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ASSESSMENT OF LEGAL ASPECTS OF THE MANAGEMENT OF SHARED WATER RESOURCES IN THE ESCWA REGION

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ABBREVIATIONS AND EXPLANATORY NOTES

ACSAD	Arab Center for the Study of Arid Zones and Dry Lands
AFESD	Arab Fund for Economic and Social Development
BGR	Federal Institute for Geosciences and Natural Resources
bm^3	billion cubic metres
CEDARE	Centre for Environment and Development for the Arab Region and Europe
ECA	United Nations Regional Economic Commission for Africa
ECE	United Nations Economic Commission for Europe
ECU	European currency unit
EEC	European Economic Community
EGC	East Ghor Canal
EIA	environmental impact assessment
EIU	Economist Intelligence Unit
FAO	Food and Agriculture Organization of the United Nations
GAP	Guneydogu Anadolu Projesi (South-eastern Anatolia Project)
GEF	Global Environmental Facility
GEMS	Global Environmental Monitoring System
GIS	geographic information systems
GCC	Gulf Cooperation Council
GCI	Green Cross International
ICJ	International Court of Justice
IFAD	International Fund for Agricultural Development
IGCWR	Intergovernmental Committee on Water Resources
ILA	International Law Association
ILC	International Law Commission
JD	Jordanian dinars
JTC	Joint Technical Committee
KFAED	Kuwait Fund for Arab Economic Development
Kwh	kilowatt
LE	Egyptian pounds
m^3	cubic metres
M&E	monitoring and evaluation
MED	multiple effect distillation
MEED	Middle East Economic Digest
MSF	multi-stage flash
NBI	Nile Basin Initiative
NGO	non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NWC	National Water Carrier
PCIJ	Permanent Court of International Justice
PJTC	Permanent Joint Technical Committee
RCADI	Recueil des cours de l'Académie de Droit International
RO	reverse osmosis
RPC	regional programme committee
SWRO	seawater reverse osmosis
TECCONILE	Technical Cooperation for the Promotion of the Development and Environmental Protection of the Nile Basin
UNEP/RSPAC	Regional Seas Programme Activity Centre of the United Nations Environment Programme
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
WAJ	Water Authority, Jordan
WHO	World Health Organization
WSI	Water Stress Index

ABBREVIATIONS AND EXPLANATORY NOTES (*continued*)

The following symbols have been used in the tables throughout the publication:

A dash (—) indicates that the amount is nil or negligible.

A hyphen (-) indicates that the item is not applicable.

A plus sign (+) before an amount indicates an inflow of water.

A minus sign (-) before an amount indicates an outflow of water.

Totals may not add up to 100 due to rounding up.

The spelling of geographical sites and place names has been standardized according to the preference of the authors of this study.

The body of water generally referred to as Lake Albert in this study is also known as Lake Mobutu Sese Seko or Albert Nyanza.

Introduction

Water is set to become one of the major issues of the twenty-first century. A proportion of the world's 300 major international river basins and a number of major international aquifers are in regions where serious water quality or quantity problems are, or soon will be, evident. A wide range of international water agreements exist. These deal with rivers, lakes and other bodies of water. While a number of these agreements refer to river basins, the majority deal with specific waterworks, water uses and measures to control and regulate water flows. Several deal with pollution or the environment.

The need for a comprehensive legal instrument relating to international water resources has been voiced by several countries. The Convention on the Law of the Non-Navigational Uses of International Watercourses was adopted by the United Nations General Assembly on 21 May 1997. It was opened for signature and ratification for three years. However, the Convention did not acquire the required number of ratifications. Nevertheless, there is a need for cooperation regarding the management of international watercourses. Cooperation will benefit all parties and minimize potential conflicts for all riparian countries.

This study seeks to analyse the current problems regarding the utilization of shared surface and groundwater resources of riparian countries in the Economic and Social Commission for Western Asia (ESCWA) region.[1] Furthermore, it examines possible frameworks for agreement.

A. Scope

Water in the ESCWA region is particularly scarce.[2] Virtually every ESCWA member depends for its water supply, to varying degrees, on rivers and/or aquifers that are shared with neighbouring countries. This is based on the fact that some 136.5 billion cubic metres (bm^3) (or approximately 78 per cent) of the region's annual renewable water resources of some 176 bm^3 flow from outside the region. Inflows from shared rivers are the main source of water for some 70 per cent of the region's population according to 1996 United Nations forecasts for 2000.

Shared groundwater aquifers, and especially aquifers containing non-replenishable fossil water, contribute significantly to the current demand for water. Indeed, these resources are expected to become even more important as the water deficit grows.

In recent years, the increasing insecurity of the water rights of member countries that rely on shared rivers has contributed to a deterioration in the problem of water scarcity. A significant decrease in the availability of water for some of these countries, namely, Iraq and the Syrian Arab Republic has inflicted severe water shortages.

Evidently, historic secured access to the natural flows of shared rivers is increasingly being challenged and even undermined by the actions of various States. These actions have led to the prevention, reduction or control of the quantity and/or quality of water flow across borders. Today, the major river basins of the Euphrates, Jordan, Nile, Tigris, and its tributaries continue to be subject to riparian tensions. These tensions have been exacerbated by the absence of "basin-wide agreements" that lay down the entitlements of each country.

In addition to large shared river basins, numerous shared groundwater basins containing major aquifers are distributed between various countries in the Arabian Peninsula. These are, namely, Iraq, Jordan and the Syrian Arab Republic. Furthermore, agreements on abstraction from shared aquifers do not exist. ESCWA has been actively involved in the development of databases for some of these basins, namely, the basalt aquifer of Jordan and the Syrian Arab Republic and the Paleogene aquifer in Saudi Arabia. With regard to these shared aquifers, cooperation mechanisms must be developed for the benefit of all riparian States.

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[1] ESCWA members are Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, the Syrian Arab Republic, the United Arab Emirates and Yemen.

[2] See annex I for an assessment of the current situation of water availability and demand in the ESCWA region.

As the demand for water increases and shortages worsen, the potential for dispute regarding the issue of shared rivers and aquifers is increasingly likely. It is therefore vital that the region attempts to further improve cooperation regarding shared water development and management. A cooperation mechanism must be developed to help member States reach an equitable development and management of their shared waters.

Previous efforts by member States to enhance cooperation regarding shared water resources have been rather modest, despite the fact that there have been extensive efforts to develop individual water resources through various projects. These range from the construction of large and small storage reservoirs to the drilling of deep wells into fossil groundwater aquifers. Indeed, only a handful of agreements or protocols have been concluded in the region since the post-colonial era. These include the Agreement between the United Arab Republic and the Republic of Sudan for the Full Utilization of the Nile Waters, signed at Cairo, on 8 November 1959, the 1987 temporary agreement between the Syrian Arab Republic and Turkey regarding the Euphrates, the Syrian-Iraqi Agreement on the Utilization of the Euphrates Waters, signed April 1990, the Treaty of Peace between the State of Israel and the Hashemite Kingdom of Jordan, 26 October 1994, regarding the Jordan river, and the Agreement concerning the distribution of the waters of the Assi (Orontes) originating in Lebanese territory, signed on 20 September 1994 (not ratified in Lebanon yet).[3]

In comparison, some 150 bilateral and multilateral agreements are either in force or have recently been signed to manage some 290 international rivers, lakes and aquifers in central and western Europe.[4] In fact, the few water agreements in the ESCWA region are bilateral and, given the acrimony and poor cooperation among most riparian States, basin-wide agreements are not likely to be achieved in the near future unless special efforts are made.

Lack of appropriate cooperation and coordination mechanisms for shared water resources at regional and interregional levels is a source of concern. This issue is highly influenced by the prevailing relationships among States in the region and adjacent countries. Mutual cooperation and coordination regarding the management of shared surface and groundwater basins will help to achieve sustainable development within the region by contributing to the rational development, utilization and conservation of these crucial resources.

B. OBJECTIVES

With this in mind, the Energy, Natural Resources, and Environment Division (ENRED) of ESCWA has undertaken several activities to enhance the capacity of its member States to manage their shared surface and groundwater resources and strengthen their cooperation to achieve sustainable development and utilization of these resources.

An expert group meeting held in Sharm el-Sheikh from 8 to 11 June 2000 on Legal Aspects of the Management of Shared Water Resources in the ESCWA Region was the first initiative towards this endeavour.

This study is the second of these efforts. Its goal is to enhance the capacities of member States in the field of international water rights. In particular, this study serves the following two objectives:

(a) Enhancing regional capacity and raising awareness with respect to the legal aspects of the management of shared water resources. This is to be achieved by providing a comprehensive review of the rules and principles that constitute the legal norms supported by the international community regarding the utilization and management of such resources;

(b) Augmenting cooperation and coordination among ESCWA member States regarding the joint management of their shared groundwater resources.

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[3] *Official Gazette of the Government of the Syrian Arab Republic*, 1995, Issue 1, part 1 (in Arabic).

[4] Economic Commission for Europe (ECE), papers submitted to the Second Meeting of the Parties to the Convention on the Protection and Use of Transboundary Watercourses and International Lakes, The Hague, 23 to 25 March 2000 (ECE/MP.WAT/1-15).

C. JUSTIFICATION

The previous objectives were dictated by the following considerations:

(a) The importance of shared water resources to the region. The large majority of ESCWA member countries depend for their water supplies, to one degree or another, on shared rivers and/or aquifers;

(b) The incomplete legal framework that governs the utilization of these regional resources must be developed as water stresses increase and the potential for disagreement among riparian States gets worse. Allocation agreements that define each State's equitable share will enable proper planning and investment in this sector;

(c) The need to enhance the capacities of ESCWA members regarding internationally and regionally accepted legal norms governing the utilization of shared water resources. ESCWA activities in the field of shared water resources are intended to prepare countries in the region for future events and lay the groundwork for a more enhanced regional cooperation towards achieving just utilization of shared water resources;

(d) The increasing challenges to the historic surface water rights of downstream member States and the growing need for strengthened cooperation with upstream States. For centuries, riparian States have accessed their shared rivers without really taking into consideration the notion of preventing, controlling or reducing adverse quantity and/or quality impacts across borders. In recent years, however, this situation has changed dramatically as a result of the increasing competition for available water;

(e) The need to enhance inter-State cooperation regarding shared groundwater resources, which remains less developed than other issues. This is largely because States have traditionally considered groundwater to be a sovereign resource that is not subject to international law;

However, various international legal bodies have attempted to draft some acceptable legal guidelines. In this regard, the works of the International Law Association (ILA) and of special professional groups must be noted. Moreover, several bilateral and regional agreements on shared groundwater have been concluded, namely, the Convention on the Protection and Use of Transboundary Watercourses and International Lakes 1992 (ECE) and the Charter on Groundwater Management, (ECE) Helsinki 1992. In many cases, these agreements were shaped according to the same principles as those applied to shared surface water resources;

(f) The anticipated role of groundwater in meeting the growing water deficit in the region. If the current trend in water demand continues in the ESCWA region, it is predicted that the majority of the water deficit will be met by mining of fossil groundwater, mostly from shared aquifers. Given that the annual mining of groundwater could exceed 60 bm^3 by 2025, it is likely that disputes concerning shared aquifers will emerge and/or grow. Current disputes over certain shared aquifers in the region seem to point to this likelihood;

The ESCWA region, therefore, needs to enhance bilateral and regional cooperation regarding shared aquifers. An essential requirement for this cooperation is a legal regime or framework. This must be developed soon. A balanced legal framework for such cooperation, if developed and adopted by member States, will greatly facilitate the development of bilateral or multilateral cooperation agreements;

(g) The growing concerns regarding transboundary pollution. The environmental dimension of shared water resources and the need for enhanced cooperation regarding transboundary pollution is an important aspect of shared water resources management. This study highlights the major environmental concerns of the region associated with shared rivers and aquifers. The obvious justification for the inclusion of this issue here is that the environmental issues associated with shared water resources require international, regional, multilateral or bilateral conventions, agreements or protocols. Furthermore, they require harmonization of environmental legislation, standards, monitoring and reporting. The efforts of ESCWA in this regard, will be highlighted;

(h) The need to promote dispute management tools. Dispute management is another important dimension in the management of shared water resources. Modern international law imposes a basic obligation upon States to seek peaceful settlement to disputes;

(i) The need to build technical, institutional and administrative capacities among member States to facilitate the conclusion and implementation of agreements on their shared water resources.

D. APPROACH

Certain sections of this study were presented as a background document for the Expert Group Meeting on the Assessment of Legal Aspects of the Management of Shared Water Resources in the ESCWA Region held in Sharm el-Sheikh from 8 to 11 June 2000. The Meeting was jointly organized with the Centre for Environment and Development for Arab Region and Europe (CEDARE), and cosponsored by the United Nations Environment Programme Regional Office for West Asia (UNEP/ROWA), the Federal Institute for Geosciences and Natural Resources (BGR) Germany, and the World Water Council (WWC).

This study contains technical information and relevant data based on the country papers presented at various expert group meetings and symposiums organized by ESCWA and other organizations active in the water sector in the region. These meetings include, the Expert Group Meeting on Water Security in the ESCWA Region held in Damascus from 13 to 16 November 1989, the Regional Symposium on Water Use and Conservation held in Amman from 28 November to 2 December 1993, the Expert Group Meeting on the Implications of Agenda 21 for Integrated Water Management in the ESCWA Region held in Amman from 2 to 5 October 1995, the Expert Group Meeting on Water Legislation held in Amman from 24 to 26 November 1996 and the Expert Group Meeting on Development of Non-Conventional Water Resources and Appropriate Technologies for Groundwater Management in the ESCWA Member States held in Manama from 27 to 30 October 1997.

In addition, Tarek Majzoub, a consultant on international water law, contributed to this study. Chapters II, III, VII, parts of annex I and the majority of annex II are largely based on his work. Furthermore, he developed the glossary of legal terms (annex VI).

Information for this study was gathered from a number of recent regional and international publications and the Internet. Annex IV lists the main Internet sites on shared water resources and international law.

E. ORGANIZATION OF THE STUDY

Chapters I and II cover the regional and international perspectives of shared surface water resources. The first chapter reviews the status of regional cooperation regarding surface water systems by inventoring and analysing the treaties/agreements concerning these systems. It highlights the main issues in relation to the cooperation of member States regarding surface water resources. The second chapter provides an international perspective by examining the international legal framework for the development, utilization and management of shared surface water resources by examining such agreements as the Helsinki Rules on the Uses of Waters of International Rivers and the United Nations Convention of the Law of the Non-Navigational Uses of International Watercourses. It aims to highlight the legal principles upon which accepted international norms, regarding the management and utilization of these resources, are founded.

Chapter III is a review of the major shared aquifers in the region, their nature and extent. Chapter IV highlights the status of regional cooperation regarding shared aquifers, in terms of previous and ongoing cooperation and joint projects for the development, utilization and management of these resources. Chapter V addresses the international legal aspect of shared aquifers, namely, the Seoul Rules on International Groundwaters, the Bellagio Draft Treaty, United Nations Convention of the Law of the Non-Navigational Uses of International Watercourses and others. Furthermore, it examines the legal principles promoted in these conventions and applications at various levels within the region.

Chapter VI addresses the need for enhanced cooperation. It attempts to identify the motivations for seeking such cooperation, potential benefits, constraints and the requirements to strengthen bilateral or even

regional cooperation regarding shared water resources. Chapter VII deals with the approaches and methodologies for managing shared water resources. Dispute management aspects are addressed in chapter VIII while chapter IX summarizes the main conclusions and recommendations.

In addition, the study comprises six annexes that address: the current situation of water availability and demand in the ESCWA region (annex I); physiographic aspects of the major surface water systems in the ESCWA region, namely, the Nile, Euphrates, Tigris and Jordan (annex II); a bibliography of ESCWA's most recent publications on the legal aspects of water resources (annex III); Internet sources on international water law (annex IV); the Helsinki Rules on the Uses of the Waters of International Rivers (annex V); and finally a glossary of legal terms (annex VI).

I. STATUS OF REGIONAL COOPERATION REGARING SHARED SURFACE WATER RESOURCES: UTILIZATION AGREEMENTS, MANAGEMENT AND PRACTICES[5]

This chapter analyses the current trends regarding cooperation on shared surface water resources in the ESCWA region. It provides background on previous water utilization agreements, management and practices regarding shared surface water resources among the ESCWA member States. Furthermore, previous and present uses and misuses of these resources are elaborated.

Many disputes and conflicts in the ESCWA region centre around the course of its rivers. Rivers flowing through the territory of several countries are likely to engender two types of problem.

The first type of problem arises when a country attempts to divert a river originating outside its own frontiers. The second category of problem emerges when an upstream country sheltering the source of a large flow of water, constructs public works, namely, dams. These works are liable to deprive downstream States of their usual hydraulic resources.

At the heart of the dispute lies a problem of law. However, in resolving the underlying issues, one would simultaneously settle all political and economic difficulties that form the background of the dispute.

The issue of shared surface water resources can be described as that which concerns a river whose waters are claimed by various riparian countries. In any dispute, therefore, it is essential to determine to whom these waters belong. Before embarking upon a legal analysis, this study will collect and classify all relevant data.

Disputes that concern water are essentially legal in nature. Therefore, only a method that constantly stresses the legality of the elements under investigation will prove to be adequate in this regard. This type of dispute falls within the realm of public international law because it involves sovereign States. Furthermore, the subject of the conflict is a river, which in some cases, can be classified as multinational.

A. THE NILE

During the European colonization of Africa, the United Kingdom of Great Britain and Northern Ireland entered into several treaty arrangements and protocols with other powers regarding the Nile (see table 1).[6]

One such arrangement is the Agreement between the United Arab Republic and the Republic of Sudan for the Full Utilization of the Nile Waters, signed in Cairo, on 8 November 1959.[7] It concerned the construction of the High Aswan Dam, the allocation of water shares and the establishment of a Permanent Joint Technical Committee.

In addition, from 1967 to 1992, cooperation between the co-basin States of the Nile was channelled through Hydromet. It studied water balance and assessed the needs of the upper riparian States.

From 1993 to 1999, the Nile Basin States participated in the Technical Cooperation for the Promotion of the Development and Environmental Protection of the Nile Basin (TECCONILE). Based on this cooperative effort, the Nile Basin Initiative (NBI) was subsequently launched in Dar Es Salaam in February 1999.

To date, the majority of Nile Basin States are in favour of "equitable allocation" of the Nile waters and sustainable integrated development. Furthermore, these States aim to establish a joint institutional legal framework and develop an integrated water master plan.

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[5] See Annex II for a review of the physiography of the major surface water systems in the ESCWA region.

[6] B.A. Godana, "Africa's shared water resources. Legal and institutional aspects of the Nile, Niger and Senegal river systems" (London, Francis Pinter, 1985), p. 197.

[7] The United Arab Republic comprised Egypt and the Syrian Arab Republic between 1958 and 1961.

TABLE 1. CHARACTERISTICS OF MAJOR CONTROL POINTS, NAMELY, DAMS, RESERVOIRS AND SWAMPS, ON THE NILE

Facility	Year of completion	Possible rise of water level (m)	Capacity (km^3)	Surface and/or length reservoir	Losses (evaporation) ($10^6 m^3$)
Edfina Sudd	(Bank for protection against marine intrusion)				
Faraskur Sudd					
Zifta barrage	1902	3.80			
Delta barrage	1847	1.50			
	1890	3.50			
Mohamed Ali barrage	1939	4.20			
Assiut barrage	1902	3.50			
	1933	3.50			
Nag Hammadi barrage	1909	4.65			
Esna barrage	1909	2.00			
Aswan dam	1902	18.00	1.00	225 km	
	1912	25.00	2.40		
	1934	34.00	6.30	360 km	
High Aswan dam	1970	97.00	164.00	500 km	
				6 000 km^2	10 000
Khasm el Girba dam	1964	(20.00)	1.20		60
Sennar dam	1925	16.00	1.00	140 km	280
Roseires dam	1966	50.00	0.45	290 km	450
Ethiopia-Sudan border					
Lake Tana				3 100 km^2	Equal rainfall
Gebel Aulia dam	1937	6.55	3.60	500 km	2 800
Baro Pibor Sobat swamp					4 000
Bahr el Ghazal swamp					15 000
Bahr el Gebel swamp				8 300 km^2	12 000
Sudan-Uganda border					
Lake Albert[a/]				5 300 km^2	Less rainfall
Lake Edward				2 200 km^2	Slightly less rainfall
Lake Kyoga					
Owen Falls					
Lake Victoria				6 7000 km^2	Slightly less rainfall

Source: Compiled by ESCWA from various sources.

a/ Also known as Lake Mobutu Sese Seko.

Since the beginning of the last century, the colonial era and competition between Belgian, British, French, German and Italian traders has marked the legal regime of shared rivers in the region. From the early twentieth century, British colonial influence has shaped agreements, protocols and exchanges of notes in such a way as to safeguard the British sphere of influence in Africa. An overview of these historical developments until 1959 is outlined below.

(a) *Treaty arrangements and protocols between European powers and the United Kingdom regarding the Nile*

The United Kingdom entered into treaty arrangements and protocols with other European powers with respect to its sphere of influence in the Nile valley. For example, Italy and the United Kingdom signed a Protocol on 15 April 1891 regarding the delimitation of their respective spheres of influence in Eastern

Africa. Article III of the Protocol provided that the Government of Italy undertake not to construct on the Atbara any irrigation or other works which might sensibly modify its flow in the Nile.[8]

In addition there was the Agreement between Great Britain and the Independent State of the Congo, modifying the Agreement signed in Brussels, 12 May 1894 relating to the spheres of influence of Great Britain and the Independent State of the Congo in East and Central Africa, signed in London, 9 May 1906. It provided that: "The Government of the Independent State of the Congo undertake not to construct, or allow to be constructed, any work on or near Semliki or Isango River, which would diminish the volume of water entering Lake Albert, except in agreement with the Soudanese Government" (Article III).[9]

The concern for the United Kingdom's interests was reflected for example, in the Exchange of Notes between the British and Italian Governments respecting the Regulation of the Utilisation of the Waters of the River Gash. Rome, 12 and 15 June 1925.

(b) *Treaty arrangements and protocols between the United Kingdom and upstream co-basin States*

The United Kingdom entered into two major treaty arrangements with Egypt and Ethiopia. The first was the Treaty between Ethiopia and the United Kingdom, Relative to the Frontiers between the Anglo-Egyptian Sudan, Ethiopia and Eritrea, signed at Addis Ababa, 15 May 1902. It was an agreement related to border delineation. The Ethiopian Emperor Menelek II, committed that his country would not introduce any development on the Blue Nile, Lake Tana (referred to here as Lake Tsana) or the Sobat that would alter the volume of the Nile's flow. Under article III, the emperor promised "not to construct, or allow to be constructed, any work across the Blue Nile, Lake Tsana, or the Sobat, which would arrest the flow of their waters into the Nile except in agreement with His Britannic Majesty's Government and the Government of the Sudan".[10]

The 1929 Nile Waters Agreement, more formerly known as an Exchange of Notes between His Majesty's Government in the United Kingdom and the Egyptian Government in Regard to the Use of the Waters of the River Nile for irrigation Purposes, Cairo, 7 May 1929, constituted an important landmark in the history of the Nile River. One of the most significant clauses of the Agreement was:

"Save with the previous agreement of the Egyptian Government, no irrigation or power works or measures are to be constructed or taken on the River Nile and its branches, or on the lakes from which it flows, so far as all these are in the Sudan or in countries under British administration, which would, in such a manner as to entail any prejudice to the interests of Egypt, either reduce the quantity of water arriving in Egypt, or modify the date of its arrival, or lower its level".[11]

The 1929 Agreement further stipulated that the construction of such works should be under the direct control of the Government of Egypt. It was further agreed that before undertaking these works, Egypt must agree with the local authorities in Sudan on measures to safeguard local interests.[12]

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[8] Original in French. Protocole entre les Gouvernement de l'Italie et du Royaume-Uni, pour la démarcation des sphères d'influence respective dans l'Afrique orientale, signé à Rome, le 15 Avril 1981; *United Nations, Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series, (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), No. 27, p. 127.

[9] United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), p. 99.

[10] Ibid., No. 13, pp. 115-116.

[11] Ibid., p. 101.

[12] In 1935, an American firm received permission from Ethiopia to construct a dam on the outlet of Lake Tana. However, this was stopped by the British according to the provisions of the 1929 Agreement.

The contribution of the 1929 Agreement to the legal regime of the Nile was significant. First, it showed a recognition on behalf of the parties concerned, regarding the principle of established rights. It must be noted that insistence on the recognition of its natural and historic rights has been the most fundamental element of Egyptian policy approach to the Nile waters. Furthermore, the principle of equitable sharing was recognised. Therefore, the natural flow of the Nile during the low season—from 19 January to 15 July (at Sennar)—was reserved for Egypt's use. Sudan, howver, was permitted to use water from the Sennar dam during the summer. The Agreement of 1929 was supplemented three times.

Other agreements that preceded the Agreement between the United Arab Republic and the Republic of Sudan for the Full Utilization of the Nile Waters, signed at Cairo on 8 November 1959, are the Exchange of Notes between the United Kingdom and Italy Respecting Concessions for a Barrage at Lake Tsana and a Railway across Abyssinia from Eritrea to Italian Somaliland. Signed at Rome on 14 and 20 December 1925 and an Exchange of Notes Constituting an Agreement between the Government of the United Kingdom and the Government of Egypt Regarding the Construction of the Owen Falls Dam in Uganda, Cairo 16 July 1952 and 5 January 1953.

(c) *Agreement between the United Arab Republic and the Republic of Sudan for the Full Utilization of the Nile Waters, signed at Cairo on 8 November 1959*[13]

After the independence of Sudan in 1956, an agreement was concluded between Sudan and Egypt in 1959 to construct the High Aswan Dam and to state the water allocation of the two countries. This was defined as: 18.5 bm^3 for Sudan, 55.5 bm^3 for Egypt and 10 bm^3 as losses from High Aswan Dam Reservoir. Furthermore, the agreement dealt with matters pertaining to the following: the gauging of the Nile, claims of other riparians, the occurrence of low flow or droughts years, the increase of the natural annual average of the Nile, the increase of the Nile yield through the reclamation of the Upper Nile swamps within Sudan and the formation of a cooperative group, namely, the Permanent Joint Technical Committee, to realize the implementation of the provisions of the 1959 Agreement.[14]

This Agreement marked the culmination of attempts to set up a definitive legal regime of the Nile between these two States. Certain features of this Agreement are listed as follows:

(a) The Agreement recognized the "established rights" of the parties. The quantities of water actually used by Egypt up to the date of the Agreement constituted the established right of Egypt. This right was fixed at 48 bm^3 annually. Sudan's established right, similarly computed, was fixed at 4 bm^3 per year;

(b) Sudan agreed to the construction of the High Dam at Aswan,[15] and Egypt permitted the construction of the Roseires Reservoir on the Blue Nile and any other works deemed necessary by Sudan;

(c) The net increase resulting from the construction of the High Dam, calculated after deducting the acquired rights of parties plus the loss caused by storage, estimated at 10 bm^3, was apportioned between the two riparian States. Of the 22 bm^3 estimated to be the net increase, Egypt was to receive 7.5 and Sudan 14.5 bm^3. The total allocation therefore amounted to 55.5 bm^3 for Egypt and 18.5 bm^3 for Sudan. Any increase in the net benefit, as a result of an increase in the mean annual flow of 84 bm^3, was to be shared equally between the two States;

(d) The Agreement granted Sudan compensation of LE 15 million to be paid by Egypt;

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[13] United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), No. 34, p. 143.

[14] Protocol concerning the establishment of the Permanent Joint Technical Committee, signed at Cairo, on 17 January 1960. ibid.

[15] The High Aswan Dam was completed in 1968 to ensure the long term availability of water for Egypt and Sudan. Its lake has a storage capacity of 130 bm^3.

(e) Sudan agreed to advance a water loan to Egypt to enable it to meet its agricultural expansion needs, provided that the loan did not exceed 1.5 bm^3 and would not extend beyond November 1977;

(f) Sudan agreed to undertake, in agreement with Egypt, projects for increasing the Nile waters by preventing the waste of water in the marshes of Bahr el Gebel, Bahr el Zaref, Bahr el Ghazal and their tributaries, the Sobat River and its branches and the Nile basin. Furthermore, provision was made for Egypt to carry out projects aimed at increasing Nile waters at times when Sudan did not need any additional supply;

(g) A Permanent Joint Technical Committee comprising equal numbers of representatives from both States was to be established. The technical cooperation between Egypt and Sudan in the context of the 1959 Agreement progressed smoothly. The Permanent Joint Technical Committee outlined several development programmes. The first was the construction of the Jonglei Canal. The project was expected to canalize the river channel in Sudan and thus reduce the evapotranspiration losses. The first phase (Jonglei I) was expected to be finished by the 1980s and would have provided 3.8 bm^3 of water at Aswan to be shared equally by the two countries. However, the project was abandoned in 1983 because of instability and security problems in southern Sudan. A total of 7 bm^3 annual discharge was expected after completion of the second phase of the Jonglei Canal (Jonglei II). This was to be shared by the two countries[16] (see table 2);

(h) This Agreement did not repeal or abolish the Nile Waters Agreement of 1929.

TABLE 2. UPPER NILE WATER PROJECTS

Project	Installation	Water savings Aswan (millions m^3 per year)
Jonglei I	Jonglei Canal, Bor Extension, Bahr el Gebel channelization	3 800
Jonglei II	Lake Albert dam, Jonglei Canal widening, Lake Victoria regulation, Lake Kyoga barrage regulation	3 200
Machar Marsh	Baro-Gambeilla Dam, Khor Mauhar embankment, Machar marsh canal	4 000
Bahr el Ghazal	North Bahr el Arab canal, Jur river tributary, Bouchery/Sewi reservoirs, Canal Tonj to Bahr el Gebel	7 000
Total		18 000

Source: Compiled by ESCWA from various sources.

An interesting provision in the Agreement relates to the course of action specified for dealing with other riparians and for the consequences that may result from their claim. It reads as follows:

"In case any question connected with Nile waters needs negotiations with the governments of any riparian territories outside the Republic of Sudan and the United Arab Republic, the two Republics shall agree beforehand on a unified view in accordance with the investigations of the problem by the Committee. This unified view shall then form the basis of instructions to be followed by the Committee in the negotiations with the governments concerned."[17]

If such negotiations resulted in an agreement to construct works on the Nile in territories outside the two Republics, the Permanent Joint Technical Committee was to assume the responsibility to contact the concerned authorities in those territories to lay down the technical details in connection with the execution, working arrangements and maintenance of the works in question. After reaching an agreement on these

[16] A minimum of some 18 km^3 to be shared by the two countries was expected to be saved from proposed conservation projects in the upper Nile sub-basins, namely, the Bahr el Ghazal and Machar swamp. However, the finalization of such schemes depends on agreements between the Nile riparian countries and available funds.

[17] Agreement between the United Arab Republic and the Republic of Sudan for Full Utilization of the Nile Waters. United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), section IV. No. 1, p. 146.

points with the Governments concerned, the Committee was to supervise the execution of the technical provisions of such agreements.

Given that other riparian countries on the Nile, apart from Sudan and Egypt, claim a share of the Nile waters, both parties have agreed to jointly study these claims and adopt a unified view thereon. If such studies result in the possibility of allotting an amount of the Nile water to one or the other of these territories, then the value of that amount was to be deducted in equal shares from the share of each of the two parties.

The Permanent Joint Technical Committee was to make arrangements with the concerned authorities in other territories in connection with the control and checking of the agreed amounts of Nile water consumption.

This last provision is an outstanding one. It recognizes the rights of other riparian countries to a share in the Nile waters.

