor developed.

30. The maritime zones of the subregion are somewhat humid to semi-arid, while the inland areas are arid to semi-arid. The climate is predominantly Mediterranean, producing hot dry summers and rainy winters with daily temperature variations which are high in Iraq and in the inland areas of the Syrian Arab Republic and Jordan.

^{3/} Economic Commission for Western Asia, "Assessment of the water resources situation in the ESCWA region" (E/ECWA/NR/L/1/Rev.1), 1981.

^{4/} Ibid., p. 16.

31. Surface-water resources in the subregion are appreciable and are represented by the following main rivers: the Nile, Euphrates, Tigris and tributaries, Yarmouk, Orentes, Barada, Litani, Hasbani, Jordan, Lebanon rivers and others.

32. Groundwater resources occur in Palaeozoic sandstones, Jurassic Cretaceous-Palaeogene carbonate rock aquifers, Tertiary volcanic rocks and Quaternary alluvium. The quality ranges from excellent to brackish. Water quality is good at the foothills of the active recharging zones, but generally deteriorates eastward, in the inland basins in the Syrian Arab Republic and Jordan, and westward from the Zagros mountains in Iraq. There are appreciable potential groundwater resources in Lebanon and, to a lesser extent, in the Syrian Arab Republic. In Iraq, further investigation is needed before the potential is known.

33. Efforts to regulate flood waters and develop surface-water resources have been remarkable in the subregion, as represented by Al-Tabaka Dam in the Syrian Arab Republic, Qaroun Lake in Lebanon, and other projects in Jordan, Iraq, and Egypt. The estimated available water resources and the projections of water demands based on the various hydrological, hydrogeological and water use investigations carried out in the region are summarized in tables 1, 2 and 3. Comments on the tables were presented earlier in the executive summary of the document.

B. Databases and monitoring networks

34. One of the main requirements for efficient assessment, management and planning of water resources, as well as for more reliable research, is the availability of adequate and accurate water data which is relevant over the long term. In many countries of the ESCWA region, the available water-sector data is insufficient and sometimes lacks the consistency and continuity required to facilitate the establishment of a national comprehensive water database for planning and management purposes. In some countries of the region, programmes designed to measure basic data from relevant observational stations, as well as to collect, process, store and periodically disseminate these data, have been undertaken in recent years. Plans to strengthen and update the existing observational networks are also being considered in most countries of the region. However, the lack of coordination and of access to reliable water data with long-term relevance is a common phenomenon in most of the concerned government institutions in the region, due to the unavailability of a comprehensive national water-resources database, or to the restrictive nature of such data (in compliance with the internal policies of some member countries).

35. As regards monitoring networks, in many countries of the region, significant progress has been made in establishing observational networks for water resources (surface water and groundwater), which serve as tools for carrying out better, more realistic assessments of water resources and more efficient water planning, and also for the establishment of a solid database on water. Table 4 shows the monitoring networks established in the ESCWA region. As the table reflects, none of the member States have networks covering the country in accordance with World Meteorological Organization (WMO) standards. Plans to strengthen and improve the existing monitoring systems in some member countries are under way.

Table 1. Estimated supply, demand and balance of water resources in the ESCWA region
(Million cubic metres [MCM])

Country	1		2		3		4 = (1-2)		5		6		7=(1+5)		8=(1+6)		9=(7-2)		10=(8-3)	
	Available water resources		Estimated Water use (1990)		Water demand (2000)		Water balance (1990)		Non-conventional water resources		Non-conventional water resources		Total available water resources		Total available water resources		Estimated balance		Estimated balance	
	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000	1990	2000
Bahrain	220	400	308		400		-88		71	186	291	406	291	406	-17	6	291	406	-17	6
Egypt	59 000	70 609	60 100		70 609		-1 100		7 000	7 500	66 000	66 500	66 000	66 500	5 900	-4 109	66 000	66 500	5 900	-4 109
Iraq ^{a/}	43 500	53 830	49 420		53 830		-5 920		..	..	43 500	43 500	43 500	43 500	-5 920	-10 330	43 500	43 500	-5 920	-10 330
Jordan	910	1 548	917		1 548		-7		37	87	947	997	947	997	30	-551	947	997	30	-551
Kuwait	217	675	329		675		-112		356	547	573	764	573	764	244	89	573	764	244	89
Lebanon	2 800	2 300	1 002		2 300		1 798		..	..	2 800	2 800	2 800	2 800	1 798	500	2 800	2 800	1 798	500
Oman	1 658	1 255	1 231		1 255		427		66	86	1 724	1 744	1 724	1 744	493	489	1 724	1 744	493	489
Palestine	710	520	..		520		..		..	..	710	710	710	710	190	190	710	710	190	190
Qatar	112	286	196		286		-84		198	274	310	386	310	386	114	100	310	386	114	100
Saudi Arabia	5 546	8 670	8 670		14 627		-3 124		1 160	1 534	6 706	7 080	6 706	7 080	-1 964	-7 547	6 706	7 080	-1 964	-7 547
Syrian Arab Republic ^{a/}	26 640	26 152	9 000		26 152		17 640		177	177	26 817	26 817	26 817	26 817	17 817	665	26 817	26 817	17 817	665
United Arab Emirates	1 962	2 170	1 986		2 170		-24		402	402	2 364	2 364	2 364	2 364	378	194	2 364	2 364	378	194
Yemen	2 265	3 971	2 899		3 971		-634		9	12	2 274	2 277	2 274	2 277	-625	-1 694	2 274	2 277	-625	-1 694
Total	145 540	178 343	136 058		178 343		16 538		9 476	10 805	155 016	156 345	155 016	156 345	18 958	-21 998	155 016	156 345	18 958	-21 998

Sources: Some figures updated from Economic and Social Commission for Western Asia, "Progress achieved in the implementation of the Madrid Plata Action Plan in the ESCWA region", E/ESCWA/ENR/1992/5; national papers submitted to the Fifth Meeting of the Permanent Arab Committee on the International Hydrological Programme (IHP), Cairo, 9-11 November 1992; direct consultation made with government authorities during missions undertaken to ESCWA member States.

Notes: Brackish groundwater predominates in the Arabian peninsula. Some figures on water resources and water demand are not confirmed but are based on reconnaissance surveys. Two dots (..) indicate data are not available.

a/ The flow of the Tigris and Euphrates rivers will be reduced by upstream abstraction in Turkey.

Table 2. Water resources presently available in the ESCWA region
(MCM)

Country	1		2		3		4		5=(1+2)		6		7=(5+6)		8	
	Surface water	Groundwater	Desalinated water	Treated effluent	Conventional	Non-conventional	Total	Projected potential	Conventional	Non-conventional	Total	Projected potential	Conventional	Non-conventional	Total	Projected potential
Bahrain	..	220	63	8	220	71	241	414	220	71	241	414	220	71	241	414
Egypt	55 500	3 500	..	4 900	59 000	4 900	63 900	70 100	59 000	4 900	63 900	70 100	59 000	4 900	63 900	70 100
Iraq ^{a/}	41 500	2 000	..	..	43 500	..	43 500	..	43 500	..	43 500	..	43 500	..	43 500	..
Jordan	492	418	..	37	910	37	947	1 198	910	37	947	1 198	910	37	947	1 198
Kuwait	..	217	365	80	217	437	654	794	217	437	654	794	217	437	654	794
Lebanon	2 200	600	..	..	2 800	..	2 800	2 850	2 800	..	2 800	2 850	2 800	..	2 800	2 850
Oman	929	729	41	25	1 658	66	1 724	1 744	1 658	66	1 724	1 744	1 658	66	1 724	1 744
Palestine	..	710	..	..	710	..	710	1 050 ^{b/}	710	..	710	1 050 ^{b/}	710	..	710	1 050 ^{b/}
Qatar	..	112	67	20	112	87	199	386	112	87	199	386	112	87	199	386
Saudi Arabia	3 208	2 338	903	257	5 546	1 160	6 706	7 080	5 546	1 160	6 706	7 080	5 546	1 160	6 706	7 080
Syrian Arab Republic ^{a/}	22 100	4 540	..	177	26 640	177	26 817	..	26 640	177	26 817	..	26 640	177	26 817	..
United Arab Emirates	194	1 768	340	62	1 962	402	2 364	..	1 962	402	2 364	..	1 962	402	2 364	..
Yemen ^{c/}	1 005	1 260	..	..	2 265	..	2 265	5 200	2 265	..	2 265	5 200	2 265	..	2 265	5 200
Total	..	18 412	..	..	145 540	..	152 827	..	145 540	..	152 827	..	145 540	..	152 827	..