It would seem, therefore, that the 1959 Agreement recognizes the principle of equitable entitlement to the waters of the Nile, with the commitment that no State shall cause appreciable harm to other users.

However, the 1959 Agreement evinced a number of harsh reactions from some riparian States. The upper riparian States of the White Nile advanced claims regarding their share of the Nile waters. Furthermore, Ethiopia stressed its legitimate rights to use the 85 per cent portion of the waters of the Nile that originate in its territory.

To study and verify these claims, Egypt and Sudan have called for the scientific identification of the water requirements of each riparian State. Furthermore, they have solicited other co-basin States to reconcile any conflicting views, and to amicably agree to establish an appropriate institutional and legal framework for cooperation agreeable to all.[18]

Egypt and Sudan have always advocated the conservation, development and use of the Nile waters and other shared water resources in an integrated, sustainable and environmentally sound manner through basin-wide cooperation among all riparians.

Furthermore, Egypt and Sudan have worked to avoid fragmentation by underlining the importance of developing national water master plans based on a unified methodology. These could be integrated into a basin-wide cooperative plan that would recognize and harmonize both the regional projects and national programmes. These are, namely, joint multipurpose water storage projects in the upper reaches of the Nile. They would control and regulate lakes or rivers and could serve national and integrated development needs.

(d) *The period subsequent to the 1959 Agreement*

In 1961, Lake Victoria experienced an unprecedented rise in its water level and a consequent increase of outflow discharge to Sudan.

To study the sudden rise of Lake Victoria, the White Nile Basin countries agreed to implement the project of the meteorological and hydrological survey in certain areas of the Nile basin. This was initiated by an Exchange of Notes in 1950 between Egypt and the United Kingdom.[19]

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[18] It appears that both countries have accepted the idea that the existing bilateral agreements may be subjected to reconsideration by the parties involved.

[19] Exchange of Notes constituting an Agreement between the Government of the United Kingdom (on behalf of the Government of Uganda) and the Government of Egypt regarding Co-operation in Meteorological and Hydrological Surveys in Certain Areas of the Nile Basin, Cairo, 19 January, 28 February and 20 March 1950. United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series, (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4) No. 11, pp. 112-114.

In 1950, Egypt and the United Kingdom had already agreed to cooperate on a meteorological and hydrological survey of the Equatorial Lakes. There was some contact between the Joint Technical Commission and an East Nile Waters Coordinating Committee (comprising representatives of Kenya, Uganda and former Tanganyika). The aim was to discuss the discharges at Owen Falls dam in Uganda and the future storage of water in Lakes Victoria and Albert.

In 1961, the three East African countries requested that the United Nations Expanded Programme of Technical Assistance assist in a meteorological and hydrological survey of the Lake Victoria catchment area. A report was submitted to the three Governments in 1963. Given that the three States were convinced that Egypt and Sudan be included in a further study, the representatives of the five States prepared a proposal in 1965 for a hydrological and meteorological survey of Lakes Victoria, Kyoga and Albert. Furthermore, they signed a plan of operation in August 1967 with the United Nations Development Programme (UNDP). The World Meteorological Organization was to be the executing agency. Later consultations were held with Burundi and Rwanda to extend the project area to cover the drainage area of Lake Victoria in these two States. [20]

Therefore, the Studies of the Equatorial Lakes Project (Hydromet), established in 1967, was initiated by Egypt, Kenya, Sudan, Uganda and United Republic of Tanzania. It was later joined by Burundi, Rwanda, and Zaire. Ethiopia was an observer member.

The purpose of Hydromet was to study the water balance of the Equatorial Lakes, the development of a mathematical hydrological model to assist in the conservation, regulation and control of the Equatorial Lakes and the development of the Nile water resources. Furthermore, a water quality model was developed. This project attempted to establish a basin-wide data base/holistic information system comprising water availability, water demand, geology, soils, vegetation, energy, biodiversity, social, economic, health and environmental aspects.

The Hydromet Project continued from 1967 to 1992 when it bcame TECCONILE.[21] Its aim was to assist participating countries in the following endeavours: the determination of their equitable entitlements to the use of the Nile; the formulation of national water master plans; the development of their capacities; the development of a basin-wide information system; preparation of a basin-wide institutional and legal arrangement; the enhancement of training procedures; environmental impact assessment (EIA) and water quality management capacity.

Furthermore, there are moves to develop a collection of modern technological data and analysis systems, namely, geographic information systems (GIS), remote sensing, telemetry and modelling, on a national and regional basin-wide basis.

TECCONILE was very much concerned with the protection of water quality and aquatic ecosystems in rivers, lakes and aquifers on national and regional levels. It contains this problem through the enactment of environmental legislation that prevents the discharge of pollutants into water bodies and provides analysis of water and protection against water-borne diseases, namely, bilharzia. Furthermore, this legislation regulates and treats sewage, industrial waste and agro-chemicals. In addition, it prevents saline intrusion and water logging. There are ongoing plans to establish multisectoral EIA mechanisms and regional water quality centres that would benefit from the Global Environmental Monitoring System (GEMS) (regarding water) and the Global Environemntal Facility (GEF).

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[20] Another notable development was the Agreement for the Establishment of the Organization for Management and Development of the Kagera River Basin, concluded at Rusumo, Rwanda, on 24 August 1977; came into force on 5 February 1978. Signed by Burundi, Rwanda, and the United Republic of Tanzania. The organization covers river development and is a regulatory body. Uganda joined the organization in May 1981. United Nations. *Treaties Concerning the Utilization of International Water Courses for Other Purposes than Navigation, Africa*, Natural Resources Water Series No. 13, New York, 1984.

[21] TECCONILE is steered by a Joint Technical Committee. Its policy issues are dealt with by a Joint Council of Ministers representing the Ministers of Water of the riparian States.

One particular environmental hazard is water hyacinth aquatic weeds. These have infested the White Nile in Sudan since 1957 and Lake Victoria since 1991 and are becoming a basin-wide problem. This hazard has been tackled on a national and regional level, with the assistance of the Food and Agriultural Organization of the United Nations (FAO).

Furthermore, there are plans to reclaim the wetlands and swamps of the Nile basin, namely, Bahr el Gebel, Bahr el Zaraf, Bahr el Ghazal, Sobat and Machar, all located in Sudan and Kagera and Lake Kyoga in the equatorial region. There is an understanding among the concerned Nile basin States that the social, economic and environmental viability of such projects must be given the utmost consideration to avoid an adverse impact on livestock, fisheries, wildlife, ecology and the biodiversity of the existing eco-systems.

The Nile basin co-riparian States have attempted, through TECCONILE, to benefit from the water related programmes of various United Nations bodies and others and to play a more pronounced role in their activities. TECCONILE was keen to strengthen the water resources unit of the United Nations Regional Economic Commission for Africa (ECA).[22]

The inception and growth of NBI over the past few years has been significant because for the first time, all Nile basin countries have expressed a serious concern about the need for joint discourse.

Various regional forums have set out to encourage meaningful cooperation regarding achieving integrated sustainable management and development of available shared water resources.[23]

While these efforts constitute a step forward, basin-wide cooperation has not yet been achieved. All parties understand and accept the need for cooperation. However, they have failed to reach a legal arrangement pertinent to water resources or to promote coordination of their activities on a basin-wide level. This state of affairs is a result of a general lack of political will, distrust among watercourse States, feelings of vulnerability and uncertainty of behalf of the two downstream States, particularly Egypt,[24] the absence of political stability in certain watercourse States and the lack of adequate financial resources and technical expertise, especially in the upstream States.

However, until a final basin-wide agreement is reached with regard to the management and utilization of the Nile, prior consultation and understanding must prevail among the co-basin States with regard to the construction of any national water project.

B. EUPHRATES AND TIGRIS

Public international law makes a distinction between three types of basins, namely, fluvial, drainage and integral basins:

(a) Fluvial or river basin refers to the hydrographical entity formed by a river and its tributaries;

(b) Drainage basin is a geographical zone spreading over two or several States and is determined by the limits of the supply area of the system of waters flowing into a communal mouth of the river (according to the Helsinki Rules on the Uses of the Waters of International Rivers, ILA 1967);

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[22] To date, TECCONILE has helped to resolve regional water disputes.

[23] The waters of the Nile are shared by 10 States, namely, Burundi, Egypt, Eritrea, Ethiopia, Kenya, Rwanda, Sudan, Uganda, United Republic of Tanzania and Zaire.

[24] Water is the most critical resource in Egypt. Water, and not land, is the main constraint to expansion of the agricultural area in Egypt. It is vital for the food security of the country. In this respect, Egypt has developed an effective bilateral hydro-diplomacy. Egypt's hydro-diplomacy on a regional level aims to achieve an environmentally sustainable development in harmony with the promotion of basin-wide integrated development of the shared water resources. Egypt has asked all co-basin States of the Nile basin to unify their views on the optimum means for the follow-up and implementation of the United Nations Conference on Environment and Development (UNCED) resolutions.

(c) Integral basin, refers to national utilization and international cooperation with the aim of assuring a complete exploitation of the basin's hydraulic resources.[25]

Admittedly, no international treaty regulates the sharing or common exploitation of the Euphrates (see table 3) and the Tigris (see table 4). However, agreements laying down general principles and emphasizing the right of downstream countries to waters entering their territory have been concluded.

TABLE 3. SOURCES AND USES OF THE EUPHRATES
(*Millions of cubic metres per year*)

			Natural flow	Uses
Iraq	Entering	Iraq	32 720	
	Removed in	Iraq		- 13 000
Syrian Arab Republic	Entering	Syrian Arab Republic	30 670	
	Added in	Syrian Arab Republic	+ 2 050	
	Removed in	Syrian Arab Republic		- 2 511
Turkey	Flow from	Turkey	+ 30 670	
	Removed in	Turkey		
	(Post GAP Project)		- 21 600	
Total			32 720 (Shatt Al-Arab)	- 37 111

Source: Compiled by ESCWA from various sources.

TABLE 4. SOURCES AND USES OF THE TIGRIS RIVER
(*Millions of cubic metres per year*)

			Natural flow	Uses
Iraq	Entering	Iraq	11 800	
	Added in	Iraq	+ 30 700	
	Reservoir evaporation	Iraq		- 4 900
	Irrigation (to Fatha)	Iraq		- 3 100
	Irrigation (to Baghdad)	Iraq		- 10 400
	Domestic use	Iraq		- 1 900
	Irrigation	Iraq		- 3 500
	Irrigation (to Tokuf)	Iraq		- 6 400
Syrian Arab Republic	Entering	Syrian Arab Republic	11 800	
Turkey	Flow from	Turkey	18 500	
	Removed in	Turkey		
	(Post GAP)[a/]		- 6 700	
Total			49 200 (Shatt al Arab)	- 36 900

Source: Compiled by ESCWA from various sources.

a/ South Anatolia Project.

It seems appropriate, therefore, to examine the regulatory framework established by these conventions in relation to the Euphrates and the Tigris basins both during the period before, and after, the emancipation of the riparian countries. Before the end of World War II, Turkey was the only independent riparian country.

[25] T. Naff and R.C. Matson, *Water in the Middle East: Conflict or Cooperation?* (Boulder, Westview Press, 1984); J.F. Kolars and W.A. Mitchell, *The Euphrates River and the Southeastern Anatolia Development Project* (Carbondale, Southern Illinois Press, 1991).

Therefore, France and the United Kingdom were the signatories of the conventions relating to the basin of the Euphrates concluded during the Mandate era.

1. *The Euphrates and the Tigris according to treaties during the Mandates*

Despite the lack of development in the Euphrates and Tigris basins between the two wars, various Franco-British and Franco-Turkish agreements on the common utilization of the waters and the possible development of the basin areas by the riparian countries were concluded.

(a) *The Franco-British Convention on Certain Points Connected with the Mandates for Syria and the Lebanon, Palestine and Mesopotamia, signed at Paris, on 23 December 1920*[26]

This convention was inherited by Iraq and the Syrian Arab Republic in accordance with the principle of succession of States with regard to treaties.

Article 3 of the Convention establishes the need for a mutual agreement before carrying out "any plan of irrigation formed by the Government of the French mandatory territory, the execution of which would be of a nature to diminish in any considerable degree the waters of the Tigris and the Euphrates at the point where they enter the area of the British mandate in Mesopotamia".

(b) *Franco-Turkish agreements between 1920 and 1930*

The first Franco-Turkish agreement of 20 October 1921, better known as the Franklin-Bouillon-Youssef Kemal Agreement, was signed at Angora (present day Ankara). This agreement concerned the utilization of the waters of the Koveik basin for the supply of Aleppo and the possibility of tapping the waters of the Euphrates.[27]

Article XIII of the agreement stipulated that the waters of Koveik will be divided between the town of Aleppo[28] and the town and the region of the North, which have remained Turkish, in such a way as to give equal satisfaction to both Parties.

The Angora Convention of 30 May 1926, dealt with friendship and good neighbourly relations between Turkey and the Syrian Arab Republic under the French mandate.[29]

Finally, a Protocol of 3 May 1930 confirmed the agreements previously signed between France and Turkey and dealt with the questions raised by the joint ownership of the Tigris.[30]

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[26] See United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), No. 88, p. 286.

[27] Original in French: Accord entre la France et la Turquie en vue de réaliser la paix; signé à Angora, le 20 octobre 1921, entre M. Franklin-Bouillion, ancien Ministre, et Youssouf Kemal Bey, Ministre des Affaires Etrangères du Gouvernement de la Grande Assemblée Nationale d'Angora. Ibid., p. 288.

[28] The Turkish spelling of the names of rivers and proper nouns will be adhered to as far as possible. Accordingly, the c is given as dj; the ç, tch; the ö, eu; the ü, u; the u, ou; the g, y; and the v, w.

[29] Original in French. Convention d'amitié et du bon voisinage entre la France et la Turquie, signée à Angora, le 30 mai 1926, Article XIII, United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), p. 289.

[30] Original in French. Protocole final d'abornement de la Commission d'abornement de la frontière Turco-Syrienne agissant conformément au traité d'Angora du 20 octobre 1921, à la Convention d'amitié et de bon voisinage du 30 mai 1926 et au Protocole d'abornemnet du 22 juin 1929. Alep, le 3 mai 1930. Ibid., No. 94, p. 290.

2. *Treaties and international relations in the post-World War II era*

(a) *The Protocol relating to the Utilization of the Waters of the Tigris and the Euphrates and their tributaries, an annex to the treaty of friendship and good neighbourliness between Iraq and Turkey, signed at Ankara, 29 March 1946*[31]

After World War II, Iraq, having expanded the confines within which its internal politics operated, started to cooperate with Turkey. This collaboration did not encompass more than a mere exchange of information on the subject of flood prevention and did not include the realization of any common projects. However, in 1946, an Iraqi-Turkish Protocol was signed.

This Iraqi-Turkish Protocol of 29 March 1946 was an annex to the Treaty of Friendship and Good Neighbourly Relations of the same date. This treaty dealt with the problems arising from the rivers running through the territory of both States, namely, the Euphrates, Tigris and Greater Zab, among others. The main purpose of this Protocol was the construction of protection and observation posts on Turkish territory to prevent downriver flooding and therefore, it mainly benefited Iraq. However, this agreement recognized the necessity for collaboration between the upstream and downstream countries.

The Treaty provided that all installation and preliminary research costs were to be borne by Iraq with the exception of the drawing up of maps. This was reserved for the Turkish cartographic departments. The expenses for the exchange of information were to be borne by Iraq, with the maintenance costs shared by both countries.

The construction of posts beyond those provided for by the Treaty was to be the subject of separate agreements. Turkey reserved the right to utilize the works constructed for Iraq for the purposes of irrigation and the production of hydropower. While no mixed commission was set up, the parties nominated representatives, who were to consult with each other on questions relating to the execution of the Protocol.

In general, the Protocol has worked well, despite tension between the two countries. Cooperation with regard to the implementation of article 5 of the Protocol, designed to harmonize projects on both sides, however, has been limited. This Protocol, in its general terms, could serve as a basis for better cooperation between the two countries. The inclusion of the Syrian Arab Republic would be an indispensable element of any future attempt to reach mutual cooperation.

Beyond this Protocol, contacts between the three riparian countries have remained limited. Indeed, there is little possibility of concerted action between Iraq, the Syrian Arab Republic and Turkey.

None of these treaties, agreements and protocols have received due attention. This tendency has been exacerbated by cases when each State has adopted policies to divert the tributaries of the Euphrates.

(b) *Respect and denunciation by the riparian States*

This study reviews only those closed[32] basins which have been designated in official documents, namely, the Koveik and Afrin basins, the subject to an agreement between Turkey and the Syrian Arab Republic and the Euphrates basin, subject to an agreement between Iraq and the Syrian Arab Republic.

It is possible that the Koveik was once a tributary of the right bank of the Euphrates. However, no geographical map refers to this closed basin. The source of the Koveik is in Anatolia (Turkey). From here the river flows past Aleppo and disappears into the marshy zones south of the city.

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[31] Original in French. Protocole relatif à la régularisation des eaux du Tigre et de l'Euphrate et de leurs affluents annexé au traité d'amitié et de bon voisinage entre l'Irak et la Turquie, signé à Ankara, le 29 mars 1946. Ibid., No. 104, p. 376.

[32] The term, closed basin, indicates all rivers or courses of water which do not flow either towards the sea or towards great lakes classified in the same category as seas.

During the mandate era, several texts regulated the utilization of these waters for the inhabitants of the Syrian-Turkish frontier regions. It would seem, however, that since 1940, Turkey has failed to fulfil its obligations towards the Syrian Arab Republic and that consequently, the waters of the Koveik no longer reach the region of Aleppo.[33]

Furthermore, the course of the Koveik was diverted at the beginning of the 1960s, as was the Afrin. It used to flow through the village of the same name in the heart of the Aleppo region. It was diverted in the early 1970s.

The issue of the Euphrates has created tension between Iraq and the Syrian Arab Republic. In 1975, the amount of water entering Iraq fell by a quarter, from 28 bm^3 per annum to approximately 21 bm^3. Baghdad responded by mobilizing its troops on the Syrian border.

Since that time, the almost complete breakdown of Iraqi-Syrian diplomatic relations has not prevented a mutual exchange of information and a certain level of cooperation. Arguably, a concerted approach has emerged. Experts from both countries have expressed similar viewpoints.

Nevertheless, in the 1950s and 1960s, after the failure of a series of diplomatic discussions between Iraq and the Syrian Arab Republic and between Iraq and Turkey, each country began to harness the portions of the rivers in its own territory. This policy of *fait accompli* had severe consequences, both on the level of the exploitation of the Euphrates basin and on the legal positions of the States involved.

After World War II, the exploitation of the Euphrates can be divided into two phases. During the first phase, from 1946 to 1960, no far-reaching projects were undertaken, with the notable exception of a project related to the collection of rainfall returns and the acquisition of meteorological information. The second phase, from 1960 until the present day, has on the contrary, been marked by a series of projects that have been exemplified by an almost-complete lack of cooperation between the three riparian States.

3. *The Joint Technical Committee*

In accordance with the agreed minutes of the Iraqi-Turkish Joint Economic Committee meeting held in December 1980, a Joint Technical Committee (JTC) was established to negotiate water issues.

The mandate of the JTC was to determine the methods and procedures that would lead to a definition of the reasonable and appropriate amount of water from both rivers for each country.

The JTC helds its first and second meetings in 1982, with the participation of Iraq and Turkey. In 1983, the Syrian Arab Republic participated in the JTC. Tri-partite meetings continued for seven years until the outbreak of war between Iraq and Kuwait in 1990.

The major discussion items on the agenda of the JTC were as follows:

(a) Exchange of hydrological and meteorological data and information on the Euphrates and Tigris basins;

(b) Exchange of information concerning the progress achieved in the construction of dams and irrigation schemes in the three riparian countries (several field trips were organized);

(c) Discussions concerning the initial filling plans of the Karakaya and Atatürk Dams;

(d) Development of a methodology to lead to definition of the reasonable and appropriate amount of water from the Euphrates and the Tigris rivers.

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[33] A. M. Hirsch, "Utilization of international rivers in the Middle East", *American Journal of International Law*, vol. 50, pp. 88-89.

In the fifth meeting of the JTC on 11 November 1984, Turkey proposed the so-called, Three Staged Plan for Optimum, Equitable and Reasonable Utilization of the Transboundary Water Courses of the Euphrates-Tigris Basin.

According to this plan, the first stage will be devoted to the exchange and verification of hydrological and meteorological data at certain gauging stations in the three countries. If necessary, additional joint measures are to be taken. Furthermore, available water quality data will be exchanged and verified. The natural (virgin) flow of the river at various points in the basin can be computed by taking into consideration the consumptive uses and evaporation losses from reservoirs.

Given that official figures for irrigable land potential in Iraq and the Syrian Arab Republic do not tally with Turkish sources, the second stage will develop a consensus on the irrigable land potential of the basin countries.

The first two stages concerning land and water resources inventory studies must be integrated into a master plan that includes water transfer projects from the Tigris to the Euphrates (the third stage). A simulation study, based on this master plan, will develop water budget and allocation models.

With regard to the Turkish proposal of studying water transfer possibilities between two rivers, Iraq and the Syrian Arab Republic have argued that the Euphrates and Tigris should be evaluated separately, giving priority to the Euphrates.

The JTC held several sessions to determine the procedure that would lead to a suitable definition of the reasonable and appropriate amount of water for each country. However, a consensus could not be reached. Iraq and the Syrian Arab Republic rejected the Three-Staged Plan.

Turkey claims that such joint studies reveal that certain agricultural practices in the downstream riparians are inefficient and uneconomical, and therefore that the water needs of these countries cannot be justified. It considers that the discontinuation of uneconomical practices for the sake of efficiency and rationality could be perceived by concerned countries, as a threat to their strategic priorities, namely, food security, and as a violation of their sovereignty.

However, Turkey has launched a gigantic integrated development programme, entitled the Southeast Anatolia Project (Guneydogu Anadolu Projesi) (GAP) for the Tigris and the Euphrates, without consulting other riparian States at any stage.

According to the former President of Turkey, Turgat Ozal:[34]

"During the 1960s, the Southeast Anatolia Project (GAP) was contemplated as a project encompassing irrigation and energy.

"After 1984 this project was converted into an integrated development project. As an integrated development project, it not only encompassed irrigation and energy but, through the preparation of a GAP Master Plan, took in industry, education, health, agriculture amd oinfarstructure as well.

" ... The project in its entity encompasses 22 dams, the biggest of which is the Attaturk Dam ... When it is completed, 1.7 million hectares of land will be irrigated and a total of 27 billion kilowatt hours (KWh) of energy will be produced. The energy produced will be equal to approximately half of the total amount produced in our country at present."

[34] Government of Turkey, *GAP, Southeast Anatolia Project* (Ankara. General Directorate of Press and Information of the Turkish Republic, [no date]).

C. JORDAN

Owing to water scarcity in the area, a modest river such as the Jordan, represents a vital source of water for the States along its course.

Several development schemes to utilize the Jordan river system date back to 1913 (see table 5), when Palestine was under the rule of the Ottoman Empire. The first plan included the diversion of the Yarmouk river to Lake Tiberias, the irrigation of the Jordan valley by water channelled from Lake Tiberias and the construction of two hydroelectric power plants.[35] However, with the defeat of the Ottoman Empire in World War I, this plan was abandoned.

Shortly after the war, the satisfaction of domestic water needs became a political issue related to the Arab-Jewish conflict in Palestine. This conflict has overshadowed efforts to reach an agreement on the cooperative utilization of the Jordan water system between Jordan, Lebanon, Palestine and the Syrian Arab Republic.

TABLE 5. DEVELOPMENT SCHEMES FOR THE JORDAN RIVER SYSTEM

Year	Plan	Sponsor
1913	Franghia Plan	Ottoman Empire
1922	Mavromatis Plan	United Kingdom
1928	Henriques Report	United Kingdom
1935	Palestine Land development Company	World Zionist Organization
1939	Ionides Survey	Transjordan
1944	Lowdermilk Plan	United States
1946	Survey of Palestine	Anglo-American Committee of Inquiry
1948	Hays-Savage Plan	World Zionist Organization
1950	MacDonald Report	Jordan
1951	All Israel Plan	Israel
1952	Bunger Plan	Jordan/United States
1953	Main Plan	UNRWA[a/]
1953	Israeli Seven-Year Plan	Israel
1954	Cotton Plan	Israel
1954	Arab Plan	Arab League Technical Committee
1955	Baker-Harza Plan	Jordan
1955	Unified (Johnston) Plan	United States
1956	Israeli Ten-Year Plan	Israel
1956	Israeli National Water Plan	Israel
1957	Greater Yarmouk Project (East Ghor Canal)	Jordan
1964	Jordan Headwaters Diversion	Arab League

Source: T. Naff and R. C. Matson, *Water in the Middle East: Conflict or Cooperation?* (Boulder, Westview Press, 1984).

a/ United Nations Reliefs and Works Agency.

Immediately after the foundation of Israel in 1948, Israel and various Arab States declared their respective water utilization projects. Certain aspects of the Israeli development plans considered the Litani river as part of the Jordan river system, while other schemes excluded the Litani waters on the basis that it is a Lebanese river in its origin, course and terminus (see table 6).

The disparities among these plans led President Dwight Eisenhower of the United States to send a special envoy, Eric Johnston, to the area in 1953 to design a comprehensive proposal for the division of the Jordan river. After two years of negotiations, Johnston offered a plan which was accepted by both the Arab and the Israeli technical committees. However, the Arab League refused to ratify the plan for political reasons.

[35] T. Naff and R. C. Matson, *Water in the Middle East: Conflict or Cooperation?* (Boulder, Westview Press, 1984).

TABLE 6. WATER ALLOCATION FOR RIPARIANS OF THE JORDAN RIVER SYSTEM
(Millions of cubic metres per year)

Plan/source	Lebanon	Syrian Arab Republic	Jordan	Israel	Total
Main Plan/UNRWA	-	45	774	394	1 213
Arab Plan/Arab League	35	132	698	182	1 047
Cotton Plan/Israel[a/]	450.7	30	575	1 290	2 345.7
Unified (Johnston) Plan					
Hasbani	35				35
Banias		20			20
Jordan (main stream)		22	100	375[b/]	497[b/]
Yarmouk		90	377	25	492
Side wadis			243		243
Total unified plan	35	132	720	400[b/]	1 287[b/]

Source: Adapted from T. Naff and R. C. Matson, *Water in the Middle East: Conflict or Cooperation*? (Boulder, Westview Press, 1984).

a/ The Cotton Plan included the Litani as part of the Jordan river system. Various plans allocated amounts in accordance with differing estimates of the resources of the system. One major variable in the reporting of the planned allocations is the amount of groundwater included in the estimates.

b/ According to the compromise "Gardiner Formula", Israel's share from the main Jordan stream was defined as the residue after the other co-riparians had received their shares. This would vary from year to year, but was expected to average 375 million m^3.

With the failure of negotiations the riparians decided to proceed with water development projects situated entirely within their own boundaries on a unilateral base.

In March 1953 Jordan and the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA) signed an agreement to implement the Bunger Plan. This included a diversion of the River Yarmouk by construction of two dams at Maqarin, namely, the Unity Dam and the Adasiya and canalization of water into the Jordan valley.[36] In June 1953, Jordan and the Syrian Arab Republic agreed to share the water of the Yarmouk.[37] However, owing to Israeli opposition, these agreements were not implemented.[38]

Jordan has carried out a number of water projects on the Yarmouk river and east Jordan valley. These have included the following:

(a) The East Ghor Canal (EGC) project to divert part of the river Yarmouk base flow (maximum flow volume of 158 million m^3) with a conveyence of some 45 million m^3 of water (Der Alla project) to meet the growing water demand for Amman and its surroundings. The EGC project was launched in 1964 and reached the Dead Sea in the early 1980s;

(b) The construction of a number of dams in Wadi Arab, Ziglab, Zarqa, Shueib and Kufrain. These dams are located in side wadis and were constructed between 1968 and 1987. They were intended to make use of the flood waters and to store treated sewage effluent from the main treatment plants of Amman, Zarqa and Irbid in Jordan;

[36] The idea behind this project was to settle 100,000 Arab refugees from Palestine.

[37] An agreement was signed between Jordan and the Syrian Arab Republic in 1953 regarding water allocation of the Yarmouk river. It provided for the construction of a dam on the Yarmouk and the subsequent division of water resources at a ratio of some 1:3 between the Syrian Arab Republic and Jordan, respectively. Revisions were made in 1987. According to the new agreement, Jordan was supposed to construct the Unity dam on the Yarmouk. Its capacity was to be 180-200 million m^3 per year of water for its own use.

[38] The Syrian Arab Republic has implemented a number of small-medium sized dam development schemes within the framework of the Upper Yarmouk.

(c) The construction of the Unity Dam (Al-Wahda Dam) on the Yarmouk river. According to the agreement between Jordan and the Syrian Arab Republic in 1988, the dam would be able to store a gross capacity of 225 million m^3 and would have an effective storage volume of 195 million m^3 annually. The stored water volume would be used for irrigation in the Jordan valley and would convey 50 million m^3 to the greater Amman area. Furthermore, it would be used to generate some 18,800 kWh of power. Project implementation was sceduled for the end of 2000.[39]

The National Water Carrier (NWC) was the major water development project carried out in Israel. The NWC diverts water from the Jordan river fork at Eshed Kinrot at Lake Tiberias to the coastal Mediterranean plain and the Negev desert. The project was initiated in 1953 and completed in 1964 with an initial annual diversion capacity of 180 million m^3. This capacity was increased to 320 million m^3 in 1967 and reached 420 million m^3 in 1999. It is believed that more than half of Israel's water resources are obtained from the Jordan river and its tributaries located outside its pre-1967 boundaries.

In the context of the Arab-Israeli peace process, Israel and Jordan signed the Treaty of Peace on 26 October 1994. The Syrian Arab Republic is still in negotiations with Israel and Palestine has postponed the issue of water until further notice.

Pursuant to article 6 of the Treaty of Peace between Israel and Jordan, with a view to achieving a comprehensive and lasting settlement of all the water problems between them:

"The parties agree mutually to recognize the rightful allocations of both of them in Jordan River and Yarmouk River waters and Wadi Araba/Arava groundwater in accordance with the agreed acceptable principles, quantities and quality as set out in Annex II, which shall be fully respected and complied with."

Israel and Jordan have agreed on seven articles concerning water-related matters namely, allocation; storage; water quality and protection; groundwater in Emek Ha'arava/Wadi Araba; notification and agreement; cooperation and Joint Water Committee. These can be found in annex II of the treaty.

With regard to the allocation of the water from the Yarmouk river, Israel was to pump 12 million m^3 and Jordan would be entitled to the summer flow. During the winter period, Israel was to pump 13 million m^3 and Jordan would be entitled to the rest of the flow subject to the provision outlined. This was, namely, that Jordan would concede to Israel pumping an additional 20 million m^3 from the Yarmouk in winter in return for Israel conceding to transferring the same quantity (20 million m^3) to Jordan during the summer from the Jordan river. During the winter period of each year, Jordan would be entitled to store a minimum average of 20 million m^3 of floods in the Jordan river. Furthermore, Jordan would be entitled to an annual quantity of 10 million m^3 of desalinated water from some 20 million m^3 of saline springs that are now diverted to the Jordan river.

Regarding additional water, it was stated that Israel and Jordan shall try to locate sources capable of supplying to Jordan with an additional 50 million m^3 per year of drinkable water. To this end, the JTC will develop, within one year from the entry into force of the Treaty, a plan for the supply to Jordan of the above mentioned additional water. The plan was to be forwarded to the respective Governments for discussion and decision.

Finally, a six-members Joint Water Committee, comprising three representatives from each country, was established to guide the operation of monitoring stations and other matters pertaining to the implementation of the agreement. Two subcommittees (north and south) were formulated to manage the mutual water resources in these sectors.