Sources: Some figures updated from Economic and Social Commission for Western Asia, "Progress achieved in the implementation of the Mar del Plata Action Plan in the ESCWA region", E/ESCWA/ENR/1992/5; Economic and Social Commission for Western Asia, "Water resources database in the ESCWA region", E/ESCWA/ENR/1992/6, April 1992; national papers submitted to the Fifth Meeting of the Permanent Arab Committee on the International Hydrological Programme (IHP), Cairo, 9-11 November 1992; direct consultations made with Government authorities during missions undertaken to ESCWA member States.

Notes: Two dots (..) indicate data are not available.

a/ The flows of the Tigris and Euphrates rivers will be reduced by upstream abstraction in Turkey.

b/ Including the share of the occupied Palestinian territories in surface water (national paper, the Fifth Meeting of the Permanent Arab Committee on the IHP).

c/ Only baseflows appear in Yemen's surface water resources.

Table 3. Projected water demand in the ESCWA region

Country	Population a/ (millions)	Water use and demand projections (MCM)						Total	
		Agriculture		Domestic		Industrial		1990	2000
		1990	2000	1990	2000	1990	2000	1990	2000
Bahrain	0.50	220	265	80	125	8	10	308	400
Egypt	52.69	49 700	51 900	10 400	Domestic and industrial	10 700	60 100	70 609	70 609
Iraq	18.92	40 000	39 400	9 420	Domestic and industrial	14 430	49 420	53 830	53 830
Jordan	4.01	613	1 088	178	359	42	101	833	1 548
Kuwait	2.14	..	..	..	..	..	..	..	..
Lebanon	2.70	700	1 700	252	450	50	150	1 002	2 300
Oman	1.55	1 151	..	80	..	..	..	1 231	..
Palestine	..	155	300	..	200	..	20	..	520
Qatar	0.49	109	139	87	Domestic and industrial	..	147	196	286
Saudi Arabia	14.87	..	13 750	750	1 261	100	315	8 670	14 627
Syrian Arab Republic	12.12	2 180	24 766	466	983	117	403	7 763	26 152
United Arab Emirates	1.59	1 570	..	416	582	184	..	2 170	..
Yemen Republic	11.28	2 700	3 328	168	553	81	90	2 899	3 971

Sources: Some figures updated from Economic and Social Commission for Western Asia, "Progress achieved in the implementation of the Mar del Plata Action Plan in the ESCWA region", E/ESCWA/ENR/1992/5; Economic and Social Commission for Western Asia, "Water resources database in the ESCWA region", E/ESCWA/ENR/1992/6, April 1992; national papers submitted to the Fifth Meeting of the Permanent Arab Committee on the International Hydrological Programme (IHP), Cairo, 9-11 November 1992; direct consultations made with government authorities during missions undertaken to ESCWA member States.

Notes: Two dots (..) indicate data are not available.

a/ United Nations, Statistical Division, Monthly Bulletin of Statistics (ST/ESA/STAT/SER.Q/244), 1993, pp. 1-6.

b/ Municipal and industrial water demand considered a single category in country statistics.

Table 4. Monitoring networks for water resources in the ESCWA region

Country	Meteorological stations		Hydrological stations	Hydrogeological stations	Sedimentation	Water quality	Total	Extent of records
	Rainfall only	Meteorological						
Bahrain	2	5	..	68	..	..	75	15-18 years, Met.; since 1980, groundwater.
Egypt	82	15	657	800	6	20	1 580	More than 50 years.
Iraq	107	17	164	..	40	72	400	About 60 years, Met.; 30-75 years, hydrometry.
Jordan ^{a/}	296	25	946	228	33	38	1 566	10-88 years, Met.; since 1960, hydrometry and Hydrogeology.
Kuwait	10	2	..	133	..	..	145	Since 1961 for all stations.
Lebanon	47	38	124	327	..	..	536	1921-1975, Rainfall; 1931-1975, hydrology.
Oman	56	3	52	820	..	..	931	Since 1970s for all stations.
Qatar	30	3	42	160	..	8	243	1966-1990, Met.
Saudi Arabia	699	61	414	509	41	..	1 724	Since 1960s for all stations.
Syrian Arab Republic	272	62	115	408	..	..	857	
United Arab Emirates	27	10	19	239	..	..	295	Since 1980, hydrology; since 1971, hydrogeology.
Yemen	148	55	48	672	..	..	923	Since 1982 (variable in some areas).
Total	1 776	296	2 581	4 364	120	138	9 275	

Sources: National papers presented at the Fifth Meeting of the Permanent Arab Committee on the International Hydrological Programme (IHP), 9-11 November 1992, Cairo, Economic and Social Commission for Western Asia, "Water resources database in the ESCWA region" (E/ESCWA/ENR/1992/6), April 1992; Economic and Social Commission for Western Asia, "Progress achieved in the implementation of the Mar del Plata Action Plan in the ESCWA region" (E/ESCWA/ENR/1992/5), October 1991; Economic and Social Commission for Western Asia, Proceedings of the Ad Hoc Expert Group Meeting on Water Security in the ESCWA Region, Damascus, 13-16 November 1989 (E/ESCWA/NR/1990/3).