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[39] "Construction work of the Unity dam is to commence in September" (*Al-Hayat*, London, 21 February 2000), p. 11 (in Arabic) states that the total cost of the project is JD 120 million. Jordan has secured the majority of the funding through credit from the Islamic Bank for Development some JD 31.5 million and the Arab Fund for Development (AFESD) has provided JD 81.5 million. The balance, JD 7 million, is to be funded by credit from the Abu Dhabi Fund for Development.

Israel, Jordan and Palestine signed a water sharing agreement (described as framework) in Oslo on 13 February 1996. The agreement which will have to be approved by the three Governments, is intended to outline principles of cooperation concerning existing supplies and new sources, namely, desalination. However, it does not include detailed plans for water management. Nevertheless, it has been described as a very important agreement because it was the first regional agreement for water sharing.

At present, it is believed that Jordan receives only 100 million to 110 million m^3 per year from the Yarmouk river and virtually nothing from the Jordan river. The Syrian Arab Republic receives 160 million to 170 million m^3 per year from the Yarmouk and nothing from the Upper Jordan. Lebanon receives virtually nothing from the Jordan river, while Israel receives at least 650 million m^3 per year from the Jordan and approximately 100 million m^3 per year from the Yarmouk. Therefore, Jordan gets the least and Israel the most.

II. INTERNATIONAL LAW ON SHARED SURFACE WATER RESOURCES

The juridical system relating to international water resources is, at present, largely driven by the economic imperatives of development and the provision of water for drinking, irrigation and the production of energy. The presence of multiple, often competing, needs is likely to provoke disputes; litigation and open conflicts between the States involved.

The issue of water sharing of multinational rivers has, for many years, been the subject of numerous disputes between the countries of the region. They mutually accuse each other of ulterior political motives regarding the utilisation of water. This situation has been aggravated by the absence of multilateral treaties between the countries of the region that would regulate the sharing of these rivers. All negotiations on this subject have failed because each country demands exclusive control of the water body in question.

This chapter focuses on the legal rules that regulate shared water resources.

A. PHYSICAL CHARACTERISTICS AND THE LEGAL NATURE OF WATER

An examination of the juridical nature of water is necessary. The water referred to here is that of perennial watercourses.

The analysis below emphasizes the particular aspects of water. It will show that water is an asset which escapes traditional criteria and is therefore a *sui generis*, or unique asset.[40]

Firstly, water is an element which constantly renews itself. This process is known as the hydrological cycle. It confers on the presence of water a character of permanence and continuity. It is mobile in space, namely, in variations of quantity and flow and in time, it becomes stable owing to the phenomenon of a continous flow at the source.

The second notable characteristic of water is its power of self-purification. It naturally cleans itself, either by eliminating waste through the current, or by a chemical reaction between waste and oxygen.

Finally, water is a movable asset. It is impossible to prevent water from flowing. This makes it suitable for the production of energy and the irrigation of land and therefore, the generation of wealth.

For western lawyers, the right to water has at all times constituted a real conundrum. Many attempts to define water have confused the terms property and usage and wrongly treated the right to water as the same thing as the right to land.

Today, despite some recent advances, the issue of the right to water remains confused and extremely complex. The legal problems created by the physical characteristics of water are highlighted in the works of the International Law Commission (ILC) and in observations related to the sovereignty of the State over water. These observations stem from the elementary consideration that State authority exercises itself differently over water compared to land. However, it is not the notion of authority itself which differs, it the extent of that authority over physical phenomena that varies.[41] In fact, water is not confined within a system of political frontiers. This phenomenon generates difficulties of a juridical nature and necessitates the limitation of State sovereignty and in consequence, limitations in the utilization of international watercourses.

The ILC has questioned whether the notion of sovereignty over natural resources was appropriate for a resource that has the physical characteristics of water, especially since the notion of permanent sovereignty over natural resources cannot, in any case, be applied in the usual manner, to a resource whose essential

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[40] This section is based on an analysis of Special Rapporteur Stephan M. Schwebel, Chairman of the International Law Commission (ILC), ILC Yearbook 1979 (A/CN4/320), vol. II.

[41] First report of the Special Rapporteur. Richard Kearney, ILC Yearbook 1976 (A/CN4/295).

characteristic is mobility. This is further emphasised by the fact that water is self-renewing compared to other natural resources, namely, oil, which is limited.[42]

With this in mind, it is necessary to determine whether such expressions as international drainage basin (of an international river) and international watercourse, are appropriate.

B. THE JURIDICAL SYSTEM FOR THE INTERNATIONAL RIVER

Research into the juridical system pertaining to international rivers, and in particular the legal problems raised by the utilization and development of international waters, has always received much attention from legal scholars.

Owing to the complexity and importance of these problems, the utilization of international waters has been considered a subject of great importance and has become a priority for international proceedings at the United Nations and in the programmes of non-governmental organizations (NGOs).

Achievements in this field by the United Nations,[43] the Institute of International Law and the International Law Association (ILA) are reviewed in box 1.

Box 1. Highlights of the Helsinki Rules on Uses of the Waters of International Rivers

The ILA discussed international river problems at its forty-seventh and forty-eighth conferences held, respectively in Dubrovnic in 1956 and New York in 1958 in an attempt to lay down rules for the utilization of international rivers. It adopted a set of articles in August 1966 in Helsinki. These articles, commonly known as the Helsinki Rules, founded a new concept of cooperation and understanding between riparian States.

Article 2 defines an international drainage basin as "a geographical area extending over two or more States determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus".

Article 3 defines a "basin State" as that which "includes a portion of an international drainage basin".

Article 4 states that "each basin state is entitled within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin". According to the ILA, this article reflects the key principle of international law in this area, which states that every basin State in an international drainage basin has the right to the reasonable use of the waters in the drainage basin.

Article 5 lays down the criteria of a reasonable and equitable utilisation of the waters of an international drainage basin by stating the following:

I. "What is a reasonable and equitable share within the meaning of article 4 is to be determined in the light of all the relevant factors in each particular case;

II. "Relevant factors which are to be considered include, but are not limited to the following:

1. "The geography of the basin, including in particular the extent of the drainage area in the territory of each basin State;
2. "The hydrology of the basin, including in particular the contribution of water by each basin State;
3. "The climate affecting the basin;
4. "The past utilisation of the water of the basin, including in particular, existing utilization;
5. "The economic and social needs of each basin State;
6. "The population dependent on the water of the basin in each basin State;

[42] International Law Commission (ILC) Yearbook, 1976, vol. II.

[43] See the report of the Secretary-General to the ILC, in the ILC Yearbook, 1974, vol. II.

Box 1 (*continued*)

7. "The comparative costs of alternative means of satisfying the economic and social needs of each basin State;

8. "The availability of other resources;

9. "The avoidance of unnecessary waste in the utilization of water in the basin;

10. "The practicability of compensation for one or more of the co-basin States as a means of adjusting conflicts among uses;

11. "The degree to which the needs of a basin State may be satisfied, without causing substantial injury to a co-basin State.

III. "The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is a reasonable and equitable share, all relevant factors are to be considered together and a conclusion reached on the basis of the whole".

Source: Available at: http://www.internationalwaterlaw.org/IntlDocs/Helsinki-Rules.htm.

In practice, the range of juridical systems that regulate the most varied of international drainage basin bears witness to the complexity of this issue and to the diversity of possible solutions. These are a function of numerous data including geography, history, economy and politics particular to those basins and to the needs of the relevant States.

It follows that international law regarding rivers is dominated by the notion of relativity, or of specificity. This notion can be negatively defined as relativity in time and relativity in space. Solutions to water-related problems vary according to rivers and regions.

1. *The notion of an international river*

A river is a physical and hydrological unit which creates sociopolitical realities. Some rivers lie entirely within the territory of a State. In this case, they are owned by the State in question. However, there are rivers which run through the territories of two or more States, or which constitute the boundary between them.

Until the end of the eighteenth century, navigation was the principal problem with regard to international rivers. A State would commonly consider that the portion of an international navigable river within its boundaries was its property. Therefore, they imposed taxes and restrictions on ships and trade at will and claimed the right to prevent any other States, even riparian States, from using that portion of the river for navigation.

After the French Revolution, France was the first to promote the theory that an international river is a common asset of the countries through which it flows. However, the principle of free navigation for all nations and concerning all European rivers was only established at the Congress of Vienna conference, 1814-1815. In 1856 the Congress of Paris applied the principle of free navigation to the Danube river and created an international commission to supervise its application.

Brazil and Argentina opened the Amazon and Plata rivers to international navigation in 1866. With regard to Africa, the Berlin Conference of 1884 and 1885 concluded a General Act related to the Congo. It provided for free navigation of the Congo and Niger. This was later confirmed by the Treaty of St. Germain, 1919. In the peace treaty after World War I, reference was made to the need for creating an international agreement for the organization of navigation of all rivers. As a result, the Convention on the Regime of Navigable Waterways of International Concern, Barcelona, 20 April 1921 was largely concerned with navigation problems.

Therefore, traditional legislation on the subject of rivers has always emphasized the issue of navigation in the definition of an international watercourse. This is because it considered that international rivers were those that, in their naturally navigable course, separate or flow across territories belonging to several States.[44]

This classic definition is taken from articles 108 and 109 of the Final Act of the Congress of Vienna of 8 June 1815. Furthermore, this defintion can be found in the Convention on the Regime of Navigable Waterways of International Concern, Barcelona, 20 April 1921.

It is evident, however, that the issue of navigability is no longer entirely relevant to present day legislation. Today, the simple framework of navigation has been overtaken by other issues and the definition of international watercourses must be considered from every aspect of water use.

International watercourses can be defined as those that are contiguous or bordering watercourses which directly serve as a frontier between two States, and the successive courses which transversely cross the frontiers of several States, without distinguishing whether or not they are navigable.[45] The Permanent Court of International Justice (PCIJ) considers that the term international river is applicable to all fluvial systems, including purely national tributaries.

It is necessary to consider the whole of a fluvial system and to recognize the character of international waters in all cases where a certain form of utilization within the territory of a State has consequences on waters depending on the same basin, situated within the territory of another State.[46]

2. *Problems linked to the utilization of international rivers for purposes other than navigation*

The use of international rivers and their waters for other purposes than navigation poses complicated questions, especially with regard to the increasing demand for water for irrigation water, hydroelectric power generation and with the progress of industry. From a legal point of view, the fundamental problem is in determining whether a State can use the waters of an international river as it likes, or whether certain legal norms exist to protect the interests of other riparian States.

The different uses of international rivers raises problems regarding the scope of sovereignty of riparian States. In fact, international watercourses continue to be a part of the territory of the States that they cross (or separate) and in consequence remain under their sovereignty. This is when the diverse uses of an international watercourse by a State can lead to harmful consequences for the territory of a neighbouring riparian State.

It is therefore, a question of reconciling interests that are often opposing and that stem from the multiple uses of water, namely, irrigation and energy production and the sovereignty of each relevant riparian State. The territorial aspect of international rivers must not be underestimated. It follows that the jurisdiction of a State is territorial. However, this does not always imply full competence and jurisdiction.

According to international drainage basin law, the sovereignty of States does not end at the banks of rivers. On the contrary, sovreignty extends to what is, and what remains, an element of the territory. In this regard, it is often stated that the notion of an international river is a purely legal notion; it presupposes that a river which crosses (or separates) the territory of several States does not appropriate this watercourse from

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[44] L. Cavaré, *Le droit international public positif*, tome II (Paris Éditions A. Pedone, 1962), p. 568; C. Rousseau, *Droit international public*, tome IV, Paris, Sirey 1980, p. 485.

[45] Adapted from French. G. Sauses-Hall, "L'Utilisation industrielle des fleuves internationaux", Receuil des Cours de l'Académie de Droit International (RCADI), 1953 (Leyde A. W. Sijthoff, 1953 [reprinted 1955]) II, vol. 83, p. 481.

[46] Adapted from French. M. Wofrom, *L'Utilisation à des fins autres que la navigation des eaux des fleuves, lacs et canaux internationaux* (Paris, Edition A. Pedone, 1964), p. 7.

the sovereignty of the States concerned. Any attempt to bend, according to the law of nations, to the same treatment things which are basically dissimilar, is doomed to certain failure.[47]

(a) *Proceedings of the United Nations*

The proceedings of the various organizations of the United Nations emphasize the need for cooperation regarding the utilization of rivers for purposes other than navigation.

The efforts of the ILC in this area have only established general principles of mutual aid.[48] It is especially through the intervention of particular agreements that States have found effectual means to resolve their problems.

More than 30 years ago, the ILC was made responsible for the codification of fluvial law relative to uses other than navigation. It is significant that the ILC decided to confine itself to the elaboration of an agreement-framework of a supplementary nature. This paved the way for system agreements that could be adapted to the diversity of watercourses. Despite efforts to narrow the scope of this endeavour, this process has been long and exacting. It has been made even more difficult by the fact that the ILC cannot ignore the tensions between international sovereignty and the need for a rational approach towards fluvial problems. If this rational approach alone is the means to bring about an optimal management of fluvial resources, it remains very far from being a dominant one.

The task of the ILC is complicated by a certain number of assumptions, namely, those of a shared natural resource, pertaining to equitable or optimal utilization, optimal sharing and management of the resources from shared waters. These assumptions are not easy to unravel.[49]

In its current proceedings, the ILC is increasingly inclined to refer to inclusive concepts which support its own representations. However, the repetitive character of the ILC's reports proves that most of these concepts need to mature before being accepted by States still fixed on absolute sovereignty. Certain premises, namely, the idea of the hydrographic basin, have been abandoned. The ILC proceedings reflect the continuing difficulty to challenge the concept of sovereignty.

(b) *International custom*

Research into rules of custom under fluvial law remains limited, especially since no general principle of limitation on sovereignty over international rivers exists. This scenario applies even more strongly to fluvial law, which is a question of reconciling two or more sovereignties.

However, the various regulations related to custom do not limit the sovereignty of riparian States. They limit the freedom of utilization of water, even to the extent where the issue of utilization has extra-territorial effects, that is to say, it affects the freedom of utilization of other riparian States.

Regulations concerning fluvial law related to custom are not so much definitive as a particular expression of the general principles of coexistence of territorial sovereignties. As such, they are mostly obligations of behaviour, or of defined fundamental standards, in cases where the methods of implementation are left to the discretion of the States concerned.

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[47] Adapted from French. B. Winiarkski, *Principes généraux du droit fluvial international* (RCADI) (Leyde A. W. Sijthoff) (1933 [reprinted 1968]), III, vol. 45.

[48] P. Buirette, "Génèse d'un droit fluvial international général (utilisation à des fins autres que la navigation)", *Revue Générale de Droit International Public*, vol. 1. 1991, pp. 6-68.

[49] The controversial concept of a shared natural resource serves as reference, namely, in the proceedings of the United Nations. However, the ILC prefers to eliminate this concept from its own proceedings. It considers it to be too recent in practice and therefore unsuitable for reference purposes. The third report of the Special Rapporteur, Stephan Schwebel, 1982, Document A/CN4/348 and Corr.1 (in ILC Yearbook, 1983, vol. II (1)).

It follows that the regulations related to custom permit a large measure of maneuverability on behalf of the States concerned. Within the context of sovereignty, it is necessary to employ a minimalist interpretation. Custom is a diffuse issue. It permits obligations based on goodwill and common sense, which depend to a large extent on the cooperation and good faith of the riparian States.

Furthermore, general regulations concern the fair utilization of a river, the obligation to negotiate, the prohibition of harmful utilization to which is added more and more frequently, an obligation to cooperate and impose a duty to exchange data and information concerning the river.

Therefore, the material approach of general regulations relating to custom in fluvial law shows a balance which is, if not disappointing, at least very modest. It cannot be otherwise since no general principles on the limitation of state sovereignty over international rivers exist. The ambiguity which impregnates research into general regulations based on custom in fluvial laws is not in any way close to being resolved.[50]

(c) *General principles of law*

The general principles of law are defined in accordance with the Charter of the United Nations, Statute of the International Court of Justice, Article 38 (c) as those "recognized by civilized nations". In the matter of fluvial law, the few general principles in existence are recent and for the most part, inspired by a series of ideas derived from private law.

(i) *Abuse of rights*

It is possible to refer to the concept of abuse of rights when the action of a State causes harm to the territory of another State.

An abuse of rights is an injury which cannot be justified when "a State avails itself of its right in an arbitrary manner in such a way as to inflict upon another State an injury which cannot be justified by a legitimate consideration of its own advantage".[51] This is based on the Roman principle of *sic utere tuo ut alienum non laedas* (referred to hereafter as not to cause significant harm) and is illustrated in the rulings of federal courts relating to fluvial law condemning the abuse of rights.

Some bodies do not accept the notion of abuse of rights. They argue that the concept does not have a precise meaning in international law. M. Wolfrom points out that there is reason to indicate that the principle of the abuse of rights does not suffice, even in national law, to resolve complex problems posed by the exploitation, in economic conditions, of hydraulic resources; it would therefore be imprudent to wish to found on such a fragile base any conclusions on the doctrine of international fluvial law.[52]

(ii) *Good neighbourliness*

The principle of good neighbourliness was adopted by the PCIJ in its judgement of 10 September 1929 on the territorial jurisdiction of the International Commission on the Oder, where the community of interests created by the neighbourhood on the subject of navigation was taken into account, on the basis that it was a question of a river internationalized by a treaty.

M. Wolfrom considers that if the legislative arrangements in force in the different countries, concerning the relationship between neighbours, present common characteristics, the legislation regulating

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[50] H. R. Fabri, "Règles coutumières générales et droit international fluvial", *Annuaire Français de droit international*, Paris, Editions du CNRS, 1990, p. 830.

[51] L. Oppenheim, *International Law, A Treatise*, H. Lauterpacht, ed., vol. 1 - Peace, eighth edition (Longmans, 1955), p. 345.

[52] M. Wolfrom, *L'Utilisation à des fins autres que la navigation des eaux des fleuves, lacs et canaux internationaux* (Paris, Edition A. Pedone, 1964), p. 67.

these relations do not constitute, at least until now, a coherent system of international law which, in the absence of agreements, allows principles borrowed from private law, to be applied to litigation between the States.[53]

(d) *Cases and doctrine*

The fundamental difference between internal law and international law is that international law is not only a question of conflicts regarding ownership or utilization of water, it is a question of sovereignty. Therefore, the necessary adjustment to federal case-law.

International case-law is not rich. There have been less than 30 cases since the beginning of the nineteenth century, the majority of which mainly concern navigation rights. It follows that most cases have become rather obsolete. Furthermore, judges seem to avoid bestowing a general character to the case in question.

International law on water resources is based in essence, on five basic principles or theories of international law have been advanced. They include the following:

(a) The theory of limited territorial sovereignty;
(b) The principle of community of interests;
(c) The principle of not to cause significant harm;
(d) The principle of reasonable and equitable utilization;
(e) The principle of prior notice and negotiation.

These principles cover a broad period of time in terms of international acceptance and while they have been applied primarily to surface water they are applicable to groundwater resources.

(i) *The theory of limited territorial sovereignty*

This theory is founded on two important assumptions of international law which are intrinsic to classical international relations among nations, namely, absolute territorial sovereignty and absolute territorial integrity. While neither is widely accepted or practiced in the international community, they are included here to highlight the foundation upon which much contemporary international water law is based.

According to the theory of absolute territorial sovereignty, which is mostly applied by upper riparian States, a State has at its disposal the waters which flow over its territory without being able to demand continuous free flow from other riparian countries. In other words, States have the right to unrestrained use of resources within their territories, regardless of the consequences of such use across borders.

This theory was upheld by Harmon, the Attorney-General of the United States of America, in a statement of 1895. It concerned litigation between the United States and Mexico over the utilization of the waters of the Rio Grande, the frontier river between the two countries, whose large tributaries flow across the territory of the United States. When asked to give his opinion on whether the United States was obliged to allow Mexico the use of part of the Rio Grande, Harmon upheld the theory of absolute territorial sovereignty. This has become known as the Harmon Doctrine. The Harmon Doctrine does not consider extraterritorial effects resulting from the actions of States to exploit resources within their jurisdiction, as long as there is no established law to the contrary.

The theory of absolute territorial sovereignty has been upheld by a few authors.[54] However, the great majority of international jurists and States reject this theory on the principle of not to cause significant harm. The accepted norm, therefore, is that upper riparian States are obliged to consider the rights and interests of

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[53] Ibid., p. 64.

[54] M. Wolfrom, *L'Utilisation à des fins autre que la navigation des eaux des fleuves, lacs et canaux internationaux* (Paris, Edition A. Pedone, 1964), pp. 31-33.

lower riparian States and to attempt to reconcile any disputes over water resource use or modification projects.

In practice, States have rarely invoked this theory[55] and it has been largely abandoned. The United States did not invoke the Harmon Doctrine during its dispute with Canada regarding the Columbia river.

The Harmon Doctrine is contrary to the principles of international law related to the responsibility of States for acts committed on their territory and having harmful consequences on the territory of another State. This principle was confirmed by the Court of International Justice (CIJ) in a decree of 9 April 1949. This was related to the case of Corfu Channel Case, which involved Albania and the United Kingdom.[56]

In the Lake Lanoux case between France and Spain, the arbitral Tribunal, in its judgement of 16 November 1957, rejected the Harmon Doctrine.

Today, it can be asserted that the principle which presumes to grant to a State the absolute freedom to use the waters flowing through its territory is contrary to general international law.

According to the theory of absolute territorial integrity, a State has the right to ask for the uninterrupted, continuous natural flow of the water from other riparian countries. Consequently, no one has the right to alter the natural course of a river that flows over its territory.

This theory, which favours downstream riparian States, immobilizes *de facto* any possible development by the upstream State. Thus, an upstream riparian State may not harness a section of an international river if it will cause harm to another riparian State. A State may not use an international river in a way which alters its course, flow rate, or water volume or quality in the territory of another State. That is to say, the State must conduct itself within the limits of its territory in such a way as not to alter the natural regime of the river when it runs through the territory of another State. Essentially, the principle allows upper riparians to exploit the waters of a river as long as such utilization does not affect the interests of lower riparians. This, in effect, gives the lower riparian States the power of veto over the water rights of upper riparian States.

This theory has been applied to settle disputes between the member States of a federal State. However, like the principle of absolute territorial sovereignty, this theory has received little support among legal publicists and in State practice. It is regarded as inequitable in its allocation of water resources, and in its biased preference for downstream States, particularly because it does not require lower riparian States to compensate upstream States for preserving water.

Those who speak in defence of this theory are more numerous than those in favour of the preceding one.[57] However, it remains heavily criticized.

The Harmon Doctrine and the theory of absolute territorial integrity constitute two extreme positions. However, there are other more moderate concepts which are more pragmatic and which take into account the great importance of irrigation works and the generation of electricity for economic development.

The two preceding theories, namely, the Harmon doctrine and the theory of absolute territorial integrity have led to impasses and the majority of States have accepted limitations on sovereignty. Therefore, the theory of limited territorial sovereignty was conceived.

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[55] Ethiopia, Kenya and Turkey appear to uphold this doctrine. The Government of Turkey argues that the quantity of water available for neighbouring States is linked to its own ever-increasing needs and concludes that once its national needs are satisfied, it is ready to contribute national resources to the well-being of the neighbouring riparian populations of the Euphrates.

[56] International Court of Justice (ICJ), "The Corfu Channel Case", *Reports of Judgements, Advisory Opinions and Orders*, Judgement of April 9th, 1949 (Leyden, A. W. Sijthoff's Publishing Company).

[57] M. Wolfrom, *L'Utilisation à des fins autres que la navigation des eaux des fleuves, lacs et canaux internationaux* (Paris, Editions A. Pedone, 1964).

According to this theory, a State can freely use the waters flowing through its territory on the condition that this utilization would not be prejudicial to the territory or to the interests of another riparian State. The riparian States have reciprocal rights and obligations in the utilization of the water of international rivers. Tenets of conventional law and international jurisprudence have sanctioned this now generally accepted theory.[58] It is possible to maintain that limitations on sovereignty can only be voluntary and that it is therefore absolutely vital to draw up an agreement. However, the basic question has in fact only been postponed. Is the drawing up of an agreement purely voluntary or is it in execution of a pre-existing obligation?

(ii) *The principle of not to cause significant harm*

Customary international law obliges States not to use, or allow the use of, their territory for acts contrary to the rights of other States. This principle is widely recognised as a general principle of international law. It is applied in numerous treaties and other international instruments. Moreover, international funding agencies, namely, the World Bank, will not provide financial support for projects that are likely to cause appreciable harm to the territory of other States.

When considering whether one State's action harms, or will harm, the territory of another, a majority of international instruments and publicists suggest that the harm must be significant before international water law is invoked. For an injury to rise to the level of significant harm, it must have significant and consequential effects upon public health, economic productivity, or the environment of another State.

(iii) *The principle of reasonable and equitable use*

This principle is a utilitarian concept, employing a cost-benefit analysis. This attempts to maximize the beneficial use of the shared water resources while limiting its burdens. It is grounded on the principle of no significant harm, where detrimental consequences are not ultimately prohibited but rather weighed against the benefits gained. Under this principle, each riparian State is entitled to a reasonable and equitable share in the beneficial uses of an international water resource. This principle is widely accepted as a general rule of customary international law and it applies to groundwater resources.

Significantly, this principle is a blend of the principles of absolute territorial sovereignty and territorial integrity in that it recognizes and evaluates the shared and competing interests of all riparian States. The use of the resource is determined by balancing competing social and economic factors of interested riparian States and by considering the physical aspects of the entire water resource system.

Under the Helsinki Rules on the Uses of the Waters of International Rivers and the Convention on the Law on Non-Navigational Uses of International Watercourses relevant factors for judgement of what is reasonable and what is not, include: geographic, hydrologic, hydrographic, climatic and ecological circumstances; prior, existing, and potential uses of the waters; social and economic needs of each State; feasibility of alternatives to the proposed project; and compensation for one State as a means for resolving conflicts.

(iv) *The theory of community of interests*

The community of interests theory goes a step beyond the principle of reasonable and equitable use in that it advances the goal of achieving the most optimal use and development of a shared water resource. Therefore it represents the most progressive of the water rights theories. National boundaries are ignored and the entire basin is regarded as one economic and geographic unit. This means that, in the case of a navigable river, all riparian States will have full and equal rights to use the entire course of the river and no riparian State will have any preferential privilege over others.

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[58] Ibid., pp. 35-40 and 51-61.

In view of the scientific developments over previous decades, the hydrological regime of rivers and the physical factors which govern them have become very familiar. Legal norms have been based upon them. According to natural science, international rivers are considered to be part of a natural unity which is the hydrographical basin.

Fundamentally, this theory seeks to achieve economic efficiency and the greatest beneficial use of water possible. However, this is often at the cost of equitable distribution and benefits of those States that share a river. Recent doctrine tends to systematize the norms governing the use and exploitation of international rivers and waters of a lake on the basis of the notion of the basin. The convention and Statutes relating to the development of the Chad Basin. Signed at Fort Lamy, on 22 May 1964 and Agreement concerning the River Niger Commission and the Navigation and Transport on the River Niger. Done at Niamey, on 25 November 1964 are some examples in this sense.[59] This theory was also followed in the Lake Lanoux Case of 16 November 1957.

While the community of interests theory may be regarded as the most efficient and advantageous for the management of shared natural resources, its acceptance within the international community is limited. However, it is widely favoured by international jurists and some State practices.

(v) *The principle of prior notice and good faith negotiation*

When considering the principles of not to cause significant harm, reasonable and equitable use, and community of interests, States are further obliged to make timely notification to other States prior to embarking on efforts to exploit shared water resources. Data and information must accompany the notification to enable the notified State to objectively evaluate the project's potential effects and to ascertain whether the project: (a) will cause appreciable harm to water resources in the territory of another State; (b) conforms to reasonable and equitable use; and (c) whether it promotes optimal use.

In the event that the notified State's analysis suggests that significant harm will result from the notifying State's actions, or a dispute arises based on opposing conclusions, the States involved have an obligation to jointly verify the findings and to attempt to reach an acceptable solution. Such consultations and discussions must be conducted in good faith and with the intention of achieving an acceptable resolution for all those concerned. Specifically, any deliberation because of a dispute over the exploitation of a shared international resource must be a sincere intention to devise a friendly solution to promote trust and cooperation among the parties.

Good faith negotiation requires the notifying State not to proceed with the planned activity, or to suspend progress of the activity, until the dispute is resolved or until the notified State has had a reasonable period of time to respond.

C. THE UNITED NATIONS CONVENTION ON THE LAW OF THE NON-NAVIGATIONAL USES OF INTERNATIONAL WATERCOURSES, 1997

The ILC, the United Nations body responsible for the " progressive development of international law and its codification",[60] was established in 1947.

In the late 1960s, following a failed attempt in the General Assembly to have the Helsinki Rules on the Uses of the Waters of International Rivers adopted as guidelines for international water law, the United Nations assigned the topic to the ILC for detailed study.

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[59] Available in United Nations, "Treaties concerning the utilization of internal water courses for other purposes than navigation"; Africa, "Natural Resources/Water series No. 13, New York, 1984.

[60] Statute of the International Law Commission, Article 1 (1).

After 23 years, the ILC adopted the final text of a set of 33 draft articles on the Law of Non-Navigational Uses of International Watercourses and a Resolution on Confined Transboundary Groundwater (ILC, 1994). The ILC recommended the draft articles and the resolution to the General Assembly.

The draft resolution concerning groundwater adopted by the Commission lay down guidelines and general principles regarding confined transboundary groundwater.

The Convention on the Law of Non-Navigational Uses of International Watercourses was adopted by the United Nations General Assembly on 21 May 1997.[61] It was negotiated during the Sixth Committee convening as a Working Group of the Whole of the General Assembly,[62] on the basis of draft articles adopted by the ILC.[63]

In accordance with its mandate, the Working Group of the Whole held a three-week session from 7 to 25 October 1996. The Working Group did not complete its task in this first session which was followed by a second session. This was held from 24 March to 4 April 1997.[64]

The Working Group primarily discussed those draft articles on which agreement had not been reached during the fist round. These included the following in particular:

(a) Article 3 relating to the normative function of the Convention;

(b) Articles 5, 6 and 7 containing both the basic principles of equitable utilization and the not to cause significant harm rule;

(c) Article 33 on the peaceful settlement of disputes.

On 4 April 1997, the Sixth Committee convening as the Working Group of the Whole of the General Assembly completed the debate on the issues and recommended the adoption of the text of the draft convention on the subject at hand.[65] However, despite extensive deliberations, no agreement was reached on the above issues. A fundamental disagreement remained concerning three central issues: (a) the status of existing treaties and the impact of the Convention on future agreements; (b) the substantive rules contained in articles 5 and 7 of the ILC Draft and the relationship between them; and (c) the rules that govern dispute settlement. Other relevant matters included details regarding procedural rules and the extent to which environmental protection should be covered.

In the discussions, States continued to adopt positions that favoured their particular interests. Upstream States supported rules that coincided with the doctrine of absolute territorial sovereignty and that gave them control of the waters that originated in their territory. Downstream States appealed to the doctrines of prior

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[61] For the text of the Convention, see General Assembly Resolution of 21 May 1997, 51/229, annex.

[62] Official records of the General assembly, Forty-ninth Session, Supplement No. 10 (A/49/46), paragraph 3, adopted by a vote of 143 in favour.

[63] The negotiations in the Working Group were open to participation by all United Nations member States, in addition to State members of specialized agencies of the United Nations.