Notes: Two dots (..) indicate data are not available.

a/ Including spring-flow measurement.

C. Assessment of water resources and flow of information
from producers to users

36. The precise assessment of water resources and the availability of information on water resources is not always a major cause of concern. The major concern, rather, involves accessibility to available data and information and the flow of information from producers to users. Equally important is reducing the cost of delivery of information to users by developing data transfer systems and ensuring that the delivered information meets the needs of information users.

37. The availability of information and the state of water resources assessment activities in the ESCWA region has been evaluated within the framework of an overall global assessment of progress in implementing the Mar del Plata Action Plan. The global assessment was based on regional evaluations of United Nations economic regions.^{5/}

38. The following conclusions were drawn:

(a) Meteorological networks in the region are fairly satisfactory. However, there are several areas lacking, including standardization of techniques and equipment, optimization of networks and application of remote sensing and automatic data collection procedures;

(b) Hydrometric networks improved noticeably in the early 1980s but later in the decade there was a deterioration in their operation and maintenance. Water quality was neglected, and the volume and reliability of data produced by groundwater observation programmes were unsatisfactory;

(c) Facilities for data processing and archiving are inadequate in most countries, in spite of some progress. Dissemination of data is deficient in general. With the exception of meteorological data, it is often difficult to obtain information. Several countries have established water resources data banks. However the real issue is the time between data collection and data storage and processing, and the continuity of data acquisition activities;

(d) Particular effort is needed for the development of database management systems. The need extends from data collection programmes, through archiving and dissemination of data, to analysis and application of modern technology such as computer modelling and geographic information systems.

39. A document prepared by ESCWA on issues related to the availability of data to assess water resources in the ESCWA region (E/ESCWA/ENR/1992/6) showed that good progress had been achieved with regard to the improvement of meteorological, hydrological and hydrogeological networks since the UNWC (1977). As indicated earlier, however, the situation deteriorated in the second half of the 1980s.

^{5/} WMO/UNESCO Report on Water Resources Assessment: Progress in the Implementation of the Mar del Plata Action Plan and a Strategy for the 1990s, WMO/UNESCO (Oxford, Words and Publications, 1991).

40. The ability of countries to monitor water quality is very limited. This may raise some serious issues pertaining to the management of groundwater resources, since overdevelopment has caused quality deterioration in many aquifers particularly in coastal areas.

41. Measurements of sediment discharge, especially for ephemeral wadis, are rare and often lacking. This is a major area of need, since most countries have ambitious programmes for the construction of small dams for storage or aquifer recharge, and since data on sediment discharge is critical for design and operation of these dams.

42. The flow of data and information from producers to users is a key issue in water resources assessment and sector planning. The issue is partly related to the stage of development in each country of improved systems of data publication and dissemination. In many countries within the region a considerable amount of valuable data is locked inside reports with limited distribution. Inadequate and discontinuous flow of information to and from users -- particularly with regard to groundwater, which is the principal resource for most countries -- is a key issue confronting the region. The results are: considerable loss of the data needed to define the hydrogeologic framework of aquifers; or drilling in saline or unproductive aquifers or to unnecessary depths, and consequent loss of capital.

III. WATER RESOURCES PLANNING AND DEVELOPMENT

A. Overview

43. Water plays a major role in the economic development of any country. Throughout the region, the demand for water is continuously increasing because of population growth, enlargement of the industrial base, and expansion of irrigated agriculture. On the other hand, potentially available water resources are diminishing and the marginal costs of supplying water are increasing at an alarming rate. The water sector in most of the ESCWA region is confronted with a number of technical, financial and institutional constraints. A regional review of the water sector suggests that throughout a good part of the region the financial resources needed to meet water demands are insufficient, and sectoral policies and institutions to meet the challenges of efficient water management are inadequate.