[64] The Sixth Committee convening as the Working Group of the Whole was chaired, as was the case in the first session, by Chusei Yamada (Japan) and the Drafting Committee was chaired, during the first session, by Hans Lammers (Netherlands). Robert Rosenstock, former Special Rapporteur of the International Law Commission on the topic, acted as Expert Consultant to the Working Group. The Working Group held 12 meetings from 24 March to 4 April 1997. The views of the representatives who spoke during those meetings are reflected in the relevant summary records (A/C.6/51/SR. 51 to 62). The Drafting Committee held six meetings, from 24 to 27 March 1997. The Chairman of the Drafting Committee introduced the report of the Drafting Committee (A/C.6/51/NUW/L.1/Rev.1 and Add.1). The statements by the Chairman of the Drafting Committee introducing its report are reflected in the relevant summary records (A/C.6/51/SR. 24 and 53).

[65] See the summary records of the Sixth Committee convening as the working group of the whole, United Nations document A/C.6/51/SR.1 to 62, 1996-1997.

appropriation or vested rights and absolute territorial integrity. This translates into an unaltered quality and quantity of water entering their territory. The two positions were clearly irreconcilable. States recognized this and adopted rules that reflected the concurrent rights and obligations of watercourse States.

When the resolution containing the Convention came before the General Assembly on 21 May 1997, Turkey requested a recorded vote. The vote was 103 in favour, three against (Burundi, China and Turkey) and 27 abstentions.[66] ESCWA member countries that voted favourably were: Bahrain, Jordan, Kuwait, Oman, Qatar, Saudi Arabia, the Syrian Arab Republic, United Arab Emirates and Yemen. Egypt abstained and Lebanon was absent.

In the context of a convention on international watercourses, 103 affirmative votes appears to constitute a strong endorsement. The significant number of abstentions does not bode particularly well. Nevertheless the fact that only three States voted against the resolution indicates broad agreement in the international community regarding the general principles governing the non-navigational uses of international uses of international watercourses. The negative votes of China and Turkey are most likely attributable to their positions as upstream States embroiled in ongoing controversies.[67] The vote of Burundi may owe more to political considerations than to hydro-geographic reality.

The Convention contained several changes from the Draft Articles. The final text of the Framework Convention was presented to the United Nations General Assembly which opened it for signature in May 1997.[68] The ultimate success of the Convention will depend on the readiness of States to adhere to its provisions.

Admittedly, achieving this Convention has been a very slow process. One reason is that the legal community and the many international bodies regulating water resources took a long time to become convinced of the need to adopt an integrated approach in handling water issues.

1. *Overview of the Convention*

The United Nations Convention on the Law of Non-Navigational Uses of International Watercourses was developed to promote sustainable development and protection of global water supplies and to help prevent and resolve conflicts over shared water resources. It offers principles, namely, the equitable and reasonable use and the not to cause significant harm rule, by which States are to conform their conduct, especially when dealing with water resources that traverse international boundaries.

As shown in box 2, the Convention is divided into seven parts containing 37 articles that provide guidelines pertaining to the use, management, and preservation of international stream water. An annex, containing 14 articles, sets forth the procedures to be used in the event the parties to a dispute have agreed to submit it to arbitration.

The present discussion will focus on key provisions of the Convention and on those that were the subject of controversy during the deliberations of the Working Group.

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[66] See United Nations Press Release GA/9248, of 21 May 1997. In the annex to this press release, Belgium is recorded as having abstained from the vote on the adoption of the Convention on the Law on Non-navigational Uses of International Watercourses. The representative of Belgium subsequently informed the Secretariat that he had intented to vote in favour. Fiji and Nigeria are recorded as being absent in the vote. The representatives of both nations later advised the Secretariat they had intented to vote in favour.

[67] Namely, Turkey's GAP project on the Tigris and Euphrates, and China's plans to construct additional dams on the upper Mekong.

[68] The required number of signatures for ratification was not achieved, though the Convention was open for signature for three years.

Box 2. Articles of the United Nations Convention on the Law of the Non-navigational Uses of International Watercourses (Adopted by the United Nations General Assembly, May 1997)

Adopted by United Nations General Assembly and opened for signature, 21 May 1997 (United Nations document A/51/869).

The present Convention, part I, article 1, states that:

(a) "The present Convention applies to uses of international watercourses and of their waters for purposes other than navigation and to measures of protection, conversation and management related to the uses of those watercourses and their waters;

(b) "The uses of international watercourses for navigation is not within the scope of the present Convention except insofar as other uses affect navigation or are affected by navigation".

Article 2 defines certain key terms that are used throughout the Convention. Other terms that are used only in one article are defined in the article in which they are mentioned. Article 2 stipulates that:

"For the purposes of the present Convention:

(a) "'Watercourse' means a system of surface waters and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing into a common terminus;

(b) "'International watercourses' means a watercourse, parts of which are situated in different States;

(c) "'Watercourse State' means a State Party to the present Convention in whose territory part of an international watercourse is situated, or a Party that is a regional economic integration organization, in the territory of one or more of whose Member States part of an international watercourse is situated."

The diversity characterizing individual watercourses and the consequent difficulty in drafting general principles that will apply universally to various watercourses throughout the world have been recognized by the ILC since the early stages of its consideration of the topic. During the course of its work, the ILC developed a promising solution to the problem of the diversity of international watercourses and the human needs they serve, in the form of a framework agreement. This provides general principles and rules governing the non-navigational uses of international watercourses, in the absence of specific agreement among the States concerned. Furthermore, it provides guidelines for the negotiation of future agreements. This approach recognizes that the optimal utilization, protection and development of a specific international watercourse are best achieved through an agreement tailored to the characteristics of that watercourse and to the needs of the States concerned. It also takes into account the difficulty, as revealed by the historical record, of reaching such agreements relating to individual watercourses without the benefit of general legal principles concerning the uses of such watercourses. It contemplates that these principles will be set forth in the framework agreement. This approach has been broadly endorsed both by the ILC and in the Sixth Committee of the General Assembly, article 3.

Part II of the Convention, article 5, equitable and reasonable utilization and participation, sets out the fundamental rights and duties of States with regard to the utilization of international watercourses for purposes other than navigation. One of the most basic of these is the well-established rule of equitable utilization, which is laid down and elaborated upon in paragraph 1. The principle of equitable participation, which complements the rule of equitable utilization, is set out in paragraph 2. This article states the following:

(a) "Watercourse States shall in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used and developed by watercourse States with a view to attaining optimal and sustainable utilization thereof and benefits therefrom, taking into account the interests of the watercourse States concerned, consistent with adequate protection of the watercourse;

(b) "Watercourse States shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention."

The purpose of article 6 of the Convention is to set out factors relevant to equitable and reasonable utilization. It stipulates that:

(a) "Utilization of an international watercourse in an equitable and reasonable manner within the meaning of article 5 requires taking into account all relevant factors and circumstances, including:

(i) "Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character;

(ii) "The social and economic needs of the watercourse States concerned;

(iii) "The population dependent on the watercourse in each watercourse State;

(iv) "The effects of the use or uses of the watercourse in one watercourse State on other watercourse States;

(v) "Existing and potential uses of the watercourse;

(vi) "Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect;

(vii) "The availability of alternatives, of comparable value, to a particular planned or existing use;

(b) "In the application of article 5 or paragraph 1 of this article, watercourse States concerned shall, when the need arises, enter into consultations in a spirit of cooperation."

Article 7 focuses on the obligation of every watercourse State, not to inflict significant harm to another watercourse State, stating that:

(a) "Watercourse State shall, in utilizing an international watercourse in their territories, take all appropriate measures to prevent the causing of significant harm to other watercourse States;

(b) "Where significant harm nevertheless is caused to another watercourse State, the State whose use causes such harm shall, in the absence of agreement to such use, take all appropriate measures, having due regard for the provisions of articles 5 and 6, in consultation with the affected State, to eliminate or mitigate such harm and, where appropriate, to discuss the question of compensation".

In this article, the Convention sets forth a process aimed at avoiding significant harm while reaching an equitable result in each concrete case. The optimal use of finite water resources of an international watercourse is considered in light of the interests of each watercourse State concerned.

Article 8 lays down the general obligation of watercourse States to cooperate with each other to fulfil the obligations and attain the objectives set forth in the Convention. Cooperation between watercourse States with regard to the utilization of an international watercourse is an important basis for the attainment and maintenance of an equitable allocation of the uses and benefits of the watercourse and for the smooth functioning of the procedural rules contained in part III of the Convention, in particular on consultations and negotiations concerning planned measures.

Article 8 indicates both the basis and the objectives of cooperation. It refers to the most fundamental principles upon which cooperation between watercourse States is founded. Other relevant principles include those of good faith and good neighbourliness. Article 8 stipulates the following:

(a) "Watercourse States shall cooperate on the basis of sovereign equality, territorial integrity, mutual benefit and good faith in order to attain optimal utilization and adequate protection of an international watercourse;

(b) "In determining the manner of such cooperation, watercourse States may consider the establishment of joint mechanisms or commissions, as deemed necessary by them, to facilitate cooperation on relevant measures and procedures in the light of experience gained through cooperation in existing joint mechanisms and commissions in various regions".

With regard to the exchange of data and information between the watercourse States, article 9 states the following:

(a) "Pursuant to article 8, watercourse States shall on regular basis exchange reasonably available data and information on the condition of the watercourse, in particular that of a hydrological, meteorological, hydrogeological and ecological nature as well as related forecasts;

(b) "If a watercourse State is requested by another watercourse State to provide data or information that is not reasonably available, it shall employ its best efforts to comply with the request but may condition its compliance upon payment by the requesting State of the reasonable costs of collecting and, where appropriate, processing such data or information;

(c) "Watercourse States shall employ their best efforts to collect and, where appropriate, to process data and information in a manner which facilitates its utilization by the other watercourse States to which it is communicated".

In fact, article 9 sets forth the general minimum requirements for the exchange of data and information necessary to ensure the equitable and reasonable utilization of an international watercourse between watercourse States. Watercourse States require data and information concerning the condition of the watercourse to apply article 6. This calls for watercourse States to take into account all relevant factors and circumstances in implementing the obligation of equitable utilization laid down in article 5. The rules contained in article 9 are residual: they apply in the absence of particularized regulation of the subject in an agreement of the kind envisaged in article 3, namely, relating to a specific international watercourse. Indeed, there is a clear need for watercourse States to conclude such agreements among themselves to provide, *inter alia*, for the collection and exchange of data and information in the light of the characteristics of the international watercourse involved, in addition to their special requirements and circumstances. The smooth and effective functioning of the regime envisaged in article 9 is dependent upon cooperation between watercourse States. The rules in this article therefore constitute a specific application of the general obligation to cooperate laid down in article 8.

Article 10 sets forth the general principle that no use of an international watercourse has inherent priority over other uses. Furthermore, the article addresses the situation in which there is a conflict between different uses of an international watercourse. According to this article, the following are applicable:

(a) "In the absence of agreement or custom to the contrary, no use of an international watercourse enjoys inherent priority over other uses;

(b) "In the event of a conflict between uses of an international watercourse, it shall be resolved with reference to articles 5 to 7, with special regard being given to the requirements of vital human needs".

Part III of the Convention outlines the procedures to be followed when planning a new activity in one State that may have a significant adverse effect on the other States sharing an international watercourse.

Article 11 introduces the articles of part III and provides a bridge between part II (which includes article 9 on the regular exchange of data and information) and part III (dealing with the provision of information concerning planned measures). Article 11 states that: "Watercourse States shall exchange information and consult each other and, if necessary, negotiate on the possible effects of planned measures on the condition of an international watercourse".

Therefore, this article lays down a general obligation of watercourse States to provide each other with information concerning the possible effects upon the condition of the international watercourse of measures they might plan to undertake. Furthermore, the article requires that watercourse States consult with each other on the effects of such measures.

Article 20 introduces part IV of the Convention by laying down a general obligation to "protect and preserve the ecosystems of international watercourses". These obligations relate to the "ecosystems of international watercourses" rather than the concept of the environment of a watercourse. The latter term could be interpreted quite broadly, to apply to areas surrounding the watercourses that have minimal bearing on the protection and preservation of the watercourse itself. Furthermore, the term environment of a watercourse might be construed to refer only to areas outside the watercourse, which is not the intention of the ILC. For these reasons, the Convention utilizes the term ecosystem which is believed to have a more precise scientific and legal meaning with regard to prevention, reduction and control of pollution.

Article 21 lays down an obligation to act, individually or jointly to prevent, reduce and control pollution of an international watercourse, by stipulating that:

(a) "For the purposes of this article, pollution of an international watercourse means any detrimental alteration in the composition or quality of the waters of an international watercourse which results directly or indirectly from human conduct;

(b) "Watercourse States shall, individually and, where appropriate, jointly, prevent, reduce and control the pollution of an international watercourse that may cause significant harm to other watercourse States or to their environment, including harm to human health or safety, to the use of the waters for any beneficial purpose or to the living resources of the watercourse. Watercourse States shall take steps to harmonize their policies in this connection;

(c) "Watercourse States shall, at the request of any of them, consult with a view to arriving at mutually agreeable measures and methods to prevent, reduce and control pollution of an international watercourse, such as the following:

(i) "Setting joint water quality objectives and criteria;

(ii) "Establishing techniques and practices to address pollution from point and non-point sources;

(iii) "Establishing lists of substances the introduction of which into the waters of an international watercourse is to be prohibited, limited, investigated or monitored".

Article 23 addresses the serious problem of pollution that is transported into the marine environment by international watercourses. It states that:

"Watercourse States shall, individually and, where appropriate, in cooperation with other States, take all measures with respect to an international watercourse that are necessary to protect and preserve the marine environment, including estuaries, taking into account generally accepted international rules and standards".

Article 24 recognizes the importance of cooperation among the watercourse States in managing international watercourses. This is with a view to ensuring their protection of all watercourse States while maximizing the benefits of modalities of management that are appropriate to the individual States and watercourses in question. This article stipulates that:

(a) "Watercourse States shall, at the request of any of them, enter into consultations concerning the management of an international watercourse, which may include the establishment of a joint management mechanism;

(b) "For the purposes of this article, management refers, in particular, to:

(i) "Planning the sustainable development of an international watercourse and providing for the implementation of any plans adopted;

(ii) "Otherwise promoting rational and optimal utilization, protection and control of the watercourse".

Part V, article 27 deals with a wide variety of conditions related to international watercourses that may be harmful to watercourses States. It stipulates that:

"Watercourse States shall, individually and, where appropriate, jointly, take all appropriate measures to prevent or mitigate conditions related to an international watercourse that may be harmful to other watercourse States, whether resulting from natural causes or human conduct, such as flood or ice conditions, water-borne diseases, siltation, erosion, salt-water intrusion, drought or desertification."

While it may be debated whether the harm results from the condition itself or from the effects thereof, there is no doubt that problems including floods, ice flows drought and water-borne diseases, are of serious consequence for watercourse States. The present article is concerned with the "prevention and mitigation" of such conditions while article 25 deals with the obligation of watercourse States to respond to actual emergency situations.

The obligations of watercourse States to respond to actual emergency situations related to an international watercourse are outlined in article 25. This can be contrasted with article 27 which concerns the

prevention and mitigation of conditions that may be harmful to watercourse States. Article 25 stipulates the following:

(a) "For the purposes of this article, emergency means a situation that causes, or poses an imminent threat of causing, serious harm to watercourse States or other States and that results suddenly from natural causes, as for example in the case of floods, the breaking up of ice, landslides or earthquakes, or from human conduct, as the example in the case of industrial accidents;

(b) "A watercourse State shall, without delay and by the most expeditious means available, notify other potentially affected States and competent international organizations of any emergency originating within its territory;

(c) "A watercourse State within whose territory an emergency originates shall, in cooperation with potentially affected States and, where appropriate, competent international organizations, immediately take all practicable measures necessitated by the circumstances to prevent, mitigate and eliminate harmful effects of the emergency;

(d) "When necessary, watercourse States shall jointly develop contingency plans for responding to emergencies, in cooperation, where appropriate, with other potentially affected States and competent international organizations".

Part VI contains two provisions that have proved troublesome. Article 32, non-discrimination, has provoked controversy. Not all States are comfortable with the idea of granting private persons from other countries non-discriminatory access to their judicial and administrative procedures relating to transboundary harm or the threat of such harm.

Article 33 provides a basic rule for the settlement of watercourse disputes. The rule is residual in nature and applies where the watercourse States concerned do not have an applicable agreement for the settlement of such disputes.

Perhaps the most interesting feature of part VII is the number of ratifying States necessary to bring the Convention into force, which is set at 35 (article 36, paragraph 1).[69] While it may seem rather modest in comparison with the number of members of the United Nations which amount to 188 to date, and regional economic integration organizations, this level of ratification will probably not be easily achieved: many States already believe they are better off not being a party to this because of ongoing disputes; others lack international watercourses or are island States and many perceive little to gain in becoming a party to such an agreement; still others have treaties governing their international watercourses with which they are satisfied and therefore may have little or no interest in the Convention.

2. *Remarks on selected issues: equitable utilization and the not to cause significant harm rule*

Regarding the core principles of the Convention,[70] separate informal consultations were conducted[71] concerning articles 5 and 6, referring to the principle of equitable utilization,[72] on the one hand, and article 7

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[69] In accordance with article 34, the Convention was open for signature at the Headquaters of the United Nations in New York, on 21 May 1997 and remained open to all States and regional economic integration organizations for signature until 21 May 2000.

[70] Attila Tanzi, "*The completion of the preparatory work for the United Nations Convention on the Law of the International Watercourses*", in *Natural Resources Forum*, vol. 21, No. 4, pp. 241-243.

[71] The Working Group and the Drafting Committee also had before them several proposals submitted by States for articles 5, 6 and 7 and others. Conference room papers relating to the deliberations of the Sixth Committee of the Working Group of the General Assembly bear the United Nations document symbol A/C.6/51/NUW/WG/CRP, followed by a number. These can be found in the United Nations Convention on the Law of the Non-navigational Uses of International Watercourses. Report of the Sixth Committee convening as the Working Group of the Whole, Fifty-first session, Agenda item 144, pp. 2-3.

[72] Indeed, the International Court of Justice referred to the principle of equitable utilization several times in its judgement in the Gabcîkovo-Nagymaros case, 25 September 1997.

concerning the not to cause significant harm rule, on the other hand. This two-track approach proved to be a useful negotiating method. However, it could not effect conclusive results.

Article 7 was treated as if it was closely linked to articles 5 and 6 throughout the negotiations. Upstream States generally favoured the equitable utilization rule of article 5 on the theory that it offered them more flexibility with regard to new uses of their watercourses. Conversely, downstream States on the whole preferred the not to cause significant harm rule of Article 7 on the ground that it afforded them, and especially their established uses, greater protection.

For this reason, the Chairman of the Working Group, Ambassador Chusei Yamada of Japan tabled a text for the three articles in question as one indivisible package.[73] This package reflected to a great extent, the results achieved during the informal consultations conducted separately on the provisions under consideration.

The Working Group finally adopted the three-article package by a vote of 38 to 4. Those who voted against included, China, France, Turkey and United Republic of Tanzania. There were 22 abstentions.[74]

Like the ILC's text, the Convention essays a difficult balancing act with regard to the relationship between the equitable utilization and no-harm rules. The language finally adopted represents an attempt to strike a balance between the two principles.

3. *Outlook*

The entry into force of the Convention on the Law on the Non-Navigational Uses of International Watercourses would have enhanced its authority.[75]

While this never happened, the Convention is likely to mark a significant step in the process of consolidation, creation, promotion and implementation of international customary water law. The sponsors of the resolution containing the Convention declared they were "convinced" that it would "contribute to the equitable and reasonable use of transboundary water resources and their ecosystems, as well as to their preservation, to the benefit of current and future generations".[76] In its resolution first calling for negotiation of a convention, the General Assembly had declared its conviction "that successful codification and progressive development of the rules of international law governing the non-navigational uses of international watercourses would assist in promoting and implementing the purposes and principles set forth in articles 1 and 2 of the [United Nations] Charter".[77]

Therefore, the Convention is likely to prove to be of significant value for several reasons. First, it was negotiated in a forum that permitted any interested State to participate.[78] It is the only convention of a universal character on international watercourses. It was adopted by a weighty majority of countries, suggesting that among the overwhelming majority of delegations, the rules embodied in the Convention are generally acceptable and on the whole, reflect a reasonable balance between the interests of upstream and downstream States.

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[73] See United Nations (A/C.6/51/NUW/WG/CRP.94).

[74] See United Nations (A/C.6/51/SR. 62), 1997.

[75] The Convention goes farther than some States would have liked in some areas, and does not go as far as it might have gone in others. Had the Convention entered into force it would have had significant bearing on water disputes between States, one or more of which is not a party to it. In addition, it might have been helpful in interpreting other general or specific watercourse agreements that are binding on the parties to a dispute, whether or not the Convention is itself binding on those parties.

[76] United Nations, Official records of the General Assembly, fifty-first session, 99th plenary meeting (A/51/pv.99), 21 May 1997.

[77] United Nations, Official records of the General Assembly, forty-ninth session, supplement, 1994, No. 49, vol. 1, preamble, General Assembly Resolution 49/52 (A/49/738).

[78] See for the list of delegations, A/C.6/NUW/INF/1 (4 April 1997).

Second, the Convention reflects existing norms on the Law on Non-Navigational Uses of International Watercourses that it was based on, and closely conforms to—from the preparatory work of the ILC to the debate of the Sixth Committee of the General Assembly convened as the Working Group on the Whole of the present Convention, a draft prepared by the ILC, responsible for the " progressive development of international law and its codification ". As is its practice, the ILC did not indicate which of the provisions progressively develop and which codify the law. However, it seems clear that the most important elements of the Convention, namely, equitable utilization and the no harm rule are, in large measure, codifications of prevailing norms. The fact that the working group did not fundamentally alter the ILC's approach indicates general satisfaction with the Commission's efforts at progressive development and codification in this field.

Therefore, diplomats and lawyers, judges and arbitrators negotiating a specific watercourse agreement or handling a watercourse dispute, will consult the text of the Convention on the Law of the Non-Navigational Uses of International Watercourses of 1997 in addition to other authoritative texts, for reference with a view to corroborating their interpretation of the Law on the Non-Navigational Uses of International Watercourses.

Even though the Convention never entered into force, negotiations and future agreements will resort to its provisions for reference.

III. OCCURRENCES OF SHARED GROUNDWATER AQUIFERS IN THE ESCWA REGION

Shared surface water resources are becoming increasingly exhausted, in terms of quantity and/or quality. Therefore, shared groundwater resources have become more important.

The over-exploitation of shared groundwater resources for irrigation has caused a marked depletion of such resources in areas of the ESCWA region. Plans to use water of marginal quality in some areas of the ESCWA region constitutes a controversial issue between some ESCWA member States.

A. GENERAL OCCURENCE AND ESTIMATED STORAGE

Groundwater in the ESCWA region is located in numerous aquifer systems. Storage and yield characteristics depend upon the extent of the area of each aquifer and its hydrogeologic properties.[79] Owing to the similarity of the geologic history of the region, the same rock unit often forms a producing aquifer in two or more countries. Therefore, many of the major aquifers are shared between two or more member States, namely the Paleogene aquifer in the Arabian Peninsula or the basalt aquifer between the Syrian Arab Republic and Jordan and with non-member States, namely the Nubian Sandstone between Egypt and other North African countries. Some hydrogeological units in the region are also vertically interconnected. Numerous investigations have been carried out on these aquifers, on individual State and subregional levels.

The objective of this section is not to provide a detailed description of the hydrogeology of shared aquifers, it is to indicate the occurrence of such aquifers and the potential for sharing them. However, this study will first review the magnitude and significance of shared groundwater resources.

Studies of total groundwater storage in the region offer extremely variable estimates. To illustrate these discrepancies, the values reported by M. A. Abu-Zeid (1993) are illustrated in table 7.[80]

TABLE 7. GROUNDWATER RESOURCES IN THE ESCWA REGION

Country	Underground storage, bm^3 a/
	Abu-Zeid (1993)
Iraq, Jordan, Lebanon, Palestine and the Syrian Arab Republic	12
Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen	860
Egypt (from Nubian sandstone basin)	6 500
Total	7 372

Source: M.A. Abu-Zeid, "Evaluation of existing status of for water resources in Arab nations", a paper prepared for the Arab Center for the Study of Arid Zones and Dry Lands (ACSAD), Damascus, June 1993.

a/ The references do not specify whether this is the total or the exploitable storage. The latter depends on technology and economics.

Despite these discrepancies, considerable quantities of groundwater are stored in major aquifers in the region. Current groundwater extraction is estimated at some 30 bm^3 per year. Therefore, it is envisaged that groundwater will have an expanding role in offsetting the deficit and meeting growing demand for water, especially in those countries that have problems with their surface water supplies.

However, having a considerable total reserve is one issue. Making sure that the reserve is available for the countries and localities where it is most needed, is another. In other words, the question of where and for what purpose can shared aquifers be developed, must be worked out on a case-by-case basis.

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[79] ESCWA, *Transboundary Water Resources in the ESCWA Region: Utilization, Management and Cooperation* (E/ESCWA/ENR/1997/7).

[80] M. A. Abu-Zeid, "Evaluation of existing status of for water resources in Arab nations", a paper prepared for the Arab Centre for the Study of Arid Zones and Dry Lands (ACSAD), Damascus, June 1993.

B. MAJOR SHARED GROUNDWATER AQUIFERS IN THE REGION

There are eight major shared aquifer systems in the region. These include the following:

(a) Eastern Mediterranean carbonate aquifer system;
(b) Jebel el Arab basaltic aquifer system;
(c) Jezira Tertiary limestone aquifer system;
(d) Jezira Lower Fars and Upper Fars aquifer system;
(e) Western Arabia sandstone aquifer system;
(f) Central Arabia sandstone aquifer system;
(g) Eastern Arabia Tertiary carbonate aquifer system;
(h) Nubian sandstone aquifer system.

The following paragraphs offer a brief description of each aquifer.[81]

(a) *Eastern Mediterranean carbonate aquifer system*

This aquifer system is part of the Eastern Mediterranean basin which covers an area of some 48,000 km^2. It extends through four ESCWA members: Jordan, Lebanon, Palestine and Syrian Arab Republic.

The Lebanese rivers, namely the Orontes, Litani and others, in addition to the Jordan River, form the major drainage network of this basin.

This regional aquifer system is found in the Alouite mountains of the Syrian Arab Republic, the Palmyrian mountains of the Syrian Arab Republic, the Anti-Lebanon range of Lebanon the Syrian Arab Republic, Mount Hermon of the Syrian Arab Republic and Lebanon, the Lebanon mountains of Lebanon and the eastern and western highlands of Jordan.

Hydrogeologically, the aquifer is a regional complex of carbonate rocks comprising two units: a lower Jurassic unit and an upper Cenomanian-Turonian unit, both composed mainly of limestones and dolomites.

(b) *Jebel el Arab basaltic aquifer system*

This aquifer system is part of the Horan and Arab Mountain basin which covers an area of 15,000 km^2. It extends through three ESCWA member countries, namely, Jordan, Saudi Arabia and the Syrian Arab Republic.

The Golan plateau constitutes the main occurrence of water resources for this basin, which is considered a main source of the Yarmouk and Azraq basins through the springs of Mazreeb, El-Hamma and El-Azraq.

Hydrogeologically, the main aquifer comprises complex layering of basalt flows of different ages. The thickness of the basalt layers changes markedly from the vast volcanic plateau of the southwest Syrian Arab Republic to eastern Jordan and northern Saudi Arabia. The total thickness ranges from 300 m near Jebel el-Arab up to 20 m in the Hamad basin. Furthermore, the saturated thickness and degree of saturation vary from one place to another.

(c) *Jezira tertiary limestone aquifer system*

This limestone and dolomite aquifer is of Middle Eocene to Oligocene age. It forms one hydrogeological unit in the Jezira area of the Syrian Arab Republic and is up to 300 m thick in Turkey. The thickness of the Paleogenic limestone increases in an eastwardly direction to some 560 m in Jezira of the Syrian Arab Republic,

[81] ESCWA, "Water resources agreements and practices in selected shared water resources in the ESCWA region", a paper prepared by B. Hirzalla, The International Congress on International and Comparative Law on International Watercourses. Education for a Shared Water Culture, Beirut, 18-20 June 1998 (no symbol).

and to 1,034 m in Qaratchik. In spite of its great thickness in the eastern area, the aquifer is hydrogeologically more important in the northwestern part of Jezira.

The water-bearing limestone formation outcrops in Turkey to the north of the border zone, extending from the Belikh area to the Khabour River in the Syrian Arab Republic. The aquifer extends along the Syrian border with Turkey, from Ain Al-Arab east of the Euphrates to Ras Al-Ain and beyond. The Khabour River channel between Ras Al-Ain and Hassakeh forms the southern border of the aquifer system, which extends southward as far as the Jebel Abdel Aziz area in the Syrian Arab Republic. Recharge to the aquifer system is estimated at 1,600 million m^3 per year and discharge occurs via two large springs in the Syrian Arab Republic, namely at Ras Al-Ain at 40 m^3 per second and at Ain Al-Arus at 6 m^3 per second.

(d) *Jezira lower and upper Fars aquifer system*

The lower and upper Fars formation comprises gypsum beds interbedded with limestones, clays and marls. It extends over the vast Mesopotamian plain of the Lower Jezira of the Syrian Arab Republic and in Iraq from the Belikh river in the west to the Tigris and Tharthar depression. The southern boundary coincides, more or less, with the middle reach of the Euphrates from Raqqa in the Syrian Arab Republic to Al-Ramadi in Iraq.

(e) *Western Arabia sandstone aquifer system*

There are four principal sandstone aquifers in the Arabian Peninsula, namely, the Saq, Tabuk, Wajid and Minjur. They range in age from Cambrian to Triassic. Hydrodynamically, they can be subdivided into three major subsystems:

(i) The Rum-Saq-Tabuk sandstone aquifer subsystem, which extends from northern Saudi Arabia to Jordan;

(ii) The Minjur sandstone aquifer subsystem, which occupies the middle of the Riyadh area;

(iii) The Wajid sandstone aquifer subsystem which mainly occurs in southern Saudi Arabia and northern Yemen.

Water of good quality for domestic, industrial, irrigation and livestock uses is available from various countries that comprise the Palaeo-Triassic aquifer system. The salinity of groundwater from the Saq aquifer does not generally exceed 1,000 parts per million (ppm), although water in the deeper horizons usually has a higher salinity and is of a sodium chloride type. Water from the Tabuk aquifer, mainly at lower and middle levels, is generally fair to good quality, with salinity ranging from 400 to 3,500 ppm. Water from the Minjur aquifer is of a calcium sodium or sulphate chloride type. Its sodium and chloride ion concentrations increase with depth. Freshwater from the Wajid aquifer is of a bicarbonate type. Its salinity is commonly less than 1,000 ppm.

The Rum group, which is underlain by the Araba Complex and the Basement rocks, mainly comprises the Disi and Umm Sahm formation of the lower Paleozoic. Its outcrops extend from central Saudi Arabia westwards and northwards through Tabuk, Disi and Petra, with the most northwesterly occurrence at the eastern shores of the Dead Sea. In sub-cropping areas, this formation is known to extend northwards and eastwards underlying the whole of the Rum group aquifer. Evidence of its thickness and depth in the subsurface has been collected from records of boreholes. Structures including faults, intrusions, and dykes are present in the area. This aquifer has a generally uniform, consistent lithology over large areas and attains thickness of more than 2,000 m. The depositional environment is fluvial. The overlying Hiswah Shale, which is a confining layer, represents a post transgression, entirely marine, depositional environment.

Groundwater flow in this aquifer commences from beyond Tabuk in Saudi Arabia, moves broadly northwards, crosses into Jordanian territory, passes Jafr and converges towards the Dead Sea. Since the 1980s, extractions have changed the pattern of groundwater flow, with a significant change in the Tabuk area.[82] High rates of extraction for irrigation purposes have produced a very extensive cone of depression,

[82] Ibid.

locally diverting the natural northeasterly groundwater flow direction. In Jordan, the aquifer is utilized by four main farming corporations and a few small private farms that were recently established around Quweira to supply Aqaba. In Saudi Arabia, the users include two farming corporations and the Tabuk town and air base.

(f) *Central Arabia sandstone aquifer system*

The Cretaceous aquifer system comprises the Biyadh and Wasia sandstone formations in Saudi Arabia. Their combined thickness is approximately 1,000 m. Groundwater occurs in form unconfined conditions, especially in the outcrop of the aquifer, which extends over a vast area, from Wadi Al-Dawasir in Saudi Arabia, to Rutbah in Iraq. The salt content of the lower member, the aquifer outcrop/recharge area, is some 150 ppm. In the Al Kharj area, salinity ranges between 550 to 900 ppm. The water quality of the Wasia sandstone aquifer varies widely from one place to another. The salinity ranges in the outcrop area vary between 1,000 to 3,000 ppm, while the water in the Biyadh aquifer is stagnant. Its salinity rises substantially from 4,000 to 80,000 ppm to 150,000 ppm. The Wasia aquifer then continues to flow with a salinity of 4,000 to 5,000 ppm.

According to a number of consultants, groundwater resources in the Biyadh and Wasia aquifers are estimated to have a potential annual recharge of 252 and 420 million m^3, respectively.[83] The water in storage is estimated at 120 bm^3, though it is possible that this could be as much as 290 bm^3.

The hydraulic characteristics of the Cretaceous aquifer system vary widely in the extensive confined and unconfined parts of the hydrogeological systems. For many areas in Iraq, Jordan, Kuwait and northern and southern Saudi Arabia, information on this aquifer system is scarce or incomplete. In some areas, the aquifer is either saline or unproductive and its development is consequently not feasible.

(g) *Eastern Arabia Tertiary carbonate aquifer system*

The East Arab Peninsula basin covers an area of some 1.6 million km^2 and extends through the Gulf States, Iraq, Jordan, Syrian Arab Republic and Yemen. Rainfall is the main water resource at the north of the basin and feeds the eastern section of the basin.

The aquifers consist primarily of limestones and dolomites. The whole sedimentary complex is hydraulically interconnected and is a recharging-discharging aquifer system.[84] The subdivisions, or main aquifers, are as follows:

(i) The Umm er Radhuma aquifer. This is composed of limestone and dolomites ranging in thickness between 240 and 700 m. It occurs in Iraq, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Yemen;

(ii) The Dammam aquifer. This is composed of limestone and dolomite interbedded with shale ranging in thickness between 20 and 500 m. It occurs in Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates;

(iii) The Neogene aquifer. This is composed of sandstone, sandy marl and chalky limestone of variable thicknesses. It occurs in Kuwait, Oman, Qatar and the United Arab Emirates.

Investigations of this aquifer system were conducted by FAO.[85] Groundwater recharge into the aquifers was estimated at 1.15 bm^3, while the estimated discharge from the system is 1.2 bm^3. Other estimates for the recharge of the Umm er Radhuma, Dammam and Neogene aquifers are 406 million m^3, 200 million m^3 and 238 million m^3, respectively. Fresh water is relatively rare in the aquifer complex, occurring in the upper and lower zones of the hydrodynamic system.

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[83] ESCWA, "Water resources database in the ESCWA region" (E/ESCWA/ENR/1992/6).

[84] FAO, *Survey and Evaluation of Available Data on Shared Water Resources in the Gulf States and the Arabian Peninsula*, vol. 2, Rome, 1979.

[85] Ibid.

Water in the unconfined part of the Umm er Radhuma aquifer is mainly of a sulphate or chloride type. The salinity ranges from 300 to 700 ppm, though water of good quality (900 to 1,400 ppm) may be found in some localities. In Bahrain and Qatar, the aquifer is highly saline (6,000 to 17,000 ppm). The salinity of the Dammam aquifer ranges between 1,000 to 6,000 ppm. In the upper reaches of the aquifer system, good water quality can be found.

(h) *Nubian sandstone aquifer system*

The Nubian sandstone basin covers an area of 2.35 million km^2. It extends through Chad (0.10 million km^2), Egypt (0.85 million km^2), Libyan Arab Jamahiriya (0.65 million km^2) and Sudan (0.75 million km^2). It has a huge groundwater reservoir, though limited in the segment from Chad to Sudan and perhaps the Ethiopian plateau. Springs, oases and depressions represent the major drainage areas of this basin. This system comprises a sequence of continental sandstones and sands intercalated with argillaceous beds of the Carboniferous to Middle Cretaceous ages. Its thickness reaches up to several thousand metres.

In the eastern desert of Egypt, the aquifer occurs under confined artesian conditions, namely, flowing wells. Water can be obtained from both the shallow carbonate and the deep sandstone formations. The deeper formations are more extensive and contain larger quantities of groundwater. The thickness of the aquifer complex in the central eastern desert is some 400 m.

In the Sinai Peninsula, the Nubian sandstone complex is the principal aquifer. On average, the depth of the aquifer is 700 to 900 m in central Sinai, increasing northwestward to some 2,500 m along the Mediterranean coast. Artesian pressure in central Sinai is some 200 m above sea level.

Groundwater encountered in this aquifer system is generally of excellent quality, ranging between 100 to 800 ppm. The storage volume in the aquifer system in Egypt—western and eastern deserts and Sinai—is estimated at 5,000 bm^3. Local groundwater is abstracted in the eastern desert, but quantities do not exceed 5 million to 10 million m^3.[86] Abstractions for agricultural use in the Sinai occurs predominantly along the northern coastal (Al-Arish) area. Average annual withdrawal is some 30 million m^3.[87]

[86] ESCWA, "Water resources database in the ESCWA region", 1992 (E/ESCWA/ENR/1992/6).

[87] S. Fahmy, "Water resources management, development and utilization in Egypt," a paper presented at the Regional Symposium on Water Use and Conservation, held in Amman from 28 November to 2 December 1993 (E/ESCWA/NR/1993/WG.1/8).

IV. STATUS OF REGIONAL COOPERATION REGARDING SHARED GROUNDWATER RESOURCES: UTILIZATION AGREEMENTS, MANAGEMENT AND PRACTICES

There is no legal framework for regional cooperation on shared groundwater aquifers in the ESCWA region. Furthermore, there is essentially no precedence in the ESCWA region with respect to bilateral or multi-lateral agreements on the use and management of shared aquifers. The main reason is that States have traditionally viewed groundwater as a sovereign resource. However, another reason is probably the inadequate understanding of the issue of sharing aquifers on the part of decision makers and the less than adequate role on the part of professionals, to improve this understanding. An additional handicap has been the weakness of international water law with respect to groundwater. This weakness has not helped professionals in the water resources and legal fields to build strong arguments to pursue an enhanced cooperation track.

Lack of appropriate cooperation and coordination of shared water resources at regional and interregional levels is a source of concern. It is necessary to take into consideration a variety of issues related to the socio-economic factors prevailing in the countries of the region. Coordinating the management of water resources would ensure their rational development, utilization and management.

Nevertheless, significant joint efforts to delineate some shared aquifers and assess their potential have been accomplished bilateral and subregional levels. In particular, agreements have been reached between groups of States for specific shared basins. In this regard, ESCWA, ACSAD, CEDARE, FAO and other regional and subregional institutions have sponsored the following activities:

(a) Studies of this project involved Hamad Basin, Iraq, Jordan, Saudi Arabia and Syrian Arab Republic;

(b) Shared groundwater resources studies in the Gulf States;

(c) Investigations of the basalt aquifer system shared by Jordan and the Syrian Arab Republic;

(d) Assessment of the carbonate aquifers of the lower tertiary (Paleogene) in the ESCWA region;

(e) Assessment of the Nubian sandstone aquifer system.

A. STUDIES OF THE HAMAD BASIN

Plans for the Hamad Basin Project began in 1975.[88] The four countries that share the basin, Iraq, Jordan, Saudi Arabia and Syrian Arab Republic, agreed to cooperate within the framework of a plan based on an integrated study of the available and potential natural resources of the basin. Water resources received special attention.

Project documents prepared by ACSAD were approved in 1978. The project commenced in 1979 and continued for four years. National follow-up teams/projects within the Hamad Basin were implemented. The project area comprised some 100,000 km^2. This was later increased to include the entire area of the basin within the countries concerned.

The objectives of the project included: acquiring the basic data and information necessary for the comprehensive socio-economic development of the basin; improving the living standard of the population and evaluating natural resources of the basin, including surface and groundwaters, vegetation and animal resources. Specific project activities included the following:

(a) A topographical survey using available maps and interpretations of satellite imagery and the preparation of a base map on a scale of 1:500,000;

(b) Climatological studies using existing meteorological data and data collected during the project;

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[88] ESCWA, "Water resources agreements and practices in selected shared water resources in the ESCWA region", a paper prepared by B. Hirzalla, the International Congress on International and Comparative Law on International Watercourses, Education for a Shared Water Culture, Beirut, 18 to 20 1998 (no symbol).

(c) Surface and groundwater points inventory, analysis and evaluation;

(d) Geological studies and hydrogeological correlations, in addition to delineation of the main water-bearing formations and determination of their hydraulic parameters;

(e) Collecting, compiling, recording and storage of water data;

(f) Soil survey, wildlife and vegetal-cover studies.

B. Studies of shared groundwater resources in the GCC States

From April 1977 to May 1979, FAO carried out an extensive assessment of the shared water resources in GCC States as requested by the Council of Ministers of Agriculture in the GCC States and the Arabian Peninsula.[89]

The aim of the assessment, as agreed between the FAO—the executing agency—and the Council of Ministers, was to undertake the following:

(a) Gather all documents which deal with the water resources of the region (project area) and evaluate them thoroughly;

(b) Develop a conceptual hydrogeological model for the Eastern Arabian basin, using all available data;

(c) Slot each country into the developed model and determine how each would share its water resources;

(d) Draw up a programme for future investigations to better quantify the shared resources and prepare a pumping programme to ensure equitable sharing among the countries concerned.

To achieve the above, FAO's technical team reviewed and evaluated the available data and documents relevant to the project area of 1.7 million km^2, including information pertaining to geological setting, geophysical surveys, hydraulic and hydro-chemical parameters and hydrogeological conditions prevailing in the project area.

Data on piezometry, water quality and well inventory were presented on maps. Geological cross-sections were drawn. A summary of all significant hydrogeological data and the results of previous studies in the area were included. The aquifer systems in the study area are described as follows:

(a) System A: comprising the main aquifer system that recharges in inland Saudi Arabia and underflows eastwardly, with eventual discharge into the Gulf;

(b) System B: comprising of discontinuous fresh-water lenses which extend from coastal Saudi Arabia across Bahrain and Qatar, into central Abu Dhabi of the United Arab Emirates. This system includes the shallow, unconsolidated aquifers of the eastern United Arab Emirates and inland Oman, and the freshwater aquifer in northern Kuwait and areas in southeastern Iraq.

Based on the data collected and a review of previous findings, a groundwater simulation model was developed. The model simulated the main aquifer systems in the basin, the recharge sources and discharge areas and water quality in the different localities of the project area.

The project concluded by classifying the resources according to their source aquifers, determining the hydrogeological situation of each aquifer system's hydraulic model and establishing the extent of possible sharing within the framework of the proposed hydraulic model. Furthermore, it concluded that further studies would be required in Bahrain, Kuwait and the United Arab Emirates. In addition, it recommended that a data

[89] Ibid.

bank and retrieval system for hydrological and hydro meteorological data must be established and an interpretation of the available and future data, records and reports must be undertaken.

The prevailing hydrogeological conditions in the Yemeni subregion of the project area, based on available data records and previous investigations, were studied and described. It was concluded that the largest area for the potential sharing of groundwater resources comprise those between Yemen and Saudi Arabia, where groundwater, in the Cretaceous sandstone and in the Umm er Radhuma aquifers, is recharged in Yemen and flows towards Saudi Arabia (see details in section D below concerning the Palaeogene aquifer). The available data do not provide enough information for a precise statement on the extent of potential sharing in this area.

In conclusion, this project explicitly recognized of the shared nature of water resources in the Eastern Arabian basin and the need to adopt a scientific approach in determining shares of those resources. GCC member States were even more explicit in requesting that the FAO: "prepare a pumping programme to ensure equitable sharing by the countries concerned".[90]

C. Investigations of the basalt aquifer shared by Jordan and the Syrian Arab Republic

The subregional basalt aquifer that extends over an area of some 25,000 km^3 between Jordan and the Syrian Arab Republic, contains groundwater resources of regional extent, with local perched groundwater in some areas. The aquifer is intensively developed in both Jordan, as one of the main supply sources for the Greater Amman, and in the southern areas of the Syrian Arab Republic. Both Jordan and the Syrian Arab Republic are currently engaged individually in further studying this aquifer to increase their respective water supplies. It is likely that further groundwater extractions will exacerbate the quantity and quality problem in this aquifer.

ESCWA, through its technical cooperation with BGR, initiated a study of this aquifer system as part of its activities for the 1994/1995 biennium. The study was implemented in cooperation with competent authorities in both countries, namely the Water Authority (WAJ) of the Ministry of Water and Irrigation of Jordan and the Department of Irrigation and Water Resources of the Ministry of Irrigation of the Syrian Arab Republic. The considerable subregional cooperation during the course of the investigation resulted in the study.

The long-term objective of the study was to "achieve an optimized sustainable management of the available water resources in the basalt aquifer region".[91] The immediate objectives were as follows:

(a) To establish an information base on the hydrogeological conditions of the basalt aquifer region, for sustainable management of the groundwater resources;

(b) To formulate proposals for further studies and technical measures for water resources development, management and conservation in specific areas;

(c) To introduce appropriate methods, namely, remote sensing and isotope hydrology, for groundwater exploration and management in the aquifer area.

Remote sensing techniques coupled with groundtruth data, the incorporation of the outcome of previous investigations and information, facilitated the preparation of a unified geological map for the study area. This proved to be a major information base for the assessment and development of groundwater resources. The map presented, in addition to the surface geology, a correlation of the main lithostratigraphic units, geotectonic framework and the major geologic structures which control the groundwater occurrence, movement and potential within the study area.

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[90] Ibid.

[91] Ibid., p. 17.

Data and information provided by cooperating agencies in Jordan and the Syrian Arab Republic, in the form of tabulated data, documents and digital files, in addition to information from publications, reports and maps were stored in computer files and processed with commercial computer software. The evaluated data comprise records on various parameters from boreholes and springs to groundwater quality and isotope hydrology.

An iterative process of data processing, digitizing of relevant features from maps, plotting of maps as working sheets and drafts and discussion with specialists of national institutions in Jordan and the Syrian Arab Republic made the preparation of some 15 thematic maps on scales of 1:500,000 and 1:1,000,000, possible. These maps were to be used for water resources planning and the execution of groundwater development and management schemes, namely, the quantitative assessment of groundwater resources, the design of irrigation schemes or the delineation of prospective groundwater exploration areas.

The prevailing hydrogeologic conditions of the basalt aquifer system described in brief in the study are mainly related to groundwater, namely, flow, depth, aquifer thickness, salinity, chemistry in the basalt layers and in underlying carbonate aquifers, aquifer hydraulics and movement in the main basalt aquiferous horizons. No particular evaluations of groundwater balances were made. However, a general discussion of groundwater balances and an outline of information available from earlier reports was presented. The study further tackled in brief, the hydrologic conditions of the area and the drainage pattern, rainfall, evaporation, surface runoff and infiltration over the basaltic region within Jordan and the Syrian Arab Republic.

The study made recommendations for follow-up actions and for integrated water resources development and management in the region. In particular, the recommendations dealt with promising areas and potential instances of groundwater exploration, water quality rehabilitation in specific areas, surface water impounding and artificial groundwater recharge, in addition to rainfall harvesting measures. Other recommendations related to, improvement of monitoring programmes for water levels, water quality and well discharges, evaluation and assessment of aquifer parameters and the establishment of a comprehensive water information database.

Finally, the study concluded that mutual cooperation and coordination for developing and managing the shared watershed, comprising the basalt aquifer, would be extremely beneficial for Jordan and the Syrian Arab Republic. The ultimate goal of shared basin development is a comprehensive and multi-faced concept. It would deal with all measures to ensure rational development, utilization and conservation of water resources. It would take into account the socio-economic factors prevailing in both countries. In this respect, the study recommended the organization of a joint advisory steering committee responsible for coordinating, follow-up and exchange of information regarding watershed investigations.

D. CARBONATE AQUIFERS OF THE LOWER TERTIARY (PALEOGENE) IN THE ESCWA REGION

Middle Cretaceous to Eocene carbonate rocks extend over large areas of the geological province of the Arabian shelf. This carbonate sequence, comprising predominantly limestone, dolomite, chalk, marly limestone and marls, includes two important aquifer complexes:

(a) Cretaceous limestone and dolomites with major outcrops in the sub-humid north-western part of the ESCWA region;

(b) Paleogene deposits comprising predominantly limestone and chalky limestone, which extend over the following:

(i) Wide parts of the steppe, Badiyeh and the Hamad areas in Iraq, Jordan, the Syrian Arab Republic and northwestern Saudi Arabia;

(ii) Areas of south-western Oman, the Gulf region, eastern Saudi Arabia and south-eastern Yemen;

(iii) Areas of the semi-arid to sub-humid region of Lebanon, Palestine and the Syrian Arab Republic.

Paleogene aquiferous formations have different names in different countries, namely, Eocene or Middle to Upper Eocene, Lutetian, Rijam and Sallala limestone, Um er-Radhuma and Dammam, Ummer Rhaduma and Jeza.

A study of groundwater resources in the Paleogene aquifers of the ESCWA region was included in ESCWA's work programme for the 1996-1997 biennium.

According to a preliminary evaluation of available information, the groundwater potential of the Paleogene aquifer system in the different subregions can be assessed as follows:

(a) Paleogene aquifers of limited extent occur in synclinal structures of the mountains and highlands west and east of the rift zone. These aquifers are important, at least for local water supplies. They include the Jenin aquifer in the West Bank;

(b) In the north-west of the Syrian Arab Republic, Paleogene chalks and limestones form a fissure type aquifer with generally medium productivity. The aquifer contains the only freshwater sources in wide parts of the country. Groundwater is replenished from annual rainfall. However, intensive exploitation of the aquifer for irrigation and domestic supply has led already to near-depletion in some areas;

(c) In the Hamad and Wadi Sirhan areas, which extend over southern parts of the Syrian Arab Republic, eastern Jordan, southwestern Iraq and northwestern Saudi Arabia; Paleogene chalks, limestones and cherts constitute an aquifer of fossil, brackish groundwater with generally low to moderate productivity. Freshwater lenses along major wadi systems are sustained by infiltration from wadi runoff;

(d) The Euphrates-Gulf basin comprises an outcrop belt of Paleogene carbonate rocks extending over some 1,500 km from southern Iraq to eastern Saudi Arabia. The carbonate rocks are partly karstified and form part of a complex aquifer system. This extends from the outcrop belt eastward and northeastward until the Euphrates and the Gulf. The Paleogene aquifer system constitutes one of the most important groundwater reservoirs of Saudi Arabia. The groundwater is, however, predominantly fossil in nature, as present-day recharge is very limited. Freshwater lenses are sustained by recent recharge under karstic surfaces in the Gulf area; namely, in Bahrain and Qatar. In Kuwait, brackish groundwater is extracted from the Paleogene aquifer system for irrigation and for mixing with better quality water to be used for domestic supplies;

(e) In the Rub al Khali Basin, the Paleogene is, to a large extent, covered by sand seas. On the southern fringes of the Rub al Khali in Hadramawt, Dhofar and central Oman, some present-day recharge apparently occurs along wadis. The groundwater of the Paleogene aquifers below the sand seas of the Rub al Khali appears to be predominantly brackish. Groundwater movement is probably directed from the mountainous fringes of the basin towards sabkha areas within the desert and along the Gulf coast.

The main challenges of utilization of the water resources of Paleogene aquifers in the ESCWA countries are as follows:[92]

(a) Safe management of the limited renewable fresh water resources;

(b) Rational extraction of extensive non-renewable resources of fresh to slightly brackish groundwater;

(c) Conservation of the quality of exploitable water resources.

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[92] Ibid.

As part of its programme for the 1998-1999 biennium, ESCWA developed a database for this aquifer system that aimed to contribute to these objectives through a comparative evaluation and presentation of available information on a regional scale.

E. Assessment of water resources in the ESCWA region using remote sensing and GIS techniques

According to its mandate to promote regional and subregional cooperation among its member States in the field of water resources development and management, ESCWA executed this regional project from 1994 to 1996. The project aimed to improve knowledge of water resources in the ESCWA region through the application of remote sensing and GIS techniques. The project included a regional assessment of surface and groundwater sources and a formulation of water strategies, with an emphasis on shared water resources through the interpretation and analysis of hydrological, hydrogeological and remotely sensed data. Advanced remote sensing and GIS techniques were applied to define key features including the physiography of major watersheds, surface water bodies, regional hydrogeology and land uses within the ESCWA region.[93]

Application of remote sensing techniques has contributed towards further refinement of the delineation of the geomorphological characteristics of 20 major drainage basins, in addition to the geological lineaments and the extent of the natural vegetal cover and irrigated areas of aquifers. Furthermore, the powerful combination of remote sensing and GIS techniques has strengthened the integration of hydrological and hydrogeological information and resulted in suggestions on development and management of both surface and groundwater resources in the ESCWA region.

Detailed analysis was carried out with respect to the shared water resources, in particular the surface water, of major rivers including the Euphrates, Jordan, Nile, Orontes and Tigris. In addition, detailed studies were undertaken regarding the groundwater potential of aquifers, Ordovician sandstone in Jordan and Saudi Arabia, Dammam in Bahrain, Iraq, Saudi Arabia and the United Arab Emirates and carbonates in Iraq, Jordan, Saudi Arabia and the Syrian Arab Republic.

The outcome of the project culminated in the publication of a technical report addressing several major components. These include the following:

(a) Methodology of remote sensing and GIS techniques and their use in water resources assessment and hydrological and regional physiography analysis;

(b) Surface and groundwater resources and suggestions for water strategies for the development and management of shared water resources in the ESCWA region;

(c) The development of regional hydrological and hydrogeological maps.

Maps prepared in the framework of the project included the following:

(a) Regional hydrological maps on a scale of 1:2,500,000 showing major catchment areas, rainfall distribution, drainage lines, patterns, rivers and other major water bodies, lakes and dams;

(b) A regional hydrogeologic map on a scale of 1:2,500,000;

(c) Hydrogeologic maps on a scale of 1:1,000,000 scale for three major shared groundwater basins of the following:

(i) Paleozoic sandstone aquifers in Jordan and Saudi Arabia;

[93] ESCWA, "Water resources assessment in the ESCWA region using remote sensing and GIS techniques", final report, February 1996, in cooperation with the United Nations Environment Programme (UNEP), the Islamic Development Bank and Royal Jordanian Geographic Centre.

(ii) The Paleogene Dammam aquifer in Iraq, Saudi Arabia, the Syrian Arab Republic and United Arab Emirates;

(iii) Upper Cretaceous and Paleogene carbonate aquifers in Iraq, Jordan, Saudi Arabia and the Syrian Arab Republic.

These maps show groundwater flow patterns, water quality, aquifer boundaries, existing development areas and potential areas for future development.

The maps have been prepared using information from existing maps, reports and evaluations of images from National Oceanic and Atmospheric Administration (NOAA) meteorological satellites and Landsat Multispectral Scanner images.

F. ASSESSMENT OF THE NUBIAN SANDSTONE AQUIFER SYSTEM

Since the early 1970s, Egypt, the Libyan Arab Jamahiriya and Sudan have agreed to form a joint authority to study and develop the Nubian sandstone aquifer system. Furthermore, they agreed to seek international technical assistance to develop a regional strategy for its utilization.

CEDARE and the International Fund for Agricultural Development (IFAD), among others, joined forces to develop a regional strategy for the utilization of the Nubian sandstone system. IFAD organized several meetings attended by CEDARE and representatives of the three countries.

(a) The 1994 meeting recommended that a regional project for the sustainable development of the Nubian sandstone aquifer system must be preceded by a preparatory phase to be implemented by CEDARE;

(b) During the preparatory phase, ongoing studies and development activities on the aquifer were reviewed in a regional workshop organized by CEDARE in 1995. The workshop recommended that IFAD and CEDARE formulate a regional programme document;

(c) In 1997, another meeting was held at IFAD. It approved IFAD's funding of a two-year programme for the development of a regional strategy for the utilization of the Nubian sandstone aquifer system to be executed by CEDARE.

The programme aims to foster cooperation between sharing countries in the following fields: groundwater studies and development, environmentally sound agricultural and agro-pastoral development, policies and programmes for the restoration of disrupted ecological balance and combating desertification.

The implementation arrangements comprise the following:

(a) On a national level: programme implementation by the national institutions;

(b) On a regional level: the regional programme committee will be in charge of the day-to-day technical and organizational management of the programme, assisted by short-term consultants. CEDARE, the executing agency of the programmes, will provide constant administrative backstopping.

V. INTERNATIONAL LAW AND SHARED GROUNDATER RESOURCES

A. NATURAL RESOURCES AND THE TERRITORY OF STATE

International law broadly distinguishes the following three categories of natural resources:

(a) Those that lie entirely within the confines of a single State and thus, belong to that State and are subject to its national laws, namely a forest, lake, or mineral resource;

(b) Those that are outside the territories of States and thus, belong to the international community and are governed by international law namely, the moon and the sea bed;

(c) Those that are shared between two or more States. They are of two kinds: fluids, namely, liquids and gases that transit from one State territory to another or extend over the territories of several States and animals that migrate, or whose habitat lies across international frontiers.

This study is concerned with resources in the last category, namely, shared natural resources. By their very nature, shared natural resources cannot be partitioned between States simply by drawing a demarcation line. A borehole driven by one State into a shared groundwater aquifer or gas deposit, may extract water or gas originating in another State.

Two issues follow from the above. The first concerns the extent of the State's jurisdiction beneath its territory, namely, whether or not there is a depth limit for State territory. The second is whether or not groundwater, considered in terms of depth, is located within the territory of a State.

For the first issue, the general rule in border treaties is that the border line extends vertically into the subsurface, unless otherwise provided. However, the extent of the State's subsurface jurisdiction under its territory has been largely neglected in scholarly writings, possibly because it has little practical importance. However, recent technological advancements have enabled States to reach greater depths in their marine territories and higher elevations in the air space belonging to them. Hence, similar questions regarding the extent of a State's jurisdiction over its continental shelf or air space have been addressed by legal scholars. It is likely that this question will continue to receive attention in the future, especially with the advent of new technologies that are able to tap subsurface energy, water, mineral and other resources.[94] At present, however, four schools of thought set the limit of State territory at the following:

(a) The centre of the earth;

(b) The depth according to where the earth's crust ends and the lithosphere begins;

(c) The depth according to where it is possible to technically exploit it;

(d) The depth at which technology allows effective exploitation, irrespective of whether or not the State is actually able to apply that technology.

In addition, there has been no systematic provision for groundwater in treaties and similar international instruments, particularly with regard to the issue of whether or not groundwater is located within the territory of a State. Legal scholars say that this is because States' do not attach much importance to disputes that arise over shared groundwater resources or because the practice of States in this regard has yielded satisfactory results. Therefore, these concerns are not embodied as specific provisions regarding groundwater in their conventions.

In any case, groundwater basins or aquifers are categorised as national or international, depending on the basin or aquifer configuration with respect to a State's boundaries.

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[94] Food and Agriculture Organization of the United Nations (FAO), "International groundwater resources law", by Julio. A. Berberis, *FAO Legislative Study* (Rome, 1986), No. 40.

A national groundwater basin or aquifer is one that belongs to only one State and is under its exclusive jurisdiction. It can be referred to as State-owned aquifer. A State-owned aquifer falls entirely within the State's territory, including its recharge area. It is not hydrologically linked with surface or groundwater in a neighbouring State.

However, an international groundwater basin or aquifer does not belong to a single State because it forms part of an inter-State hydrologic system. Many groundwater basins or aquifers fall into this category. The various field situations or configurations that make a basin or an aquifer international include the following:

(a) The basin or aquifer is traversed by an international boundary. Therefore certain section are located in different States. The aquifer need not be linked hydrologically with other groundwater or surface water and consequently, only the aquifer itself can be considered a shared resource. A confined aquifer traversed by an international boundary would fit this situation;

(b) The aquifer is entirely situated within the territory of one State but it is hydraulically connected to an international river. Here, distinction must be made between influent and effluent rivers;

In the case of an influent river, the aquifer receives recharge from the river so that the use of river water by an upstream State may affect the aquifer recharge. In an effluent river, where the aquifer feeds the river, the excessive exploitation of the aquifer could decrease the flow of the river. In both cases, the aquifer, that is entirely within the territory of the State, will form part of an international hydrologic system only if its use affects the water in the system;

(c) The aquifer is entirely situated within the territory of one State but is hydraulically connected, through a semi-permeable layer, namely, sandy or silty clay, to another aquifer in a neighbouring State. In this case, groundwater percolates from one aquifer to another depending on the hydraulic head difference. Hence, an increase in the exploitation of one of the aquifers modifies the hydraulic heads and trigger increased groundwater movement towards the more exploited aquifer at the expense of the water reserves in the less exploited aquifer. Excessive exploitation of one aquifer can reverse directions of flow. Therefore, an aquifer that naturally feeds another aquifer, will cease to do so;

(d) The aquifer is entirely situated in the territory of one State but its area of recharge is in another State. Such aquifers are often found in mountainous areas where the water divide of surface waters does not coincide with that of the groundwaters. Modifications made by one State in the recharge area, namely, changing its permeability, could affect exploitation of the aquifer by another State.

In all of these examples, it is possible that activities affecting the groundwater aquifer or the connected river resources or recharge zone within the territory of one country could have an impact that extends beyond its frontiers. Over-pumping of an international aquifer on one side of the border could affect the portion located on the other side. Altering a river regime could bring about a change in the water table level in another territory.

It follows that while shared natural resources fall within the exclusive jurisdiction of the State in whose territory they happen to be, international law lays down certain norms that must be respected by sharing States. Moreover, the similarity between legal rules governing the use of various shared natural resources of wildlife, gas, oil and atmosphere, warrants the conclusion that there are certain general international rules of law that apply to all such resources.[95] The relevant applicable principles include the obligation not to cause appreciable harm, the duty of equitable and reasonable use, the obligation to provide prior notice and the duty to negotiate.

In conclusion, there is a "need to have legal rules governing activities whose consequences may be, or indeed are, felt well beyond the territory of the State in which they are carried on".[96]

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[95] FAO, "International groundwater resources law", by Julio A. Berberis. FAO Legislative Studies (Rome, 1986). No. 40.

[96] Ibid.

B. THE EVOLUTION OF INTERNATIONAL GROUNDWATER LAW

Groundwater, like surface water and many other natural resources, knows no political boundaries. An aquifer system can lie beneath a vast territory within the jurisdictions of several political entities, with discharge and recharge areas in differing jurisdictions and abstractions throughout its areal extent. Such a physical situation invites contention, between States, municipalities or a city and its nearby rural communities.

Until recently, however, international law on the use of shared water resources has largely focused on surface water. Matters relating to shared aquifers have been relatively ignored. One reason for the negligence of groundwater is the inadequate understanding on the part of decision makers and legislators of the physical interrelationship between surface and groundwater resources and of groundwater as an integral part of the hydrologic cycle. Today, most legislators and decision-makers continue to regard groundwater sources as dissimilar from surface water sources with respect to ownership and usage. Therefore, they omit this resource from the legal regime of international water law. It follows that the first step in the evolution of the legal regime for groundwater is the acknowledgement of the interrelationship between surface and groundwaters.