44. It has been frequently observed that most of water resources development plans fail to realize the planned targets. The shortcomings can be attributed to a variety of planning deficiencies. Sometimes the plan objectives are not clearly defined. If the objectives are stated, it often happens that the means for attaining them have not been revised. The plan results may be poor because of inadequate communication between planners and those for whom the plans are produced. For example, water users follow their own "plans" with little reference to the plans produced at the national level. Similarly, sometimes programmes to develop water resources are prepared in isolation of other sector programmes. Also, the water sector plan for a country as a whole cannot be realistic unless it takes adequate account of the varying ecological requirements in the different areas of the country. Water resources planning must take into account multiple users, multiple purposes and multiple objectives.

B. Water resources planning

45. National master planning of water resources has been practised by many countries in the region. Jordan established an overall national water master plan as early as 1977, aimed at encouraging the most efficient use of the available water, funds, manpower and other relevant resources, the most suitable methods and operations, and as far as possible the reuse and renewal of water resources. Kuwait, Egypt, Iraq, Saudi Arabia and Oman have also been active in water planning and national water-policy formulation, while other countries have this subject under consideration. These national water policies and plans are expected to encompass many aspects of water resources that aim at the wise management, conservation and development of their vital resources. Surface-water impounding, artificial groundwater recharge, rainwater harvesting, reuse of drainage water and treated sewage effluents, and desalination of sea-water and brackish groundwater have been commonly practised in many countries of the region over the last decade to optimize water utilization and to manage and develop the available water resources at the national level.

46. Jordan and UNDP started a cost-sharing project in 1989 to update the national water master plan for the major basins in the country.

47. Another master plan for rural water supply was completed in Iraq, and a strategy was formulated accordingly. The plan evaluates the country's water resources vis-a-vis water demand in the inhabited rural areas of Iraq.
48. In Saudi Arabia, preparation for a national water plan was initiated during the second Five-Year National Development Plan (1975-1980) and completed in 1984, after incorporating Saudi Arabia's various ongoing and planned socio-economic development projects. The plan identified water supply/demand projections up to the year 2020 for the whole Kingdom.
49. In Egypt a water master plan project (UNDP/EGY-73/024) was launched in January 1977. The project was financed by UNDP and executed by the International Bank for Reconstruction and Development (IBRD), with the Ministry of Irrigation acting as a cooperating agency. Work on the project started in October 1977; the first phase was completed in December 1981, while the second phase commenced in 1982 and was completed in 1986. The first phase of the project involved the preparation and evaluation of development plans in which the water supply and the needs of various users were matched, while the second part carried out supporting studies and analyses. The plan in general provided a comprehensive evaluation of water supply and demand countrywide, and considered aspects such as effective use of available water resources, economic performance in the agricultural sector, social and environmental impacts, and capital investment and energy requirements.^{6/}
50. In the other member States of ESCWA, national water master planning is lacking; subregional water master plans to develop and manage shared water basins do not exist. Only one activity at the interregional level has been agreed upon since 1959, involving Egypt (ESCWA and ECA member State) and Sudan (ECA member State) in a project to develop the Nile River waters. Work related to this project is still under way.
51. In many countries of the region, significant water resources development projects having positive environmental impact were carried out during the last decade. Such projects were related to flood control (Iraq, the Syrian Arab Republic, Jordan), soil preservation and reduced salination (Jordan, Yemen), pollution control (the Syrian Arab Republic, Iraq, Egypt), provision of adequate sanitary services and minimizing health hazards (the Syrian Arab Republic, Iraq, Egypt, Jordan), enhancing artificial groundwater recharge and augmenting potential surface-water resources (Jordan), and provision of recreational facilities (Iraq).
52. From the national development plans of some of the ESCWA member States, it is clear that environmentally sound water resources development and management have been the object of serious consideration during the last decade. Efforts have been made in Iraq, the Syrian Arab Republic and Egypt to overcome waterlogging and soil salinity by installing drainage networks, and to improve water-application efficiency through better management practices.

^{6/} Egypt, Water Master Plan (executive summary of main reports), a joint project of the International Bank for Reconstruction and Development, the United Nations Development Programme and the Egyptian Ministry of Irrigation (UNDP/EGY-73/024), 1981, pp. 1-31.

In Iraq, several small regulating dams have been constructed upstream and downstream of the major dams to reduce floodhazards and the rate of sedimentation and for recreational purposes.