Indeed, numerous international legal instruments, namely, treaties, agreements, resolutions of international organizations and scientific bodies recognize that groundwater is deemed to form part of one and the same cycle as surface water. This reciprocal dependence between surface and groundwaters is recognized in provisions of many agreements and conventions. FAO (1986) has reviewed several such agreements in which explicit provision is made for this reciprocal relationship and for the reverse hypothesis that the working of surface waters may affect groundwater.[97]

State practice with regard to international groundwater is an important element in determining the juridical regime, because it could provide the basis for developing general or particular customary rules.

International organizations have in turn, adopted a series of recommendations that consider groundwater as an integral part of the hydrological cycle, for example, the Declaration of Policy On the Rational Use of Water, ECE 1984.

Furthermore, the ILA adopted similar resolutions. These recognize the reciprocal influence between water and other natural resources.

In addition, several international treaties and numerous resolutions have made recommendations to international organizations and scientific bodies to further consider surface water and groundwater as forming part of the same cycle.[98]

1. *Particular cases in international groundwater law*

International groundwater law and treaty practice are still young.[99] There are only a few treaties and agreements that contain provisions dealing with groundwater at various multinational levels, namely, continent, region and catchment basin and bilateral levels. Furthermore, there has been no international ruling on groundwater to date. However work is being carried out by international bodies, namely, the ILA. It has produced some useful legal instruments, including the Helsinki Rules and the Seoul Rules.

There are certain cases where shared aquifers are subject to conventional juridical regimes by the States in whose territory they occur. Some treaties provide for a joint-use regime, others for a special regime.

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[97] Ibid.

[98] Ibid.

[99] L. Teclaff and A. E. Utton, *International Groundwater Law* (London-Rome-New York, 1981).

In international law it is necessary to distinguish between cases in which two States exercise joint sovereignty over a given territory and where two States exercise joint sovereignty only over its use or exploitation. The former situation is generally referred to as a *condominium*, the second as an international joint use.

In border treaties since the eighteenth century, it is possible to find provisions dealing with groundwater situated along boundary lines. To facilitate the use of such water by neighbouring populations, it is usually agreed that the boundary line should pass through a spring or a fountain and that the two bordering States could use the water in common.

One example of this situation was the Notes Exchanged between Great Britain and France agreeing to the ratification of the Protocol defining the boundary between French Equatorial Africa and the Anglo-Egyptian Sudan together with the Protocol, London, 21 January 1924.[100] It permitted the boundary line to pass through several wells. These wells were declared to be of common use for the riparian tribes inhabiting either side of that line. Another example is the Agreement between the Governments of Great Britain and France with regard to the Somali Coast, London, 2 and 9 February 1888. This established the right of inhabitants across the borders of the Somaliland protectorates to access dugwells across border lines.[101]

In each example, the international boundary, therefore, is a clearly determined line, despite the fact that a water resource is under joint use. The *condominium* scenario does not necessarily apply in this case, because community refers only to the use and development of groundwater. However, each State continues to exercise jurisdiction within its borders for all other purposes. In case the aquifer dries up, the joint use would cease and the frontier line alone would continue to be enforceable.

2. *Contributions by various international organizations to the evolution of international groundwater law*

The evolution of international law on groundwater has lagged behind the evolution of international law on surface water, for the reasons illustrated above. However, this is mainly because of the failure of legal scholars to acknowledge the surface water/groundwater interrelationship.

Historically, national laws have provided for absolute ownership of groundwater. Moreover, many of the efforts to modify this attitude have largely remained on a national level, namely, by declaring the resource a public property. On an international level, groundwater aquifers have been considered sovereign resources and therefore, the use of international law to limit a State's sovereignty over shared aquifers was not warranted. One reason for this scenario is that decision-makers often find it difficult to recognize the inseparable relationship between surface and groundwater. The root of the problem, however, appears to lie in the nature of the development of the modern legal system. This can be viewed as a reactionary process to individual situations rather than a proactive process to prevent predicaments.

In recent decades, the sharing of groundwater resources has received the attention of the international community. Therefore, efforts to remedy the mishandling of groundwater in international law and integrate shared international groundwater aquifers into international water law are very recent. These efforts have resulted in comparatively rapid advances in groundwater law.

The reforms are the result of the work of international organizations responsible for the codification of international customary law pertaining to shared international waters. Most noteworthy of these organizations are the ILA and the ILC, whose works are summarized below.

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[100] United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), No. 25, p. 125.

[101] United Nations, *Legislative Texts and Treaty Provisions Concerning the Utilization of International Rivers for Other Purposes than Navigation*, United Nations Legislative Series (ST/LEG/SER.B/12) (United Nations publication, sales No. 63.V.4), No. 16, p. 118.

(a) *Work of the ILA*

From the early 1950s, international controversies over water have affected most regions of the world and prompted international bodies, namely, the ILA, to study the law applicable to these disputes. The work of the ILA began in 1954 and with the exception of seven years, continues to this day.

One of the earliest explicit recognitions of the interrelationship of surface and groundwater was in a statement of principles at the forty-eight Conference of the ILA in 1958. This provided that while international law heretofore focused predominantly on surface water sources, it would be essential to give due regard to all the interdependent hydrological features of a drainage basin.

In 1966, the early work of the ILA culminated in the Helsinki Rules on the Uses of International Waters of International Rivers (see annex V for full text). These represented one of the earliest attempts to codify customary international law pertaining to shared international water resources.

Significantly, article II of these rules defines an international drainage basin, as a transboundary geographic area defined by the extent of the watershed, "including surface and groundwater."

The overarching general principle of the work of the ILA on international water law is contained in article IV of the Helsinki Rules which provides that the principle of equitable utilization governs the use of the waters of international drainage basins, including groundwater.

The Helsinki Rules have played an important role in the codification and progressive development of this branch of international law. States' refer to these guidelines to date and some have recommended that elements of the Helsinki Rules be included in the United Nations' framework convention on watercourses.

In 1986, the ILA adopted the Seoul Rules on International Groundwaters (see box 3). These expand the Helsinki Rules because they relate to shared international groundwater resources. The ILA felt that the topic was ready for restatement, that is, unofficial codification. Paragraph 3 of article 2 provides that States of a drainage basin must consider the interdependence of "groundwater and other waters, including any interconnections between aquifers...." The inclusion of groundwater in the definition of a drainage basin, and the obligation to give due regard to international groundwater resources, affirms the premise that groundwater is subject to contemporary international water law.

Box 3. The Seoul Rules on International Groundwaters

(Adopted by the ILA at the sixty-second Conference held at Seoul in 1986)

Article I: The waters of international aquifers

"The waters of an aquifer that is intersected by the boundary between two or more States are international groundwaters if such an aquifer with its waters forms an international basin or part thereof. Those states are basin States within the meaning of the Helsinki Rules whether or not the aquifer and its waters form surface waters part of a hydraulic system flowing into a common terminus.

Article II: Hydraulic interdependence

1. "An aquifer that contributes water to, or receives water from, surface waters of an international basin constitutes part of an international basin for the purposes of the Helsinki Rules.

2. "An aquifer intersected by the boundary between two or more States that does not contribute water to, or receive water from, surface waters of an international drainage basin constitutes an international drainage basin for the purposes of the Helsinki Rules.

3. "Basin states, in exercising their rights and performing their duties under international law, shall take into account any interdependence of the groundwater and other waters including any interconnections between aquifers, and any leaching into aquifers caused by activities and areas under their jurisdiction.

Box 3 (*continued*)

Article III: Protection of groundwater

1. "Basin states shall prevent or abate the pollution of international groundwaters in accordance with international law applicable to existing, new, increased and highly dangerous pollution. Special consideration shall be given to the long-term effects of the pollution of groundwater.

2. "Basin states shall consult and exchange relevant available information and data at the request of any one of them: (a) for the purpose of preserving the groundwaters of the basin from degradation and protecting from impairment the geologic structure of the aquifers, including recharge areas; (b) for the purpose of considering joint or parallel quality standards and environmental protection measures applicable to international groundwaters and their aquifers.

3. "Basin states shall cooperate, at the request of any one of them, for the purpose of collecting and analyzing additional information and data pertinent to the international groundwaters or their aquifers.

Article IV: Groundwater management and surface waters

"Basin states should consider the integrated management, including conjunctive use with surface waters, of their international groundwaters at the request of any one of them."

(b) *Work of the ILC*

As stated above, this United Nations body was entrusted with the drafting of the United Nations Convention on the Non-Navigational Uses of International Watercourses. It prepared the Draft Articles of the Convention and a Draft Resolution on Confined Transboundary Groundwater. This lays down guidelines and general principles regarding these resources.

The Convention acknowledges the surface water- groundwater inter-relationship when it defines, in article 2, "watercourses," as "a system of surface and groundwaters constituting by virtue of their physical relationship a unitary whole . . . ." In recognizing that the two sources of water constitute a part of a unitary whole the ILC acknowledged the fact that groundwater is governed by international water law. Moreover, as the Convention articles are based on State practice, existing international agreements and other potential sources, they are regarded as obligatory and operative insofar as they codify current customary international law. However, the above definition of a watercourse creates some problems as to its applicability to groundwater. Several legal scholars have pointed out that the Convention applies only to non-confined aquifers.

The Resolution on Confined Transboundary Groundwater resolution lays down guidelines and general principles regarding the confined transboundary aquifers. The text of the draft resolution is as follows:

"The International law Commission,

"Having completed its consideration of the topic "The law of the non-navigational uses of international watercourses,

"Having considered in that context groundwater which is related to an international watercourse,

"Recognizing that confined groundwater, that is groundwater not related to an international watercourse, is also a natural resource of vital importance for sustaining life, health and the integrity of ecosystems,

"Recognizing also the need for continuing efforts to elaborate rules pertaining to confined transboundary groundwater,

"Considering its view that the principles contained in its draft articles on the law of non-navigational uses of international watercourses may be applied to transboundary confined groundwater,

(i) "Commends States to be guided by the principles contained in the draft articles on the law of non-navigational uses of international watercourses, where appropriate, in regulating transboundary groundwater;

(ii) "Recommends States to consider entering into agreements with the other State or States in which the confined transboundary groundwater is located;

(iii) "Recommends also that, in the event of any dispute involving transboundary confined groundwater, the States concerned should consider resolving such dispute in accordance with the provisions contained in article 33 of the draft articles, or in such other manner as may be agreed upon".

(c) *The Bellagio Draft Treaty, 1989*

In view of the lack of both legal and institutional arrangements in most cases, and the weakness of the existing institutions dealing with international aquifers, the need for a model or blueprint treaty became apparent. The Bellagio Draft Treaty was developed in response to this need. Specifically, it was developed for the following purposes:

(a) To be used as a blueprint for treaties regulating international groundwater resources;
(b) To facilitate cooperation;
(c) To achieve optimum utilization of the resource.

The Bellagio Draft Treaty was crafted by a multidisciplinary group of specialists who worked on it for eight years. It provides mechanisms for international aquifers to be managed by mutual agreement. The Treaty addresses contamination, depletion, drought and transboundary transfers in addition to withdrawal and recharge issues. The fundamental goal was to achieve joint, optimum utilization and the avoidance or resolution of disputes over shared groundwaters in a time of ever-increasing pressure upon this resource.

The Bellagio Draft Treaty is yet another example of an international instrument that considers groundwater within the unitary whole of the hydrologic cycle.

The preamble to the Draft Treaty provides that the joint use of surface and groundwater resources is the foremost means of achieving rational and efficient water use while simultaneously safeguarding those resources for the future. The Treaty created a theoretical commission and empowered it to declare shared conservation areas, protect water quality and establish comprehensive management plans for the rational use of waters in the shared area.

However, the Bellagio Draft Treaty has not yet been adopted as an actual treaty, perhaps because it would significantly threaten the autonomy of nations sharing groundwater. In addition, it is not clear that the commission established by the treaty could effectively address the vast array of issues presented by various groundwater disputes.[102]

(d) *Work of other international organizations*

Many other international organizations have recognized the surface water-groundwater interrelationship in addition to the need to follow an integrated approach when dealing with international watercourse systems, in their work.

[102] For more information on this subject, see: http://www.law.berkeley.edu/faculty/ddcaron/courses/icl/ie01005.htm.

The European Economic Community (EEC) has issued several directives that have acknowledged that groundwater is subject to international water law. Directive 80/778, EEC, 15 July 1980, Related to with the Quality of Water Intended for Human Consumption, states in article 2 that water intended for human consumption,.... Is any water used for that purpose, regardless of its origin.[103]

3. *Limitations and issues pertaining to the applicability of the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses with regard to shared groundwater aquifers*

Recent legal works such as the Bellagio Draft Treaty and the Seoul Rules, the ECE Charter on Groundwater Management indicate a growing recognition of the applicability of international law to groundwater resources, equally and without distinction. This application is founded on the indissociable nature of, and the interdependency between, the two water resources. That is to say, that they cannot be utilized or protected adequately or efficiently unless they are considered simultaneously under the same rubric of management and law. In this regard, legal scholars commonly refer to three principles of international water law that they consider equally applicable to shared ground and surface water resources. These are the equitable and rational use, the not to cause significant harm and the prior notification principles.

However, there are more difficulties applying these principles to groundwater aquifers than applying them to surface water. Some of the difficulty lies in the complexity of delineating subsurface extensions and the hydrogeologic properties of aquifers to enable assessment of storage, allocations, and optimal pumping plans. Other difficulties arise when interconnections between surface and groundwaters are considered, as detailed below.

A close examination of the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses reveals that its provisions promote a partial governance of water resources, by separating surface from groundwater resources. This is especially apparent in articles 1 and 2.

While article 1 limits application of the Convention only to "international watercourses," article 2 defines a "watercourse" as "a system of surface waters and groundwaters constituting by virtue of their physical relationship a unitary whole and normally flowing to a common terminus." Although this definition appears innocuous, it is important to point out what is not included in the definition.

Firstly, the definition excludes water resources which are related but do not "flow to a common terminus." Thus, for instance, water infiltrating from a stream to an underlying aquifer may, because of certain hydrogeologic characteristics, end up flowing towards different termini than the stream water. Under this condition, a use or management scheme which is developed for the stream would not be bound under the Convention to take into account concerns of those whose groundwater interests might be affected, quantity or quality-wise, by the scheme. Since almost every country in the world shares a groundwater aquifer with one or more countries, such a situation is extremely disturbing.

Secondly, and consequent to the first point, the definition excludes water resources that are indirectly related. Namely, a third water resource directly related to the above mentioned aquifer but not to the stream would likewise be indirectly related to the stream. Thus, any use or management scheme developed for the stream would not have to consider the effects on the indirectly related water resources. Again, this implicates the potential for disputes between States over the impacts of the scheme on water quality and quantity.

Finally, the Convention excludes watercourse aquifers unrelated to surface water. In the context of hydrologic reality, this limitation ignores regions where surface water is sparse or nonexistent, namely, arid and desert environments in which groundwater aquifers often traverse international boundaries.

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[103] Original provided in French: "Au sens de la présente directive on entend par eaux destinées à la consommation humaine toutes les eaux utilisées à cette fin, soit en l'état, soit après traitement, de quelque origine qu'elles soient".

This complex and narrow definition of a watercourse has caused misunderstandings and misuse of hydrogeologic terminology. The first such misuse occurred at the ILC, which drafted the Convention, when it defined groundwater that is not related to surface water, as water in confined aquifers. Hydro-geologically, confined aquifers can be, and often are, related to surface water. Therefore, this misuse of terminology has caused an unwarranted exclusion of confined aquifers by the Convention.

The ramifications of the misuse of terminology are twofold:

(a) Firstly, it could lead States to embark on strategies designed to use, regulate, or manage a particular water resource without regard to the consequences of such an action on related but excluded water resources;

(b) Secondly, it could permit the possibility that related water resources will be used or regulated under different systems that assert diversified and perhaps conflicting objectives.

For instance, an aquifer that has proved to be unrelated to any surface water resource in the region (and receives only negligible recharge through occasional rains and rare flash floods) will not comply to the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses' definition of an international watercourse. Thus, as long as an aquifer neither forms part of a "system of surface and groundwaters constituting ... a unitary whole" nor flows to a "common terminus" with any other surface water, then any exploitation or management scheme of this aquifer by one or more of the nations sharing it would be exempt from abiding by the principles of the Convention, regardless of the potential or actual consequences to the quality or quantity of the water in the aquifer.

VI. THE NEED FOR ENHANCED COOPERATION REGARDING SHARED WATER RESOURCES IN THE ESCWA REGION: THE CASE FOR GROUNDWATER COOPERATION

ESCWA countries seek enhanced cooperation regarding shared water sources (in general) and groundwater (in particular) largely because of the growing water deficit in the region. This situation makes it inevitable that those countries with significant groundwater reserves stored in deep-shared aquifers will increase their extractions from these sources.

In recent decades, the increased water stresses in many countries have magnified the need for cooperation regarding the protection of shared river and aquifer resources.

Furthermore, there is now a wider recognition of the fact that cooperation will protect and sustain the use of shared water resources. Evidence of this change of opinion is evident in the greater United Nations role in this regard, and in the many cooperation agreements that have been established with the assistance of various regional and international organizations. Examples can be drawn from the recent United Nations Convention on the Law of the Non-Navigational Uses on International Watercourses and from the EEC's charters on water quality protection and on groundwater management.

A mechanism for cooperation is vital for the ESCWA region. A suitable institutional framework to develop and promote such a mechanism among member States is the Committee on Water Resources. This was established by ESCWA, resolution 205 (XVIII) 25 May 1995.[104]

A. THE MOTIVATION FOR COOPERATION IN THE ESCWA REGION

Current recharge of most shared shallow and deep aquifers in the region is much less than extraction. Therefore, most shared aquifers will essentially become overused. Without agreed allocation of the resource, it is possible that States will become competitive in this regard. This will adversely affect the aquifer and can have a variety of political, socio-economic and environmental consequences.

To reduce potential adverse impacts and to avoid and manage future disputes, States must discuss mechanisms to jointly utilize and manage their shared resources.

1. *Political drives*

The main political drive for initiating cooperation regarding shared aquifers is to avert disputes by eliminating or reducing potential tension over shared groundwater. In addition, water cooperation can lead to broader economic cooperation among countries.

Indeed, groundwater, like surface water, has no political boundaries. The fact that it is possible for an aquifer system to lie beneath a vast territory within the jurisdictions of several States, with discharge and recharge areas in differing jurisdictions, invites conflicts of interest on various levels, whether between States, municipalities or a city and its nearby rural communities. On an international level, the need to avert potential disputes over such an aquifer is in the interest of all those concerned. The alternative would be the uncontrolled exploitation of the aquifer by riparian States. However, this could build tension and lead to irreversible damage of the aquifer, in addition to having an adverse impact on the economies and relationships between sharing States. Moreover, avoidance or ignorance of the issue would neither make the problem disappear nor serve the good management of the resource.

In the ESCWA region, the increasing demand for water is often met by shared systems. This means that the potential for disputes in the region is quite high. In fact, a number of cases at various bilateral, multilateral levels and even local levels, namely, city versus semi-urban regions, already exist.

In any case, if a framework for cooperation regarding shared groundwater resources is developed for the region, it must provide guidelines for dispute management.

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[104] ESCWA, "Report of the eighteenth session" (E/ESCWA/1995/84) (E/ESCWA/18/97).

2. *Socio-economic motivation*

Water plays an important role in socio-economic development. This role is even more vital in the ESCWA region where there is a growing demand for water, increasing water scarcity and ambitious socio-economic development plans.

In essence, States must enter into legal arrangements to strengthen their cooperation regarding the utilization and management of shared aquifers. They must be motivated or driven by the desire to achieve certain socio-economic gains. The most important gains can be identified as follows:

(a) *Meeting growing demand*

As pointed out earlier, the water deficit in the ESCWA region is expected to grow to some 69 bm^3 by 2025. Since the potential for augmenting surface water supplies is generally limited, in addition to being strongly vulnerable to external influences, it is likely that increased mining of fossil groundwater will take place in many member States. This is already happening in many States. It is therefore, in the interest of sharing States to enter into proper legal arrangements to facilitate equitable exploitation of their shared aquifers.

Competition for a shared aquifer without a joint management plan could lead to damaging mining of the aquifer. In addition, mining of the aquifer will deprive future generations of their right to this water. However, joint management will facilitate a certain degree of resource sustainability.

(b) *Protecting the interests of sharing States*

Without cooperation, uncontrolled exploitation of a shared aquifer is likely to damage the medium and long-term economic and social interests of those States that are not tapping the resource or utilizing it as extensively as other States. In either case, this condition means that some sharing States will be deprived of their right to an equitable share of the resource. This could lead to increased tension between concerned States.

Ideally, a framework for cooperation would contribute to safeguarding the interests of all sharing States.

(c) *Creating opportunities for broader economic cooperation*

Water cooperation can create opportunities for broader economic cooperation. This is especially true when shared aquifers are developed in heavily populated border areas and where water is used for economic activities that have the potential to generate economic benefits for other sharing States. Furthermore, if opportunities for water-related mutual benefits are identified and pursued, they could reinforce dialogue over the primary cooperation area of water and beyond.

A framework for cooperation must include appropriate arrangements for encouraging water-related economic activities, for cost-sharing arrangements and for other aspects of broader economic activity.

3. *Environmental motivation*

The environmental motivation for elaborating a cooperation mechanism to utilize and manage shared aquifers essentially stems from the adverse environmental impact of competitive pumping. Competitive pumping can lead to water quality deterioration, excessive lowering of water levels and damage to related ecological systems. In many situations, these adverse impacts (or externalities) could make it impossible for individual States to apply appropriate plans for resource use and management unless they cooperate with other States to establish equitable and reasonable allocation and management of the shared resource. Specifically, the following environmental motivations for enhanced cooperation can be identified:

(a) *Resource conservation.* A shared aquifer that is utilized without user coordination can easily be abused by overexploitation or quality degradation. If restraint and proper management of such an aquifer is to be achieved, cooperation is vital.

Uncontrolled competitive pumping or mining of shared aquifers harms all parties involved by causing costly lowering of the piezometric/water table levels and possible water quality degradation, if and when changing gradients induce inter-flow of low quality water.

All parties could suffer from aquifer mining, not just downstream riparians. Indeed, unlike shared rivers where the upstream riparian State often has full and permanent leverage over downstream States, the leverage of an upstream State in a shared aquifers is often limited. It is usually largely dependent on field hydro-dynamic conditions, particularly when the regional hydraulic gradients are small and easy to manipulate and reverse. Firstly, this leverage is limited because an upstream State in a shared aquifer cannot completely cut off the flow to a downstream State. Secondly, the leverage depends on field conditions. An upstream State can find itself on the defensive when excessive pumping from the aquifer reverses the hydraulic gradient and induces flow of polluted water from a downstream State.

This vulnerability of both upstream and downstream States provides yet another strong motive for sharing States to cooperate. Cooperation and an integrated approach towards the management of shared resources will enable States to conserve and manage these resources effectively.

(b) *Enhanced resource planning and management.* Cooperation contributes to improved planning and management of a shared resource. Delineation of the scale of groundwater development through agreement would eliminate uncertainty in the planning process. The objective is to avoid resource abuse, as this would be detrimental to both the economy and the environment, and to maximize the benefits for all parties involved. The prerequisite for this is good bilateral or multilateral relations.

The framework for cooperation regarding shared water resources must incorporate arrangements to share the substantial investments required to monitor, conserve and manage resources effectively and efficiently. Owing to the fact that management involves substantial investment of resources, States must recognize the long-term economic and environmental benefits of management and absorb the short-term costs.

Enhanced cooperation will ensure the following:

(i) The avoidance of potential disputes;

(ii) The satisfaction of growing water demands and the protection of the water rights of parties involved;

(iii) The creation of new opportunities for broader socio-economic cooperation;

(iv) The conservation of water and the reduction of adverse mutual impacts;

(v) The reduction of uncertainty regarding the planning of socio-economic activities that depend on the shared aquifer;

(vi) The improvement of the management of the resource and hence sustainability of the economic growth.

B. CONSTRAINTS OR DIFFICULTIES HINDERING COOPERATION: A THEORETICAL FRAMEWORK

The difficulties of developing cooperation on the issue of shared rivers are small compared to those relating to shared aquifers. One reason for this factor is the occurrence of groundwater in the subsurface. This makes it more difficult to quantify. In general, these difficulties may be divided into technical, political, legal and institutional categories.

1. *Technical difficulties*

Technical data are essential to develop an equitable allocation and use regime for a shared aquifer. Data are needed to estimate the volume of water in the aquifer, plan the extraction scheme, make allocations,

design well fields and manage the aquifer. More specifically, the requirement here is a thorough understanding of the aquifer's hydrogeology, its subsurface extensions, the direction and velocity of water flow, the storage volumes on both sides, the zones and quantities of recharge, the quality variations, the hydrogeologic properties and the long-term impact of abstractions across borders.

Technical difficulties are inherent in the assessment and harmonization of the above parameters. Water professionals on both sides often possess data that contradicts their respective arguments.

2. *Political difficulties*

Cooperation requires good political relations among sharing States. Strained relations hinder water cooperation. However, it could also be argued that continuing water shortages will encourage dialogue and help restore relations, especially because water scarcity is becoming an important issue on the agendas of most politicians in the region. The need to secure water supplies and maximize benefits from shared aquifers will facilitate the construction of required legal cooperation arrangements.

There is another related problem. This is a lack of political will and understanding on behalf of decision makers and the judicial community regarding the seriousness of the various legal, social, economic and scientific issues related to water resources and the need for enhanced management and enhanced cooperation on shared water resources. Adequate understanding will help to develop policies and laws that effectively address modern water problems. To educate those concerned, the technical and scientific community must become more involved in the political, legislative and judicial process. This integrated approach is vital. It will enable States to use, manage and protect their shared resources efficiently and effectively, for present needs and for future generations.

3. *Legal difficulties*

Legal difficulties occur on international and national levels. Internationally, States have traditionally considered groundwater as a sovereign resource. Laws emphasize the sovereign right of a State to exercise control over its own resources. Hence, the international legal regime for the management of shared aquifers is, relatively, much less developed or clearly defined than that for shared surface water resources. There is, however, an increasing recognition of the need for groundwater protection on an international level. However, the law is not yet capable of controlling the exploitation of shared aquifers. There is no internationally accepted legal framework for the exploitation of shared aquifers. However, the Bellagio Treaty could be considered a useful blueprint or starting point in this regard.

On a national level, the difficulty lies in the fact that the law has provided for absolute ownership of groundwater. In many member countries, there are still provisions which consider groundwater to be part of the land or a commodity, susceptible to ownership by the act of capturing it, namely, by sinking a well. Recognition of the international dimension of this resource will occur when this approach is modified.

Furthermore, politicians and legislators must consider the development of a required legal regime to be an anticipated need rather than a manifested one. Indeed, according to some legal scholars, the creation or progressive development of law comes only as a direct reactionary response to the changing needs of a society.[105] In essence, therefore, the call for a framework agreement on shared aquifers in the region might not receive the required response from decision-makers unless there is a manifested need.

4. *Institutional difficulties*

Management of water resources on a regional level requires strong water institutions on a national level, in addition to coherent sector objectives and policies. Weak national institutions would hinder the implementation of joint management plans for shared aquifers.

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[105] G. Eckstein, "Application of international water law to transboundary groundwater resources, and the Slovak-Hungarian dispute over Gabcikovo-Nagymaros", *Suffolk Transnational Law Review* (Winter 1995), vol. 19, p. 67.

The principle institutional difficulty with respect to shared aquifers is the weakness of the water management institutions on a national level. Often, the organization and division of the technical, institutional, managerial, legal and operational activities and responsibilities of water resources management among the many key players in the sector in a given country, are not clear. In the ESCWA region, the issue of water is often spread across many governmental and non-governmental bodies with little or no coordination. Therefore, the development of water resources is often the result of fragmented sectoral plans rather than coordinated multisectoral and integrated water plans. Another prominent issue, that could have an impact on the capacity of national institutions to jointly manage a shared aquifer, is the weak enforcement capacity of regulatory policy on water legislation.

C. BASIS AND REQUIREMENTS FOR ENHANCED COOPERATION IN THE ESCWA REGION

1. *Basis for enhanced cooperation*

When no agreement exists to govern the relations of States sharing an international watercourse or basin, the basis for cooperation must be founded on internationally accepted legal norms. Three key principles of international law limit a state's sovereignty with respect to the development of shared aquifers. These are as follows:

(a) States are entitled to "a reasonable and equitable share of the beneficial uses of the waters";

(b) States are obligated not to cause each other substantial injury regarding water quantity or quality;

(c) States have a duty to inform, consult and participate in negotiations with each other regarding development plans and projects affecting shared water resources.

Any legal arrangement to augment and enhance cooperation among ESCWA member States regarding shared aquifers must be founded on these three principles.

2. *Requirements for enhanced cooperation*

A necessary condition for enhanced cooperation among ESCWA member countries regarding shared aquifers is to create a cooperation mechanism. This could be steered by the ESCWA Secretariat through the Committee on Water Resources. It is envisaged that the process of developing such a mechanism comprises two phases: a short development phase and a long implementation phase (see table 8).

Phase I (mechanism development phase) entails the drafting of a Framework for Enhanced Groundwater Cooperation. This would comprise the following basic components:

(a) A Charter on Management of Groundwater. This would define the guiding principles upon which cooperation on groundwater management in the region is to be founded. It will reinforce the concepts, objectives and scope of cooperation, basis, namely, legal principles and other basic aspects of cooperation and management;

Member States could draw upon the Charter on Groundwater Management to develop or refine their own national policies on shared groundwater utilization and management and ultimately, contribute to the development of the Draft Agreement.;

(b) A Draft Agreement similar to the Bellagio Draft Treaty. This would define the technical, financial, institutional and other arrangements for co-management of a shared aquifer. It would address issues related to the aquifer co-management process including, water division, aquifer monitoring, data exchange arrangements and cost sharing;

This agreement would serve as a blueprint for bilateral or multilateral agreements on the co-management of shared aquifers. However, it would have to incorporate special features of the groundwater regime in the region, namely, non-perennial wadi flow;

(c) A Draft Action Plan and discussion of the financial requirements for the Phase II (implementation phase). At this stage the Charter and Agreement would be further refined and pilot projects would be developed.

None of the above documents would be binding to ESCWA member States. Their purpose would be to assist member States in their bi- or multilateral negotiations on shared groundwater co-management issues.

Phase II, the implementation phase, comprises the following stages:

(a) Pilot project identification. This would assist member States to further develop or refine strategies for shared aquifers and identify possible pilot projects;

(b) Pilot project development. At this stage, ESCWA would facilitate discussions regarding the pilot project and provide assistance in the development of project scope, adopting the Draft Agreement to the project needs and the development of a project document for joint aquifer Management;

(c) Pilot project implementation. This would entail the actual implementation of co-management agreements for the pilot aquifer(s). Once pilot project documents have been developed, donors would be pooled for support regarding implementation. Progress would be monitored and evaluated.

During this phase, developed cooperation instruments will be put to practical test through implementation. Monitoring and evaluation would be ongoing. The scope of activities in phase II depends on the number of member States that actively participate in phase I.

In both phases, ESCWA will provide expertise and support to member States to enhance their interaction with the framework development process and achieve their goals of cooperation.