53. Forestation of the Zarqa River Basin to prevent soil erosion and reduce the rate of salination in the King Talal Dam reservoir is considered a major environmental issue in Jordan. Also in Jordan, the Azraq springs and swamps, formed by natural flooding, were substantially reduced or even completely depleted as a result of overexploitation of groundwater in the area. In order to compensate for the loss of natural flooding, groundwater pumping was rescheduled and rationalized among public and private beneficiaries in Azraq so as to secure minimum spring flows to restore as far as possible the ecosystem prevailing in the Azraq Oasis prior to the overdraft conditions.

54. Regarding health hazards, sewage systems constructed without adequate treatment facilities in some member countries have resulted in groundwater contamination and pollution problems, though plans to overcome them are under way.

55. Serious efforts to minimize health hazards have been made in some countries of the region to ensure adequate and safe water supplies in both urban and rural areas. These undertakings have been substantive in the Gulf States and Jordan, while in Iraq several water-supply projects and treatment plants are under way. Only the main cities are partially covered by such projects in Yemen, while plans to construct waste-water treatment plants in five major Syrian cities are progressing well.

56. Due to extensive agricultural development projects in the coastal areas within the region, overexploitation of groundwater has occurred, resulting in sea-water intrusion and depletion of the groundwater resources in some of the GCC member States.

C. Patterns of water resources planning and development

57. A review of the literature pertaining to water resources development plans in the ESCWA region shows that such plans vary from one country to another. They rely on many factors related to: the prevailing hydrologic and hydrogeologic set-ups, the overall socio-economic conditions, the objectives and goals identified, the planning horizons and others. Table 5 shows the various activities included in water resources planning in the region. It can be concluded that surface-water impounding for both water storage and/or flood controls is among the most common practices in water planning, in addition to the continuous conventional exploitation of surface water and groundwater resources.

58. Appreciable efforts have been made to develop surface-water resources at the national level in various ESCWA countries. A number of surface-water reservoirs have been built, while plans for new projects are being carried out. Iraq, the Syrian Arab Republic, Jordan, Yemen and Saudi Arabia have been the active member States in this respect during the last two decades.

Table 5. Patterns of water resources planning in the ESCWA region

Activity	Egypt	GCC countries	Iraq	Jordan	Lebanon	Syrian Arab Republic		Yemen
Surface-water impounding: Storage Recharge Diversion	X	X	X	X	X	X		X
		X		X				
			X	X				X
Irrigation networks: Rehabilitation Modernization	X	X	X			X		X
	X	X	X	X		X		
Reuse: Drainage water Treated waste effluent	X	X	X					
		X		X		X		X
Desalination		X						
Efficient utilization: Irrigation Industry Domestic	X	X	X	X		X		X
	X		X	X		X		X
	X	X	X	X		X		X
Groundwater	X	X	X		X	X		X
Water transference	X		X			X		
Water quality control	X	X	X		X	X		
Technology applications	X	X	X	X		X		
Water legislation		X	X	X		X		X

Note: X indicates the inclusion of the item in the concerned country's water-sector planning.

59. The Iraqi Government plans to achieve a total live storage capacity of 55,000 MCM, an amount that does not include water from the Tharthar Lake and existing marshes. The total storage capacity of the existing and future reservoirs when completed is estimated to be 95,000 MCM/year.

60. Most of Jordan's flood waters flow into the Dead Sea or evaporate in the desert mud-flats. By 1988, about 15 reservoirs had been constructed in Jordan; the total capacity of these dams is about 126 MCM. A number of dam sites with a potential total storage capacity of about 387 MCM were identified in different localities in the country; studies and construction of some of these structures are under way.

61. In the Syrian Arab Republic, about 125 dams were recently constructed, including the major Euphrates dam, whose storage capacity is 14.1 BCM. In 1991 the completion of nine dams added a storage capacity of 3.8 BCM. Currently, construction work is being carried out at 23 sites in the areas of Yarmouk, Orentes, Al-Badiya Barada, Euphrates and Al-Khabour basins. Projected storage capacity is around 2.6 BCM. The total storage capacity of all dams so far constructed or under construction in the Syrian Arab Republic amounts to 20.5 BCM.^{7/}

62. About 199 small and large dams were constructed during the last decade in Saudi Arabia, with an estimated total storage capacity of 750 MCM. These dams are mainly for making use of flood waters for irrigation, livestock and/or artificial groundwater recharge.^{8/}

63. Because of their limited water resources and the rapidly decreasing quantity and quality of water, many oil-producing countries of the region have turned to the sea for their freshwater supply; considerable progress in desalination activities has been achieved in recent years.