TABLE 8. ENVISAGED REQUIREMENTS AND APPROACH TO DEVELOP A COOPERATION MECHANISM REGARDING SHARED AQUIFERS IN THE ESCWA REGION

Activity		Action plan			
		Target	By	To be implemented by	Venue for implementation
Phase I: Mechanism Development Phase					
Legal regime component	Legal instrument				
Charter on GW[a] Management (Highlights the objectives, guiding principles and other basis for integrated GW management)	Groundwater Charter	Charter, agreement and action plan are ratified by a sufficient number of MS[b]	End of 2001	ESCWA/FP	CWR[e]
Draft Agreement (Blue-print for bi- or multilateral agreements on shared aquifers)	Draft Agreement		End of 2002	ESCWA/FP	CWR
Action Plan (Step by step plan for implementation of Phase II, along with financial estimates)	Action Plan		End of 2002	ESCWA/FP	MS/CWR
Phase II: Implementation Phase					
Project identification	Strategies, possible project lists	At least two projects identified	End of 2003	MS/ CWR	MS/CWR
Project development	Project document	At least one project document is prepared	End of 2004	MS/CWR	MS/CWR
Project implementation	Project reports, M&E[d] reports	At least one project is under implementation	End of 2005	MS/CWR	MS/ESCWA/ Donor(s)

a/ Groundwater.
b/ Member State.
c/ Focal Point.
d/ Monitoring and evaluation.
e/ Committee on Water Resources.

Accomplishing the above scheme would require essential inputs from numerous entities. In addition, some pre-conditions which would have to be met. These include the following:

(a) *Institutional reforms*

The international dimension of shared water resources must be recognized to enable the building of strong national institutions to achieve sustainable use of shared aquifers. States need to cooperate in creating strong institutions that will be empowered to regulate water use and that can proactively manage use and resolve disputes before crises develop.

Currently, the general principles of international law often govern groundwater disputes by default. However, the adjudication of these disputes does not effectively address underlying problems. Groundwater disputes involve complicated scientific issues that judges may not be qualified to resolve. Moreover, adjudication creates an adversarial relationship which prevents future cooperation between the States involved.

The legal regime must provide an institution with the power to conduct scientific research, implement and construct water conservation projects, apportion and regulate the use of the groundwater and adjudicate international groundwater disputes free of diplomatic constraints. While granting these powers to an institution might threaten the autonomy of the subject States, this would benefit the economy and the environment of those States. Disputes would no longer be resolved on a case-by-case basis and sustainable use would be ensured.

Indeed, there are many examples of the transfer of sovereign powers from sharing States to a joint basin management authority within the international community, namely, the Senegal River. Furthermore, the region has sound experience in establishing institutional arrangements for the development of another important natural resource, namely, oil. In this regard, two types of arrangements are recognized in this sector, namely, the creation of so called neutral zones and the straight concessions under what is called Production Sharing Agreements. It is worthwhile to investigate the legal feasibility of drawing upon these arrangements to develop appropriate arrangements for the deveshared aquifers.

(b) *Legal reforms*

Where shared international water management and protection schemes are contemplated, an integrated approach must be undertaken. This requires cooperative efforts and communication among co-riparians based upon the principles previously discussed. Furthermore, it requires legislative reforms of national water laws, to recognize shared international aquifers and to enable the establishment of appropriate mechanisms for the management of these resources.

VII. APPROACHES AND METHODOLOGIES FOR MANAGING SHARED WATER RESOURCES

A number of ESCWA member States face the challenge of meeting increasing water demands in all sectors. While some countries have adequate water supplies for short-term requirements, others have limited resources. Furthermore, some countries have limited options for developing additional if they are to avoid heavy reliance on groundwater mining and the use of non-conventional desalination and treatment facilities that require substantial financial and technological investment.

Water problems in the ESCWA region are diverse. Furthermore, they are evolving as the gap between supply and demand widens. Water issues are linked to scarcity and to distribution. It follows that drilling an increasing number of wells, building more dams or desalinating more seawater will not meet this growing demand. A new approach to the management of water resources is vital. Indeed, wider cooperation among riparian States and even among groups within nation States, is necessary.

Therefore, the development and management of regional water resources in the ESCWA region presents a challenge for water managers and experts. There is a clear need for a conceptual framework or a methodology to manage shared water resources. Two case studies are reviewed in this chapter. They examine the opportunities for cooperation regarding the management of shared water resources.

A. General considerations

Water is the critical component for sustainable development in the ESCWA region. Therefore, this section examines long-term scenarios and trends and suggests development priorities.

Given the limited amount of renewable fresh water resources and a continued increase in water demand, the question of future planning regarding water is vital. Long-term planning must be given more serious consideration.

To combat the steady decrease in per capita availability of fresh water in the ESCWA region, several post-2000 scenarios have been proposed and are currently under discussion. However, no scheme has yet been adopted.

Based on experience and constraints, the following three scenarios estimate water supply and demand up to 2025.[106]

(a) "Business as usual": this represents the worst case scenario;[107]

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[106] All scenarios are based on W. Al-Zubari, "Water vision for the Arab countries of Western Asia: alternative water policies", a paper prepared for the Expert Group Meeting on Harmonization of Environmental Standards in the Water Sector of ESCWA Member States, Beirut, 28 September to 1 October 1999 (E/ESCWA/ENR/1999/WG.2/12).

All scenarios are quantitative and do not take into account the impact of groundwater overdraft on the quality of groundwater withdrawn. These scenarios assume that withdrawing water will lead to an inevitable deterioration of water quality and a reduction of groundwater, in addition to the salinization of agricultural lands.

[107] Justifications for consideration of (a) are as follows: West Asia is an arid region. A total of 80 per cent of its land is classified as desert or semi-desert; most of its promising water sources have been developed and untapped sources require heavy investment, intensive investigations and research programmes; the potential conflicts concerning shared water resources (these constitute a sizeable magnitude of the total resources) requires lengthy and difficult negotiations before equitable reconciliation is attainable. This has resulted in the postponement of many water development schemes. Furthermore, many of the countries of West Asia have experienced regional wars and disputes. These have drastically affected the economy of the region and have upset the socio-economic development plans of all ESCWA members, resulting in the postponement of many water development schemes.

Scenario (a) takes into account the following: 1997 United Nations population projections; no further development of water ressources; total water demand estimated based on the criteria given in box 4; secure domestic and industrial water uses as first priority; maximum food self sufficiency policies; improving agricultural productivity per unit of water to achieve 20 per cent saving in agricultural water demand by 2025; settlement of shared water resources disputes.

This scenario aims to reduce agricultural water demand by 20 per cent by 2025. It aims to achieve this by utilizing agricultural research that can maximize productivity per unit of water and by applying appropriate technologies, including biotechnology.

(b) "Supply augmentation": this combines (a) and (c);[108]
(c) "Supply augmentation and policy remedies".[109]

The results of these scenarios are shown in tables 9, 10, and 11. Proposed remedy policies are outlined in table 12. Failure to achieve the set targets of these scenarios would result in deterioration of both the quantity and quality of water supplies, increasing food deficits, deterioration of living standards, increased social unrest and possible regional conflicts. Furthermore, assumptions built into the other scenarios will delay these problems, not solve them, unless stringent measures are put into force, and policy shifts, including population policies, are strictly implemented.

(a) *"Business as usual"*

Acute water shortages in the Arabian Peninsula in the future, will result in decreased food production. The percentage of water deficit to water demand in the area will increase from -37.4 per cent in 1995 to 68.2 per cent in 2025. Total water deficit of some 40 bm^3 in 2025 is foreseen.

A positive balance of water in the Mashreq subregion up to 2015 ensures it will fare better than other regions.[110] The percentage of water balance to water demand will be reduced from +47.9 per cent in 1995 to 13.2 per cent in 2025. A water deficit of some 15 bm^3 is foreseen in 2025. The major problem in this subregion is the reconciliation of the issue of shared water resources with neighbouring countries. If early equitable resolutions are not reached, the development plans of the majority of countries will be considerably affected.

This scenario suggests that West Asia will experience a deficit from 2005. This is likely to increase to 55 bm^3 by 2025. The percentage of water balance to total demand will vary from +21.5 per cent in 1995 to— 32 per cent in 2025. These figures assume that there will be a reduction in agricultural water demand and that disputes over shared water resources will be resolved.

(b) *"Supply augmentation"*

In the context of assumed supply augmentation, water deficit in the Arabian Peninsula will be slightly reduced to 31.3 bm^3 in 2025, while the percentage deficit in the water balance to total demand will increase

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[108] Scenario (b) takes into account the following: increased surface and groundwater resources for both the Arabian Peninsula and the Mashreq subregion. This would amount to 100 million m^3 per year, with a total increase of 3 bm^3 in 2025 for each subregion; increased desalination capacity. This would reach 3.26 bm^3 per year in the Arabian Peninsula by 2025. This capacity would remain unchanged in the Mashreq subregion; increased recycled wastewater. This would amount to 5.09 bm^3 per year in the Arabian Peninsula and 3 bm^3 in the Mashreq subregion by 2025; increased irrigation water reuse. This would amount to 1.62 bm^3 in the Mashreq subregion in 2025 and would remain unchanged in the Arabian Peninsula.

Additional factors that should be taken into account with regard to this scenario include, population, water consumption rates, priority for domestic and industrial water use and policies of maximum food self-sufficiency, improvement in agricultural production research, settlement of shared water resources disputes, as in scenario (a).

Scenario (b) further takes into consideration the outcome of intensive foreseen investigations and research works in various fields for both conventional and non-conventional water sources that would eventually yield an additional 6 bm3 in conventional water resources and an additional 8.87 bm^3 in non-conventional water resources by 2025.

[109] With regard to scenario (c), extensive research, investigation, development and reform programmes would play a crucial role in developing the additional water resources foreseen in scenario (b). Furthermore, these factors would help to affect optimum rationalization of water use and minimization of water losses to gain some 24.4 bm^3 by 2025. This might be achieved through the resolutions of the major problems that impede efficient use of the limited available water resources as outlined in table 12.

Factors that should be taken into account with regard to this scenario are: further gradual, rational decrease of the consumption patterns outlined in scenarios (a) and (b) by increasing the efficiency of irrigation, reviewing the price of water, and improving wastewater management. This would result in a decrease in total water demand of the Mashreq subregion and the Arabian Peninsula of 13.7 and 10.68 bm^3, respectively, by 2025.

[110] The Mashreq subregion includes Iraq, Jordan, Lebanon, Palestine and the Syrian Arab Republic.

from 37.4 per cent in 1995 to 53.3 per cent in 2025. In contrast, there would be relatively smaller deficit in overall water resources in the Mashreq subregion. This would amount to -9 bm^3 in 2025. Furthermore, the percentage of water balance to total demand will decrease from +47.9 per cent in 1995 to a critical -7.8 per cent in 2025.

West Asia will experience a deficit of 6.1 bm^3 in 2010. This will amount to 40 bm^3 in 2025, mainly as a result of the Arabian Peninsula deficit. The percentage of water balance to the demand will drop from +21.5 per cent in 1995 to -23.3 per cent in 2025.

TABLE 9. WATER BALANCE IN WEST ASIA ACCORDING TO THE "BUSINESS AS USUAL" SCENARIO
(*Billions of cubic metres*)

Subregion/year	1995	2000	2005	2010	2015	2020	2025
Arabian Peninsula							
Available water resources	18.64	18.64	18.64	18.64	18.64	18.64	18.64
Total water demand	29.79	33.70	37.70	42.19	47.18	52.95	58.68
Water balance	-11.15	-15.06	-19.06	-23.55	-28.54	-34.30	-40.04
Water balance/demand (percentage)	-37.43	-44.68	-50.56	-55.82	-60.49	-64.79	-68.23
Mashreq							
Available water resources	98.35	98.35	98.35	98.35	98.35	98.35	98.35
Total water demand	66.50	72.95	80.06	87.69	95.74	105.00	113.26
Water balance	31.85	25.40	18.29	10.66	2.61	-6.66	-14.91
Water balance/demand (percentage)	47.9	34.82	22.84	12.16	2.73	-6.34	-13.16
West Asia							
Available water resources	116.99	116.99	116.99	116.99	116.99	116.99	116.99
Total water demand	96.29	106.65	117.76	129.88	142.92	157.95	171.93
Water balance	20.70	10.34	-0.77	-12.89	-25.93	-40.96	-54.94
Water balance/demand (percentage)	21.50	9.7	-0.66	-9.92	-18.14	-25.93	-31.96

Source: W. Al-Zubari, "Water vision for the Arab countries of Western Asia: alternative water policies", a paper prepared for the Expert Group Meeting on Harmonization of Environmental Standards in the Water Sector of ESCWA Member States, Beirut, 28 September to 1 October 1999 (E/ESCWA/ENR/1999/WG.2/12).

TABLE 10. WATER BALANCE IN WEST ASIA ACCORDING TO THE "SUPPLY AUGMENTATION" SCENARIO
(*Billions of cubic metres*)

Subregion/year	1995	2000	2005	2010	2015	2020	2025
Arabian Peninsula							
Available water resources	18.64	19.92	21.17	22.52	24.05	25.70	27.42
Total water demand	29.79	33.70	37.70	42.19	47.18	52.95	58.68
Water balance	-11.15	-13.78	-16.54	-19.67	-23.14	-27.24	-31.26
Water balance/demand (percentage)	-37.43	-40.90	-43.87	-46.62	-49.03	-51.45	-53.27
Mashreq							
Available water resources	98.35	99.10	100.16	101.23	102.30	103.37	104.45
Total water demand	66.50	72.95	80.06	87.69	95.74	105.00	113.26
Water balance	31.85	26.15	20.10	13.54	6.56	-1.64	-8.81
Water balance/demand (percentage)	47.9	35.84	25.11	15.44	6.85	-1.56	-7.78
West Asia							
Available water resources	116.99	119.01	121.32	123.75	126.34	129.07	131.87
Total water demand	96.29	106.65	117.76	129.88	142.92	157.95	171.93
Water balance	20.70	12.36	3.56	-6.13	-16.58	-28.88	-40.07
Water balance/demand (percentage)	21.50	11.59	3.02	-4.72	-11.60	-18.28	-23.30

Source: W. Al-Zubari, "Water vision for the Arab countries of Western Asia: alternative water policies", a paper prepared for the Expert Group Meeting on Harmonization of Environmental Standards in the Water Sector of ESCWA Member States, Beirut, 28 September to 1 October 1999 (E/ESCWA/ENR/1999/WG.2/12).

(c) *"Supply augmentation and policy remedies"*

Despite augmentation and policy remedies, the Arabian Peninsula will continue to experience an increasing water deficit. This was 11.2 bm^3 in 1995 and is expected to incraese to 20.6 bm^3 by 2025. The percentage of water balance to demand will, more or less, level off at some 40 per cent. However, the Mashreq subregion will continue to enjoy a surplus of water resources throughout the projection period, varying from 31.9 bm^3 in 1995 to 4.9 bm^3 in 2025. Nevertheless, the percentage of balance to water demands will decrease from 47.9 per cent in 1995 to a critical 4.9 per cent by 2025. West Asia will experience a deficit of 1.4 bm^3 in water resources in 2015. This will increase to 15.7 bm^3in 2025. The percentage of water balance to demand will gradually fall from 21.5 per cent to -10.6 per cent from 1995 to 2025 (see table 11).

This scenario would appear to be the most suitable of those considered in this study. It constitutes an appropriate base for an alternative strategy to secure sustainable development of water resources. Even so, it is clear that the Arabian Peninsula will continue to experience a deficit in its water resources if its targets of maximum food security are adhered to and its population growth rates continue as projected. In this case, it would be necessary to mine some 400 bm^3 of shallow and deep groundwater resources during the projected period. However, the usefulness of this water is questionable as a result of an expected deterioration of the quality of groundwater quality. In the Mashreq, potential conflicts over shared water resources remain a fundamental issue that require early equitable settlements.

The previously presented scenarios clearly indicate that the Mashreq subregion will have to depend on the goodwill of non-ESCWA member States.

TABLE 11. WATER BALANCE IN WEST ASIA ACCORDING TO THE "SUPPLY AUGMENTATION AND POLICY REMEDIES" SCENARIO
(Billions of cubic metres)

Subregion/year	1995	2000	2005	2010	2015	2020	2025
Arabian Peninsula							
Available water resources	18.64	19.92	21.17	22.52	24.05	25.70	27.42
Total water demand	29.79	32.10	34.45	37.20	40.38	44.25	48.00
Water balance	-11.15	-12.19	-13.28	-14.68	-16.33	-18.54	-20.57
Water balance/demand (percentage)	-37.43	-37.96	-38.56	-39.46	-40.45	-41.91	-42.87
Mashreq							
Available water resources	98.35	99.10	100.16	101.23	102.30	103.37	104.45
Total water demand	66.50	71.04	76.13	81.60	87.35	93.86	99.54
Water balance	31.85	28.05	24.03	19.63	14.94	9.51	4.90
Water balance/demand (percentage)	47.90	39.48	31.57	24.05	17.11	10.14	4.93
West Asia							
Available water resources	116.99	119.01	121.32	123.75	126.34	129.07	131.87
Total water demand	96.29	103.15	110.57	118.80	127.73	138.10	147.54
Water balance	20.70	15.86	10.75	4.95	-1.39	-9.03	-15.67
Water balance/demand (percentage)	21.50	15.38	9.72	4.16	-1.09	-6.54	-10.62

Source: W. Al-Zubari, "Water vision for the Arab countries of Western Asia: alternative water policies", a paper prepared for the Expert Group Meeting on Harmonization of Environmental Standards in the Water Sector of ESCWA Member States, Beirut, 28 September to 1 October 1999 (E/ESCWA/ENR/1999/WG.2/12).

Box 4. Criteria for the assessment of the water demand in west Asia

(a) The development of water demand for sectoral users, namely, agriculture, domestic and industry, depends on the normal growth rate of the population in West Asian countries. This currently stands at 3 to 4 per cent. It is possible to use the medium variant scenario as used in United Nations, *World Population Prospects, The 1994 Revision,* New York, 1995 (UN ST/ESA/SER.A/15);

(b) The figure for the 1990 population was used as the base year for projections for 1995-2025;

(c) The rates of domestic and industrial water consumption (see table B) are taken from national reports for 1995. The proposed increases in water consumption rates are based on estimates of the general availability of water, the status and trends in urbanisation, the predicted rates of industrial development, and anticipated agro-industrial developments and other social development targets.

Estimated rates of agricultural water demand are based on 1995 national reports shown below (see table C). Increases are based on population growth. A gradual reduction of water for agricultural demand starting from 2000 to reach 20 per cent is foreseen by 2025 as a result of an anticipated improvement in agricultural production research, in the fields of genetic engineering including plant salt tolerance, tissue culture and particularly through savings in consumptive use.

TABLE. ASSESSMENT OF WATER DEMAND

Country/territory	1995	2000	2005	2010	2015	2020	2025
A. Domestic water demand (litres per day per person)							
Bahrain, Kuwait, Qatar, United Arab Emirates	540	555	570	585	600	615	630
Lebanon, Saudi Arabia	365	370	375	380	385	390	395
Iraq	160	170	180	190	200	210	220
Jordan, Oman, Syrian Arab Republic	130	135	140	145	150	155	160
Palestine, Yemen	90	95	100	105	110	115	120
B. Industrial water demand (litres per day per person)							
Iraq	50	75	100	125	150	200	225
Bahrain, Qatar, United Arab Emirates	95	100	105	110	115	120	125
Lebanon	55	65	75	85	95	105	115
Jordan, Saudi Arabia, Syrian Arab Republic	30	35	40	45	50	55	60
Kuwait, Oman, Yemen	15	20	25	30	35	40	45
Palestine	5	10	15	20	25	30	35
C. Agricultural water demand (litres per day per person)							
Arabian Peninsula							
Bahrain	792						
Kuwait	168						
Oman	1 428						
Qatar	1 685						
Saudi Arabia	2 788						
United Arab Emirates	1 908						
Yemen	598						
Mashreq subregion							
Iraq	6 488						
Jordan	554						
Lebanon	683						
Palestine	177						
Syrian Arab Republic	2 627						

Source: W. Al-Zubari, "Water vision for the Arab countries of Western Asia: alternative water policies", a paper prepared for the Expert Group Meeting on Harmonization of Environmental Standards in the Water Sector of ESCWA Member States, Beirut, 28 September to 1 October 1999 (E/ESCWA/ENR/1999/WG.2/12).

Table 12 is a proposed matrix for the water sector in West Asia. It aims to highlight methods for improving the current situation.

TABLE 12. PROPOSED POLICY MATRIX FOR WATER SECTOR IN WEST ASIA

Policy	Planning and analysis	Legal and institutional	Economic regimes	Projects and programmes
Prioritizing water use for domestic, industry and agriculture, respectively	Water resources assessment and development; Population growth projection; Water demand projections; Water quality monitoring	Protection zones for surface water supplemental, well-field, springs, and catchment area; New competent authorities; Control illegal connections; Training staff	Higher tariffs for high segments of water use; More funds for operations and maintenance (O&M) and new water facilities; Strict regulation and penalties; Wide application of metering system; Water viewed as economic commodity; Users participation; Control of industrial intake and discharge	Hydrological and hydrogeological studies; Maintenance of water facilities and networks; Water treatment plants, desalination plants for future needs; Campaign to change user behaviour; Improve sanitation
Settlement of shared water resources conflicts	Negotiation; Data and information	Regional/international cooperation		Monitoring water flow (quality and quantity); Drainage water treatment
Rational water use	Mapping of connections to detect leakage	Regulation to support water saving measures; Control of illegal connections; Full application of metering system; Adequate institutions and staff training for proper water use control	Proper water pricing; Rotational check of metering system and reviewing water-supply costing	Use of water saving technologies/ facilities; Studies to rationalize water use; Change user behaviour; Calibration of metres; Leak detection/ control; Regular maintenance and network rehabilitation
Groundwater protection	Comprehensive groundwater quality monitoring; Conjunctive use of surface and groundwater	Controlling rate of pumping to prevent mining the reserve; Closer coordination for efficient management; Application of metering system; Adopt well drilling licensing; Penalties for groundwater depletion and contamination	Irrigation charge on volume of water used; Removal of subsidy for well drilling; Incentives for improved irrigation technology; Review water tariff for domestic and industrial uses	Application of water saving technologies; Update studies on groundwater availability for sustainable water management; Artificial recharge; Public awareness campaign and educational programmes

TABLE 12 (*continued*)

Policy	Planning and analysis	Legal and institutional	Economic regimes	Projects and programmes
Water pollution control and environment protection	Standardization of drinking water quality and industrial effluents; Improving water quality monitoring system; Provision funds for studies	Staff training in water conservation; Stringent legislation for drinking water pollution; Restricted activities in watershed area or well field zones; Regulation for treating industrial effluents before discharging; Competent authority for control of water pollution	Applying the polluter pays principle; Pollution charges to be assessed proportional to volume and quality of effluents	Expansion of sewage water works; EIA for water projects; Education campaign and public awareness; Wastewater treatment plants in large communities and industries; Improving sewage networks
Increasing water use efficiency	Encouraging conjunctive use of surface and groundwater; Conducting studies on consumptive use studies for crops; Extensive application of water saving irrigation systems; Continuous monitoring of water use for different sectors	Meeting system for different water uses; Licensing of well drilling and abstraction; Strict regulation to control illegal abstraction; User group participation	Irrigation charges to be based on volume of water consumed; Incentives for modern irrigation; Rotational review of irrigation charges; Increased domestic water supply tariff with high segment of water consumption	Application of water saving technologies; Increasing efficiency in the distribution system and irrigation canals; Multipurpose water use; Education campaign; Re-use of wastewater and drainage; Regular maintenance of water supply networks
Institutional capacity building	Human resources development; Support research institutes/ universities; Use new techniques for administration and management; Upgrading monitoring network and equipment; Modelling for water resources development and management	Update legislation to enforce coordination between water administrations; Clear responsibilities and duties of water administrations; Integrated programmes for water use management	Financial support for institutional capability; Employment incentives should replace civil service rules; Improving accounting and costing systems; Budget control systems	Training program for skilled technicians and professionals; Considering options for privatizing services

B. STUDIES ON THE MANAGEMENT OF SHARED WATER RESOURCES

The first case study addresses the issue of sharing water along the Euphrates river. The Euphrates river flows from Turkey through two downstream ESCWA member States, the Syrian Arab Republic and Iraq. Turkey is rich in water resources while both the Syrian Arab Republic and Iraq are generally poor in water. The Euphrates and the Tigris account for approximately the same flow of fresh water in the ESCWA region as does the Nile. The Euphrates accounts for 32,700 million m^3 per year, the Tigris, 49,200 million m^3 per year. This amounts to a total of 81,900 million m^3 per year. The Nile accounts for 83,600 million m^3 per year.

The Euphrates and Tigris rivers provide a regional opportunity for either water agreement or conflict regarding the allocation of water resources. Turkey encompasses 28 per cent of the Euphrates basin, but accounts for 98 per cent of the river's runoff. Some 17 per cent of the basin is within the borders of the Syrian Arab Republic. However, it accounts for only 2 per cent of the total runoff. The remaining 55 per cent of the basin can be divided as follows: 40 per cent, Iraq and 15 per cent, Saudi Arabia. They contribute virtually nothing to the flow of the Euphrates.

The second case study addresses the management of shared groundwater resources between Palestine and Israel, namely, the West Bank aquifer.

It is not the intention of this study to state specific figures for the amount of water to be shared among riparian States; rather it aims to develop possible guidelines and principles that will help riparian States reach agreements on the management of shared water resources.

1. *First case-study: management of shared water along the Euphrates*

The geographical situation of Turkey has endowed it with abundant precipitation and mountain catchment areas. "It is estimated that Turkey has a flow of 185 bm^3 of water in its rivers annually, much of which is lost into the sea".[111]

Given this situation, Turkey has proposed two major water projects, namely, the GAP project and the so-called Peace Pipeline.

The Government of Turkey conceived the GAP project to combat shortages of water. If the project is realised, it will comprise 22 dams, 19 hydroelectric power plants and irrigation facilities.[112] The final energy production capacity of the scheme will be 25,000 gigawatt hours (GWh) per year of hydroelectric power.[113] Furthermore, the project will irrigate more than 1.7 million hectares of land.

If all the projects of the GAP are completed, officials estimate that the project will cost US$ 32 billion.[114] However, critics have argued that Turkey cannot afford this.

To combat the expense of this project, the creation of various regional development projects has been proposed, including the export of surplus water to the GCC States, where water shortage problems are expected to become acute.

Current and future water shortages in the GCC States are, and will be, met by desalination. However, the costs inherent in desalination technology have forced some Governments to consider alternative sources to boost their water supplies.

Since the mid-1980s, Turkey has advocated the idea of supplying the Arabian Peninsula through what has been labelled the Peace Pipeline. The estimated cost is some US$ 21 billion and it would supply the peninsula from from the Ceyhan and Seyhan[115] watercourses. However, the project has not been realised yet.[116]

This name was suggested by Turkey because it was thought that the project would soothe relations with the country's southern neighbours. It was envisaged that the pipeline would settle complex disputes concerning water rights in the region.

Two broad routes were proposed. The western route was to run southwards through the Syrian Arab Republic and Jordan to the Red Sea shores of Saudi Arabia. The eastern route was to cross the Syrian Arab

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[111] J. Kolars, "The hydro-imperative of Turkey's search for energy, "*Middle East Journal*, vol. 40, No. 1 (Winter 1986), p. 67.

[112] Government of Turkey, *GAP, Southeast Anatolia Project*, Ankara General Directorate of Press and Information of the Turkish Republic (no date).

[113] 1 GWh = 10^3 MWh = 10^6 KWh. Compared to the GAP's hydroelectricity production, electricity demand in Egypt is expected to rise to 257 GWh by 2017.

[114] This figure is subject to increase as a result of inflation and delays.

[115] Some reports give credibility to the Tigris and Euphrates' option. See N. Beschorner, "Water and instability in the Middle East", *Adelphi Paper 273*, London, International Institute for Strategic Studies (Winter 1992/3), p. 43.

[116] Sheikh Zayed was the only GCC ruler to seriously consider the proposal. A preliminary feasibility study concluded that the US$ 21 billion cost alone would be prohibitive.

Republic and transport water to eastern Saudi Arabia and the GCC States of Bahrain, Kuwait, Oman, Qatar and the United Arab Emirates.

According to Brown and Root, the American engineering giant that undertook a study of the pipeline in 1987, the plan is feasible. The pipeline could deliver water at a third of the cost of desalination. However, momentum for the project has sagged as potential financial resources have dried up.

The Peace Pipeline would have been a major boost to the Turkish economy. Turkey has argued that it would had given the countries of the region a common constructive interest.[117] It was considered that if Turkey was able to forge agreements with Egypt, Iraq, Jordan and the Syrian Arab Republic regarding a plan to link their respective electricity networks, there was no reason why they could not devise a plan to cooperate on harnessing water resources.

Therefore, the Five Countries' project was conceived to link the grids of Egypt, Iraq, Jordan, the Syrian Arab Republic and Turkey. A link between Iraq and Turkey is already operating, albeit at a capacity of only 132 KV.[118]

Such links will provide an alternative source of power in case of power failures and a subsequent saving with regard to installation and maintenance of reserve capacity,[119] in addition to an outlet for surplus generation capacity. An additional advantage of a link between Turkey and each of its two neighbours derives from the differences in the pattern of consumption and from the non-coincidence of peak demand. The five-country link will cost some US$ 12,000 million.

Sceptics argue that inter-state political rivalries will hinder the Five Countries' grid connections and the projected Peace Pipeline. On the contrary, some experts state that the obvious economic benefits from these schemes will override political rivalries.

(a) *Short-term regional co-operation: promise or fiction?*

With regard to the Peace Pipeline, Arab participants in the scheme will be more dependent on Turkey than vice-versa. To a lesser extent, similar drawbacks might affect Arab participation in an integrated Middle East electricity network. However, every participant would continue to generate electricity and exchanges could focus on temporary gaps between production and consumption in the participants' countries.

(i) *Wrangle over the Tigris and Euphrates and the knock-on effects*

Some commentators have suggested that the issue of water may result in Arab-Turkish cooperation, especially with regard to the pressing need to satisfy the demands of growing populations in the countries concerned. However, this scenario has not yet occurred. Iraq and the Syrian Arab Republic feel that the GAP project could severely reduce their flow of the water.[120]

The latest tripartite meeting collapsed in disagreement. Iraq and the Syrian Arab Republic claim that the current flow of 500 m^3 per second southwards, according to a 1989 *modus vivendi* with the Syrian Arab Republic, is too low and insist that their demand for an adequate quota of water supply downstream, 700 m^3 per second, be met. This is a request that Turkey repeatedly denies, saying that any temporary shortfall in

[117] Cem Duna, "Turkey's peace pipeline", *The Politics of Scarcity*, J.R. Starr and D.C. Stoll eds., published in coooperation with the Center for Strategic and International Studies, Washington D.C. (Boulder, Westview Press, 1988), pp. 121-122.

[118] Further studies will be necessary to install a decided 400 KV connection.

[119] Some 30 per cent of Jordan's generating capacity, 20 per cent of Turkey's and 10 per cent of Egypt's, is in reserve.

[120] T. Mazjoub, "La Turquie, le GAP et le point de vue irako-syrien (aspects juridiques)", Enjeux et rapports de force en Turquie et en Mediterranée orientale, Paris, l'Harmattan, 1996.

Euphrates flows in Iraq could be compensated to some extent by water from the Tigris via the Tharthar depression into the Euphrates.[121]

The official Turkish view is that the Tigris and Euphrates are sovereign resources. The Government of Turkey[122] has maintained that there are no international laws that would force them to "share" what they call "cross-border water" or "transboundary watercourses".

It seems that there are no immediate prospects for the clarification of the Turkish legal position. The Government of Turkey is disinclined to participate in any negotiated accord until the main GAP projects are complete. When this happens they will be in a commanding bargaining position.