64. In Bahrain additional desalination units designed to produce 50 MCM/a would give the country a total production of 125 MCM/a in 1998.^{9/} In Kuwait, more desalination plants were constructed at the Doha East and Doha West stations, raising total production capacity to 365 MCM/year.^{10/} Six new plants were constructed in Saudi Arabia, bringing the total installed

^{7/} Syrian Arab Republic, Ministry of Irrigation, Directorate of Planning and Follow-up, "Memorandum on dams constructed in the Syrian Arab Republic", February 1993 (Arabic).

^{8/} Economic and Social Commission for Western Asia, "Progress achieved in the implementation of the Mar del Plata Action Plan in the ESCWA region: water-resources management: institutional and legislative aspects" (E/ESCWA/ENR/1992/5), October 1991.

^{9/} Mubarak Aman Al-Na'imi, "Water plan for Bahrain to the Year 2000, country paper presented at the Fifth Meeting of the Permanent Arab Committee on the International Hydrological Programme (IHP), Cairo, 9-11 November 1992.

^{10/} Arab Planning Institute, working paper presented to the Workshop on the Water Crisis in the Arab World, Bahrain, 15-16 June 1993.

capacity of the Kingdom to 657 MCM/year.^{11/} In Oman, additional units were installed at the Ghabrah Station to increase the freshwater production capacity to 41 MCM/year.^{12/} In Qatar, the expansion of Ras Abu Aboud and Ras Abu Fontas stations, with a designed capacity of 96 MCM/year, was completed in 1986. Finally, total production of desalinated water in the United Arab Emirates has reached 264 MCM/year.^{13/}

65. Treated waste-water effluent as a nonconventional water-supply augmentation has become an important developmental activity in the region. Waste-water reuse has been practised by some member States of ESCWA for a considerable period of time, although in a limited way; only recently have plans been formulated for large-scale development of this nonconventional source. Lack of knowledge about the long-term effects of treated sewage effluent use for various purposes and the availability of other water resources have prevented the reuse of treated waste water on a wider scale; however, the development of new technologies and the rising cost of desalinating water have led to a higher, more substantial rate of waste-water reuse in the ESCWA region during the last decade.

66. Jordan, the GCC States and Egypt have practiced waste-water reuse in agriculture and public gardening. Treated waste-water production is presently estimated at about 1,290 MCM/a, with an additional production of 1,140 MCM/a of treated waste water for Bahrain, Egypt and Jordan by the year 2000.

67. Water-saving measures have figured prominently in water resources development plans in the region in recent years. Such measures were related to irrigation or agriculture water use and drinking water supply schemes.

68. In general, irrigation and agricultural water-use projects have received a great deal of attention in member States of ESCWA in recent years, particularly in Iraq, Egypt, the Syrian Arab Republic, Jordan, Saudi Arabia and Oman; about 60 projects were completed or are ongoing in the region. Modern irrigation projects have been executed extensively in Jordan and Saudi Arabia, while rehabilitation of the existing irrigation-drainage networks in Iraq and Egypt is progressing well. In the Syrian Arab Republic, several irrigation projects and parallel dam construction activities are also in progress. Studies concerning the use of treated drainage water are being considered in Iraq and Egypt, where the volume of reused drainage water reached 12.168 km³/year in 1989.^{15/}

^{11/} Ibid; p. 7.

^{12/} See note 8; and "The role of water resources management in combating desertification in Oman" (E/ESCWA/ENR/1993/2), January 1993.

^{13/} See note 10.

^{14/} E/ESCWA/ENR/1992/5, p. 30.

^{15/} Economic and Social Commission for Western Asia, "Water resources planning in Egypt: issues ahead to the year 2020" in the Proceedings of the Ad Hoc Expert Group Meeting on Water Security in the ESCWA Region" (E/ESCWA/NR/1990/3), Damascus, 13-16 November 1989.

69. The oil-producing countries--particularly Oman, Saudi Arabia and Iraq -- are proceeding with plans to increase agricultural production through the implementation of modern and efficient irrigation-drainage projects, to become as self-sufficient in food production as the available water resources will allow.

70. All member countries of ESCWA have vigorously undertaken drinking-water supply projects aimed at improving the living standards of their populations, as a follow up to the Mar del Plata Action Plan. It was reported that in 1980 about 92 per cent of the urban population in the ESCWA region and about 51 per cent of the rural population were supplied with safe drinking water. Most of the member States' national development plans have included a target date of the year 2000 to secure a safe and adequate water supply for their populations.

71. In recent years, the GCC countries have carried out several drinking-water supply and sanitation projects aimed at raising the standards of these utilities and at making them compatible with the newly achieved economically developed status and improved living conditions. In Bahrain, Kuwait, the United Arab Emirates and Qatar, 100 per cent of the urban areas are supplied with piped water.

72. More than 500 large and small water supply projects in urban and rural areas have been completed and/or are ongoing in the region.^{16/}

73. Water supply projects vary from one country to another according to the water supply source; such projects rely on surface-water resources in Egypt (the Nile River) and in Iraq (Tigris and Euphrates rivers) and equally on surface water and groundwater in the Syrian Arab Republic (Euphrates, Orentes and Al-Kabir rivers). The rest of the member States of ESCWA depend largely on groundwater for their water supply. This source is not reliable, as it is a depletable source which deteriorates in quality when overpumped; overpumping is common and is a result of the increased water demand in large cities like Amman, Aden, Riyadh and Sana'a. Frequently, sources are distant from inhabited areas. Groundwater of poor quality occurs in the United Arab Emirates, Bahrain, Qatar and Kuwait; brackish groundwater is blended with desalinated water to provide adequate water supplies to these Gulf States.

74. Given these situations, water supply projects are dictated by supply sources, rather than individual needs. For example, water is piped from remote areas to distribution areas like Amman, Riyadh and Aden; in countries using surface-water resources, the large and small treatment plants are constructed for the large cities in Jordan, Iraq and Egypt and the rural areas in Iraq, respectively.

^{16/} E/ESCWA/ENR/1992/5, p. 29.

IV. CONCLUSION AND RECOMMENDATIONS

75. In general, good progress in water resources management, development and conservation has been achieved during the last decade in the region. In spite of this progress (which was briefly summarized in the present document), it can be concluded that still more efforts have to be spent in the region in order to achieve efficient water sector planning and water resources assessments at both the national and regional levels. The following are major areas of concern which have to be considered during the 1990s in the region, relative to water-resources management and development in the ESCWA region:

(a) Focusing on issues related to shared water resources and considering them a priority. The development and utilization of surface water and groundwater resources at the national level could result in serious tensions among riparian countries; those concerned should therefore be encouraged to develop resources in cooperation with one another.

(b) Improving manpower capabilities for multidisciplinary planners and those at the managerial level in the field of water resources.

(c) Enhancing activities pertaining to the establishment of a comprehensive water-sector database at national and regional levels. The use of computers and the latest software packages to upgrade the knowledge of national water resources should be promoted. Because the water data for national water resources assessment are inadequate in many countries of the ESCWA region, research to apply limited water data to tentative assessments should be enhanced.

(d) Considering water resources management as integral to regional security and stability. This would dictate designing water resources policies and institutions within the region in compliance with plans for integrated economic development.

(e) Enhancing public awareness at national levels by promoting incentives designed to encourage people to abide by water legislation. Efficient water use policies cannot be implemented unless they are supported by appropriate water legislation which defines the ownership of water and the use, waste and reuse of water resources.

(f) Promoting the application of new technologies in the major areas of concern to augment available water resources within the ESCWA region. These are:

- (i) The use of nonconventional energy resources to desalinate brackish groundwater occurring in the non-oil-producing countries. In the meantime, further research should be carried out to reduce the cost of desalination methods currently being applied in the oil-producing countries, as desalinated sea and/or brackish groundwater is a major element of the national water resources of many member States of ESCWA;

- (ii) The use of treated sewage and industrial waste. This type of water resource has become one of the most important elements augmenting national water supplies. The usage of such resources must be carefully monitored, in view of health considerations;
- (iii) Improving efficiency in irrigation and reuse of the resultant drainage water. Because this offers the greatest potential for augmenting the available water resources in the region, projects that consider improving such efficiencies must be given priority in the region, particularly in countries where misuse of irrigation water prevails;
- (iv) Rehabilitation of water supply networks and water storage facilities. A good deal of water loss is reported to occur in many countries of the region from dam reservoirs, water supply networks or conventional irrigation projects.
- (g) Giving priority to projects pertaining to better management of sea-water encroachment, as most of the major coastal aquifers in the region have been endangered, particularly in the Gulf States.

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