Disagreement between Iraq, the Syrian Arab Republic and Turkey also constitutes a serious constraint to the project. Furthermore, it contributes to the slow pace of Arab-Turkish cooperation.

Without a comprehensive resolution to the Tigris and Euphrates water dispute, the knock-on effects will be considerable, not just among the three countries.

(ii) *The possibility that electric power sharing will spark Arab-Turkish co-operation*

Linking transmission grids and the two-way sale of electric power is one of the most promising options for Arab-Turkish cooperation and could lead to increased dialogue on the issue of water.

Opportunities for trade in electric power arise when power failures occur or when installed capacity is insufficient to supply peak demand. This makes it necessary to discontinue supply to consumers. These types of supply interruptions entail considerable losses for industrial and non-commercial consumers. The damage caused by supply failures in the Middle East has been estimated at some US$ 1 per kilowatt hours (kWh) compared with a generating cost of 7 cents per kWh.

No more than 2,600 million KWh would have to be traded between the five countries initially. However, the real potential for trade in electric power is considerably greater. Indeed, for Arab States, this trade would not create an unacceptable degree of interdependence.

It would seem that the scope for economic and technical cooperation between the Arab States and Turkey is limited in the short term. Previously, each side has forged economic links with partners outside the region. It is possible that they will prefer to continue and develop these links, for economic and indeed, emotional reasons. To some considerable extent this state of affairs is consistent with the peripheral or semi-peripheral nature of these States. This is not to say that beyond a relatively moderate level of collaboration and exchange more complex networks of economic interdependence could not be devised and implemented which would lock Turkey and the Arab States into inescapable cooperation.

(b) *Future possibilities*

Lasting Arab-Turkish cooperation is of considerable interest to the countries in the region. Economic relations contribute to the creation of opportunities for collaboration rather than continued discord and conflict.

Economic benefits for Arab countries and Turkey, can be gained from the joint development of gas fields and water supply systems. Such cooperation will benefit both parties and create a vested interest in interdependence.

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[121] An added complication might arise, as recently Syrian Arab Republic has approached Turkey about the possibility of abstracting water from the Tigris and diverting it westwards to the Euphrates.

[122] Norman Frankel, "Water and Turkish foreign policy", *Political Communication and Persuasion* (Crane Russak, Philadelphia, Washington D.C. and London), vol. 8, No. 4, 1991, pp. 294 and 298. This article, a set of interviews, examines throughly Turkish perspectives on the Tigris and Euphrates watercourse.

However, any economic intercourse contains elements of conflict arising from the unequal distribution of gains and losses, or from a tilt in the balance of power in favour of one side.

Economic transactions produce gains, at a cost, and since there is no automatic mechanism to distribute the costs and gains equitably, conflicts may arise over their distribution. It is therefore vital that the initial transactions in which the parties engage—that have the crucial role of building mutual trust—must offer an acceptable trade-off between economic gains and potential conflicts.

Furthermore, economic transactions create a greater or lesser dependence of one party on the other. Such dependence can be, or become, asymmetric and lead to abuses, actual or potential, by the stronger party. Recent antagonists seeking to cement cooperation are likely to be highly sensitive on this point.

(i) *Vested interest in cooperation and optimal interdependence*

If the economics of cooperation are the deliberate use of economic policy to enhance economic intercourse, then that policy must be guided by two key concepts: first, the conscious development of a vested interest in cooperation and second, the creation of a balanced interdependence among both parties. This is an interdependence that does not tilt the balance of power significantly in favour of one side.

The concept of the cost of dissocation is introduced at this point, to clarify how the interdependence created by bilateral economic relations can be optimised.

This concept is the cost of discontinuing economic transactions in which the parties had previously engaged. When parties agree to work together, they expect to obtain benefits. If they stop working together, the expected benefits fail to materialise; the cost of dissociation thus represents the gains foregone as a result of the discontinuation of the planned transactions.

If the cost of dissociation for one party is disproportionately lower than for the other, and the latter is unable to retaliate, the first country has the power to inflict substantial hardship on the second, and to use its superior bargaining power to exact political and economic concessions from the other country.

Optimal interdependence, therefore, is a state in which dissociations are both substantial and roughly equal for both sides.

To illustrate this point, it is necessary to consider two examples of potential economic transactions between Arabs and Turks: the Five Countries' power grid, and the Peace Pipeline.

In the case of the Five Countries' power grid, both parties gain from the transaction. Arab countries that have an exportable surplus of electric energy, gain a secure market and payment in scarce foreign currency. Turkey, which does not have any excess energy of its own, obtains a convenient and assured source of supply. The cost of possible dissociation would nevertheless be very low for both parties. The agreement is economically insignificant for both parties, since both can fall back on alternatives at little cost. Arab States can sell its electric energy elsewhere and probably at a cost not significantly lower than that paid by Turkey. Turkey however, has alternative and similarly priced sources of supply.

The Peace Pipeline represents a case where the cost of dissociation would be very high (see table 13). This is because if one party lacks water, the party who has water, could be liable to blackmail the party who does not. The blackmail need not to be explicit; it might remain an implied threat.

Applying the concept of the cost of dissociation, it is clear that even if that cost is initially roughly equal for both parties, there is no assurance that it would remain so—if only for technical reason that each country would have had to ensure the availability of back-up facilities. The interdependence resulting from such a scheme would therefore have presupposed the prior existence of what it was intended to create, complete mutual trust and near-total integration.

TABLE 13. WATER FLOW THROUGH THE PROPOSED PEACE PIPELINE

Gulf Pipeline			Western Pipeline		
Location		(m^3 per day)	Location		(m^3 per day)
Bahrain:	Manama	200 000	Jordan: Amman		600 000
Kuwait		600 000	Syrian Arab Republic:	Aleppo	300 000
Oman:	Muscat	200 000		Hama	100 000
Qatar:	Doha	100 000		Homs	100 000
Saudi Arabia:	Jubail	200 000		Damascus	600 000
	Ad Dammam	200 000			
	Al Khoubar	200 000	Saudi Arabia:	Tabuk	100 000
	Al Hofuf	200 000		Medina	300 000
United Arab Emirates:	Abu Dhabi	280 000		Yanbu	100 000
	Dubai	160 000		Mecca	500 000
	Sharjah/Ajman	120 000		Jeddah	500 000
	Ras al-Khaimah/	40 000			
	Fujairah/		Turkey		300 000
	Umm al Qaiwan				
Total		2 500 000	Total		3 500 000

Source: Brown and Root International, Inc., Prefeasibility Studies, in C. Duna, "Turkey's peace pipeline", *The Politics of Scarcity: Water in the Middle East*, J.R. Starr and D. C. Stolls, eds., published in cooperation with the Centre for Strategic and International Studies (Boulder, Westview Press, 1988).

(ii) *The development of Arab-Turkish co-operation*

Unlike many other natural resources, water is often shared by several countries. The allocation of the respective shares of water from a common source is a source of tension and latent conflict, even among countries in total harmony with one another. Among countries that disagree, open conflict is further exacerbated by water disputes.

Agreements governing the cooperative use of the region's water resources will be only one more building block in the construction of mutual understanding. Nevertheless, it remains true that multinational projects for the utilisation and distribution of shared water resources rank high among the instruments that could bolster cooperation. Cooperation in this field must be prioritised because these projects are indispensable for consolidating mutual understanding in the region. Failure to implement suitable projects means that existing tensions will remain unresolved and may indeed sow the seeds of future conflicts over water.

A case in point is the Tigris and Euphrates water sharing scheme. It suggests cooperation with regard to the distribution of water. However, lack of mutual trust between the countries concerned could cause tension, conflict and result in the failure of the Peace Pipeline project.

The feasibility of the Peace Pipeline therefore, depends on its political costs and benefits, or the dissociation from it by one of the parties involved.

The political implications of such a project are as follows: Turkey and the Syrian Arab Republic and/or Iraq—which would have to cooperate in any scheme conveying water through its territory to third party—would hold the key to what might become a major cooperation-building undertaking in the region. The Syrian Arab Republic and/or Iraq would be an indispensable partner in any multi-national water plan, particularly in water exchange schemes between the countries and territories of the region.

On the one hand, the financial cost of a project that would convey water to the South is not forbiddingly high. On the other hand, the economical and political cost of dissociation, would be substantial.

An integrated scheme to supply the GCC States with water from Turkey, involving an exchange of energy from the Gulf, would leave these territories completely dependent on these sources and means of transfer.

In fact, energy is one of the key ingredients in Turkey's recipe for sustained economic growth into the next century. Turkish domestic gas demand is forecast to rise to some 60,000 million m^3 per year by 2010 from some 8,000 million m^3 per year.

Furthermore, the GCC States could be a major gas or electric power supplier to Turkey. The urgency of Turkey's search for energy combined with the its abundant water resources and the fact that it has potential customers located beyond the arid southern border, has delayed imaginative thinking on the subject of export of water in exchange of cheap energy. "The major stumbling block will be the development of mutual trust between recipients and suppliers, with guaranteed safe passage and compensation for intermediate countries enroute."[123]

If the economic cost of dissociation is combined with its political costs, it is reasonable to assume that an overall approximate balance of interests might emerge.

The ability of Arab States to deliver scarce energy reserves to Turkey is a significant point of leverage. This factor, in addition to their ability to absorb large water exports from Turkey, could pave the way to a peaceful resolution of differences between both parties.

Finally, it is in the interests of the Arab States and Turkey to complement each others strengths. The Arab States and Turkey have a great deal in common. They could assist each other greatly, provided that Turkish political will exists concerning the sharing of the Euphrates and Tigris waters.

2. *Second case-study: groundwater in West Bank aquifer*

The average total amount of rainfall on the land area of Palestine is estimated at 3000 million m^3 (approximately 2900 million m^3 in the West Bank and 118 million to 130 million m^3 in the Gaza Strip). Infiltrating water can either be retained in the soil for use by vegetation and evapotranspiration or penetrates more deeply into the ground to replenish the groundwater system. It can reappear as seepages and springs or be tapped as well water. Some 65 to 75 per cent of this estimated total rainfall of 3000 million m^3 is accounted for through evaporation and surface runoff.

Annual evaporation in the West Bank averages between 1.8 mm per year on the western slopes of the watershed up to 2.6 mm per year on the Dead Sea shore. The highest monthly average is in July with evaporation of 8 mm per day in the West Bank and 11 mm per day in the Jordan Valley. In the coastal Gaza Strip, the mean annual evaporation is 1.8 to 1.9 mm per year.

Runoff can vary between nil to some 15 per cent in wetter years. On average, the potential runoff element varies between 7 and 14 per cent of the annual rainfall. Area-wide runoff occurs in Palestine when rainfall in any one day exceeds 50 mm or when the total on two successive days is more than 70 mm. Runoff in hilly treeless areas occurs with much less rainfall.

Based on the above estimates, runoff in the West Bank is estimated at 435 million m^3 and evapotranspiration at 1700 million m^3. The remaining 765 million m^3 recharges the inland regions aquifers. Some 60 million m^3 of water are lost in the Gaza Strip coastal region per year because of evapotranspiration and 12 million m^3 are lost to surface runoff, leaving only some 45 million m^3 to recharge Gaza's shallow aquifer.

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[123] J. Kolars, "The hydro-imperative of Turkey's search for energy", *Middle East Journal*, vol. 40, No. 1 (Winter 1986), p. 67.

The remaining 750 to 900 million m^3 (some 765 million m^3 in the West Bank and 45 million m^3 in the Gaza Strip) constitutes the potential average renewable water balance which is an estimated annual infiltration rate of some 30 per cent in the West Bank and 35 per cent in the Gaza Strip. Of this amount of annual infiltration, only approximately 600 million m^3 of this water recharged to the aquifers is estimated to be easily usable.

The West Bank contains the following six major aquifers:

(a) The Pleistocene aquifer comprises unconsolidated sands and gravels of varying sizes separated by impermeable layers of saline marls. It extends along most of the Jordan valley between Jericho in the south and Marj Na'jih and lower Wadi El-Fara'ah in the north. This aquifer is believed to have been fully exploited through some 100 pumping wells extracting some 15 million m^3 annually with a chloride content ranging from 100 mg per litre to over 200 mg per litre. Further exploitation would increase the salinity levels and could destroy the fresh water zone in the Jordan valley unless fresh water artificial recharge is introduced;

(b) The Neogene aquifer comprises well-cemented conglomerates containing relatively small quantities of fresh water. This aquifer is situated in the northern part of the Jordan Valley near Bardala and Ein El-Beida. This aquifer is also believed to have been fully exploited by two pumping wells that extract some 7 million m^3 annually with a relatively low chloride content;

(c) The Eocene aquifer comprises thin limestone layers with chalk and marl intercalations. It is located in the northwestern part of the West Bank around Jenin and upper Wadi El-Fara'ah. Owing to its limited thickness and extension, the storage capacity and utilization of this aquifer is directly affected by rainfall. It is believed that this aquifer system has been fully exploited by some 60 pumping wells extracting 3 million to 4 million m^3 of fairly good quality water annually;

(d) The Turonian aquifer comprises massive, locally interbedded limestones and dolomites. It extends over a large area in the Tulkarem district. It has been only partially exploited by some 50 pumping wells that extract 8 million to 9 million m^3 of high quality water annually;

(e) The Upper Cenomanian aquifer is shallow and mainly comprises interbedded dolomites and chalky limestones. It is located in the Qalqilia area south of Tulkarem. It has been only partially exploited through some 70 pumping wells that extract 5 to 6 million m^3 of good quality water annually;

(f) The Lower Cenomanian aquifer mainly comprises limestones. It is deep and covers a large area in the central and southern parts of the West Bank on both sides of the central mountain chain and has substantial natural recharge from rainfall. It is only partially exploited by eight wells that extract approximately 8 million m^3 of good quality water annually (see table 14).

TABLE 14. SUMMARY OF AQUIFER YIELDS IN THE WEST BANK

Age of aquifer	Main area of location	Number of Palestinian pumping wells	Annual Palestinian pumpage (millions m^3)	Aquifer exploitation estimate
Pleistocene	Jordan Valley and Wadi Fara'ah	100	15	Full
Neogene	Northern Jordan Valley	2	7	Full
Eocene	Northwest West Bank and Wadi Fara'ah	60	3-4	Full
Turonian	Tulkarem area	50	8-9	Partial
Upper Cenomanian	Qalqilia area	70	5-6	Partial
Lower Cenomanian	Central and Southern West Bank	8	8	Partial

The West Bank has more abundant resources than much of the surrounding area. However, all of the West Bank's groundwater is dependent upon rainfall. A mountain range runs from north to south for almost the entire length of the region, creating watershed areas to the east and west. The runoff of each watershed constitutes some 25 million m^3 annually. Groundwater is the most important water source. The potential

supply from the West Bank aquifers totals some 600 million m^3. The entire water supply from the West Bank is estimated at approximately 850 million m^3, of which only 200 million m^3 is from the Jordan river.

Therefore, Israel has had a longstanding interest in the waters of the West Bank. The two aquifers arising there supply the majority of the groundwater for northern and central Israel. Indeed, one-third of Israel's pre-1967 water consumption of 1.6 bm^3 came from the West Bank. Israel's bored wells just on their side of the Armistice line, drew off as much West Bank water as possible, not only for irrigation but to counteract overpumping of the coastal aquifers. The annual volume of Arab water controlled by Israel since 1967 has recently reached 600 - 700 million m^3, almost the total increase in Israel water consumption since the mid-1960s. In other words, Israel's expansion of settlements and an increase in agricultural production since that time has essentially been accomplished solely with water from the West Bank and Upper Jordan. The importance to Israel of control over these waters cannot be overemphasized.

By the same token, Israel considers its "historic rights" to the Mountain aquifer, which originates on the West Bank but which has been exploited by Israel from its side of the Green Line (that delineates the pre-1967 Israel-Jordanian border) since the 1950s, irrevocable and tied to greater issues of security. Measures to restrict pumping on the West Bank have been described by Israel as defensive, necessary to protect their coastal wells and the integrity of the water system as a whole. It is argued that unchecked Palestinian water development or pollution in the Jordan and Samarian hills west of the watershed line, could endanger both the quantity and quality of water sources on which the heavily populated coastal plain of Israel relies. Israel's focus for the future will be to try to retain as many of its current sources as possible, and to introduce large-scale desalination and interbasin transfer projects into the region with international backing and financial assistance.

Given the possible failure of managing shared water resources between ESCWA and non-ESCWA members, ESCWA members must promote institutional and legal arrangements pertinent to shared water resources in the ESCWA region.

Future attempts to avert water shortages require water policy and strategy formulation, with an emphasis on an integrated approach to achieve simultaneous management of supply and demand. The implementation of an integrated approach to water resources development and management must be supported with institutional arrangements and legal instruments, in addition to the promotion of capacity-building.

Unfortunately, little or no progress at all has been achieved, in most ESCWA member States, regarding measures for coping with scarcity in a sustainable manner. To have a positive impact in these areas, genuine regional programmes and action plans are urgently needed.

Given the vital need for a regional water development plan that would incorporate the political realities of the region and the limitations imposed by economics and hydrology, possible steps that might be taken are described below, in addition to institutional and legal arrangements for shared water resources management in the ESCWA region.

C. Institutional and legal arrangements for shared water resources management in the ESCWA region

The majority of ESCWA countries produce food by using the method of irrigated agriculture. Approximately 80 per cent of water resources are used for this purpose. This form of agriculture provides food, work and rural stability to certain segments of the population in these countries. Furthermore, industrial and household demand for water is increasing in countries that suffer from shortages of food and high levels of unemployment. Certain countries are unable to secure enough foreign currency to import vital goods and services. A crisis scenario is imminent, if not a reality, in some ESCWA countries.

Therefore, it is essential that Arab experts note the various legal and managerial development trends particularly in other arid zones and adapt this information to benefit ESCWA societies.

ESCWA members have witnessed a variety of disputes and disagreements regarding this issue. An understanding of these problems has developed in addition for to a resolution of some conflicts. This is the case with regard to the Tigris and Euphrates basins and partly true for other international river basins in the ESCWA region.

ESCWA members are therefore qualified to embark on a regional operation that would aim to achieve an agreement regarding the principle of sharing common international waters on the basis of regional cooperation in all water-related aspects. Such cooperation would be designed to combat the evident imbalance in the population/water resources equation.

One possible solution is a regional water charter. It would contain generally agreed upon principles and the means to defuse water-related conflicts and the means to facilitate regional cooperation.

Furthermore, Islamic water principles also have an important role to play in finding agreeable solutions.[124]

[124] International Development Research Centre, *Water Management in Islam*, Naser I. Faruqui and others, eds. (Tokyo, New York, Paris, United Nations University Press, 2001).

VIII. DISPUTE MANAGEMENT ASPECTS

A number of conflicts linked to freshwater are already apparent, in the region and elsewhere, on various levels. Moreover, as demand and degradation pressures accelerate, more conflicts are likely.

Despite this negative observation, cases in which water conflicts have developed into wars over water are rare.[125] On the contrary, shared water resources tend to lead to cooperation, even between traditional adversaries. Water problems are often exploited to resolve other issues between States. Therefore, the issue of shared water resources must not be strictly considered in terms of conflict. Cooperation is possible regarding large water development projects, namely, dams. In this type of scenario, they may be no other option but to cooperate and indeed, a suitable outcome is perceived to be mutually beneficial.

Nonetheless, given that many water basins and groundwater aquifers cross international borders, the potential for conflict on the issue of freshwater remains enormous. Shared water resources are a trigger for conflict.

In the ESCWA region, the dependence of several member countries on surface water inflows from neighbouring countries is a cause for concern, especially in view of unilateral developments of the resources by upstream States and the absence of binding basin-wide agreements that define the allocation of each riparian State. Under such circumstances, the potential for conflict is likely to increase. Table 15 illustrates that some ESCWA member countries depend on water originating outside their territories for the majority of their supply, namely Egypt. It depends on external sources for 97 per cent of its water supply.

TABLE 15. DEPENDENCE OF SOME ESCWA MEMBER COUNTRIES ON SURFACE WATER ORIGINATING OUTSIDE THEIR TERRITORIES

Country	The percentage of total water resources originating outside the country's territory*
Egypt	97
Iraq	66
Jordan	36
Syrian Arab Republic	79

Source: Samson, P. and B. Charrier. 1997. "International freshwater conflict: issues and prevention strategies", Green Cross International. Available at: http://www.gci.ch/GreenCrossPrograms/waterres/gcwater/study.html.

* These figures have not been verified by ESCWA. In particular the figure for the Syrian Arab Republic appears to be too low.

Internationally, concerns regarding freshwater conflict are increasing. However, these issues are rarely discussed openly, perhaps because of their political sensitivity. The United Nations Water Conference at Mar del Plata in from 7 to 18 March 1977, clearly recognized the need for cooperative management and development of shared water resources. However, it did not explicitly deal with the issue of conflict management. It can be argued that it is only recently that the urgency of the problem has become broadly apparent. However, Agenda 21, Chapter 18, "Protection of the supply of freshwater resources: Application of integrated approaches to development, management and use of water resources", the main document produced by the Rio Conference held from 3 to 14 June 1992 barely mentions the potential for conflict over this resource. This is the same case for the 1992 Dublin Statement. For its part, the United Nations 1997 Comprehensive Assessment Commission on Sustainable Development - Freshwater, makes the following point:

> "The analyses show that if many of the current approaches to water management do not change, this will lead to increasing water stress. As scarcities increase, there will be the risk of greater conflict over the water in the more than 300 transboundary rivers as well as many underground aquifers. This shows the importance of cooperation regarding river systems shared by countries. It will be crucial to work out water sharing arrangements which seeks to maximize benefits for all users (Chapter 2, paragraph 94)".[126]

[125] A. T. Wolf and J. H. Hamner, "Trends in transboundary water disputes and dispute resolution", *Water for Peace in the Middle East and Southern Africa*, Green Cross International, Ruckstuhls SA, Renens, March 2000.

[126] Available at: http://www.un.org/esa/sustdev/freshwat.htm.

Meanwhile, the issue of international water conflict is extensively tackled by many institutes including the World Water Council, Worldwatch Institute, the Pacific Institute and the World Resources Institute. However, there must be more effort to increase awareness on an intergovernmental level.

A. CONFLICT MOTIVATORS, TYPES AND SEVERITY

1. *Conflict drivers*

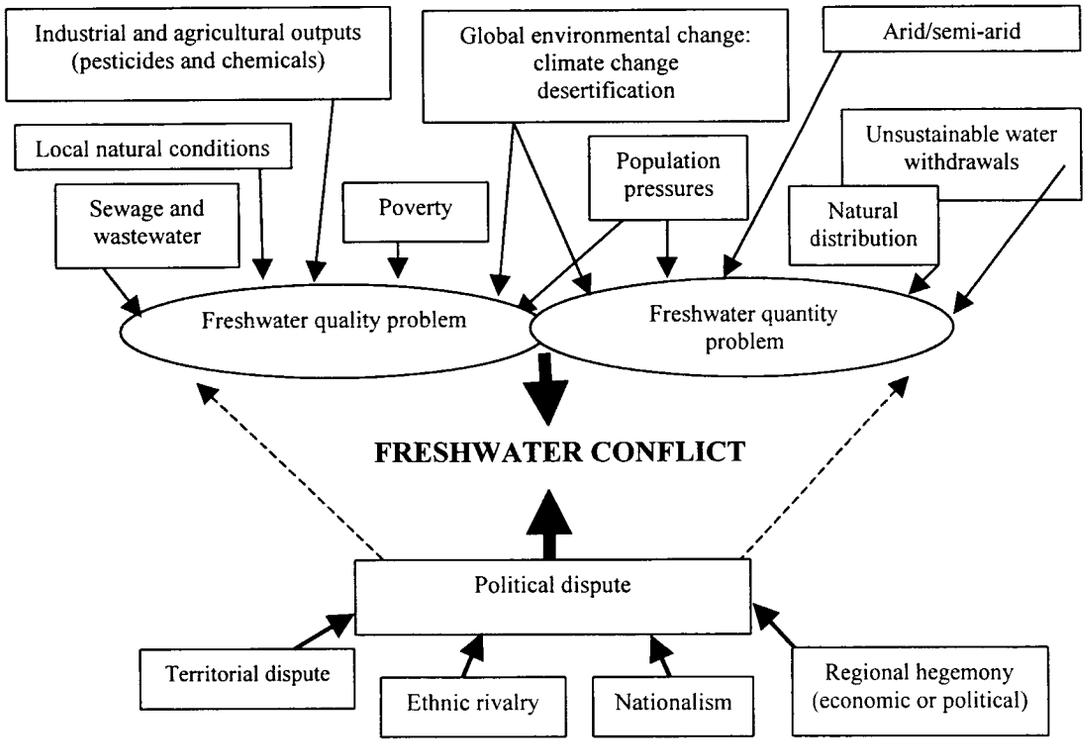
The main motivations for freshwater conflict are illustrated in the figure below. While this figure is not intended to be an exhaustive inventory of all possible motives, it clearly demonstrates the large number of possible multiple motives behind a freshwater conflict.

In essence, the two main motives for freshwater conflict are unsustainable use patterns and issues of access and quality.

Unsustainable use patterns inevitably accentuate water stress and scarcity. Often finite water supplies are further diminished by over-exploitation and/or quality degradation. These problems are driven by natural scarcity, growing demand and lack of adequate management. Therefore, it is possible that scarcity and inadequate management will lead a country into a cycle of overexploitation and pollution. This, in turn, may worsen the scarcity situation. Indeed, the problem of unsustainable use patterns is an increasing problem for many developing and developed countries. The previously mentioned "Comprehensive assessment of the freshwater resources of the world" issued by the United Nations in 1997 highlights this problem as follows:

> "In many countries, both developing and developed, current pathways for water use are often not sustainable. There is clear and convincing evidence that the world faces a worsening series of local and regional water quantity and quality problems, largely as a result of poor water allocation, wasteful use of the resource, and lack of adequate management action".

Figure. Schematic illustrating the scope and motivators of freshwater conflict



Source: P. Samson and B. Charrier, 1997. "International freshwater conflict issues and prevention strategies", Green Cross International. Available at: http://www.gci.ch/GreenCrossPrograms/waterres/gcwater/study.html.

Water access and quality issues are perhaps the principle, or at least the underlying drive of the majority of water conflicts. These issues arise from the uneven global distribution of freshwater, both temporally and spatially. Less than 10 countries possess some 60 per cent of the globe's accessible freshwater resources.[127] Frequent and regular rainfall in some regions contrasts sharply with prolonged drought in others. This variation in freshwater availability has significant consequences for food security, notably agricultural. Furthermore, it will continue to be a limiting factor on socio-economic development, especially for some ESCWA countries. Growing conflict, as a result of increasingly scarce freshwater resources, is imminent.

Access and quality issues are significant driving forces behind conflicts at various levels of society, not just internationally. Local challenges are multiplied when water resources are shared across borders and the potential scope for conflict becomes greater.

Furthermore, many of the motives for conflict illustrated in this study are becoming more apparent—often at an alarmingly accelerated pace. Numerous studies indicate that the pressures of global environmental change are increasing in addition to other forms of environmental stress. Moreover, population growth is continuing at very high rates in many countries in the region. Finally, poverty and poor water resource infrastructures are commonplace, often in the most disadvantaged regions.

In the ESCWA region, issues of unsustainable use of water resources and access and quality are on the agendas of water managers in most member countries. Unsustainable use is of particular concern for groundwater-dependent countries. However, even member countries which depend mainly on surface water, namely, Iraq and the Syrian Arab Republic are likely to become concerned, as access to surface waters is threatened by upstream developments and the dependence on groundwater resources increases. As far as water access and quality issues are concerned, all ESCWA countries suffer from varying degrees of water scarcity. Quality issues are of concern to many member countries. This is especially the case regarding groundwater pollution. However, there are growing concerns with respect to surface water inflows, as a likely impact of upstream projects. For instance, it is reported that the salinity of Euphrates waters will increase from 457 ppm to 1220-1275 ppm and that of Tigris will increase from 250 to 375 ppm, because of the Turkish GAP and Syrian projects.[128]

2. *Conflict type*

International water conflicts generally vary in type depending on the region. In non-arid regions, water conflicts or disputes are often centred on environmental concerns resulting from dam construction or transboundary pollution. In arid and semi-arid regions, however, water conflicts centre on the problem of scarcity. Furthermore, they can involve similar issues related to dam construction or even consequential quality degradation issues. More broadly, however, conflicts often concern issues of navigation, hydropower generation, ecology or endangered species.

Table 16 provides a list of documented conflicts over freshwater. Despite the length of this list, cases in which freshwater was, or is, the sole cause of tension are rare. Often relations regarding shared freshwater management are affected by concerns from initially unrelated disputes. This is the case of India and Pakistan, where religious tension has exacerbated the potentially contentious issue of the Indus river and between Hungary and Slovakia where ethnic issues affect cooperation regarding the Danube. Similarly, disproportion in respective levels of cross-border development can be an issue. This is the case of the United States and Mexico concerning the Rio Grande. In short, political issues are an important driving force of freshwater conflicts and are inseparable from freshwater quality and quantity issues. Therefore, shared freshwater issues cannot be examined in a political vacuum.

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[127] P. Samson and B. Charrier, 1997. "International freshwater conflict issues and prevention strategies", Green Cross International. Available at: http://www.gci.ch/GreenCrossPrograms/waterres/gcwater/study.html.

[128] A. Moaed, "The adverse consequences to Iraq of Turkey's water development projects in the Tigris and Euphrates basins" (E/ESCWA/ENR/2000/WG.1/CP.1) (in Arabic).

However, it can be argued that cooperative water regimes, once established through treaty, turn out to be tremendously resilient over time, even between otherwise hostile riparian States and even as conflict is waged over other issues.[129]

Table 16 excludes two continents: Australia and Antarctica. Australia is excluded because it has no international freshwater conflicts, despite the fact that it suffers from a significant scarcity of water in a number of central and northern regions. For its part, Antarctica could eventually become embroiled in conflict over access, and transportation of, its vast frozen reserves of exceptionally pure freshwater.

Problems related to freshwater access and quality do not automatically lead to conflict on an international or at any other level. As reviewed below, the impact of political tension is a significant, if not equal, component in the conflict equation. Analysis of the cases in table 16 supports the claim that international freshwater conflicts are multidimensional, beyond ecological, economic and technical aspects.

TABLE 16. CASE HISTORIES AND ANALYSES OF FRESHWATER CONFLICTS

Continent	Freshwater body	Countries	Important issues	Conflict intensity
Africa	The Chobe	Botswana, Angola and Namibia	Chobe-Vaal project launched by Botswana to divert water to South Africa; implications for riparians	Tension
	The Komati	Mozambique, South Africa and Swaziland	Joint construction by South Africa and Swaziland of Driekoppies and Maguga Dams. Decided in 1992	Informal mechanism
	The Nile	Burundi, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Uganda United Republic of Tanzania and Zaire	Egypt's heavy reliance on the waters of the Nile; it uses its regional power to influence upstream basin development	Diplomatic action
	The Okavango	Angola, Botswana, Namibia, Zimbabwe	Namibia currently plans to withdraw large amounts of water from the river, threatening the survival of an important inland delta in Botswana	Tension
	Saharian fossil groundwater aquifer	Chad, Egypt, Libyan Arab Jamahiriya, Niger and Sudan	Libyan Arab Jamahiriya's artificial river, diverting surface and fossil waters (1991); riparian countries oppose the project	Open dispute
	Senegal river	Mali, Mauritania, Guinea and Senegal	Dispute between Mauritania and Senegal in 1989 after years of cooperation regarding the control of river banks	Tension
	Volta river	Benin, Burkina, Côte d'Ivoire, Ghana, Mali, Togo	Droughts	Informal mechanism
Asia	Ganges and Brahma-Putra rivers	Bangladesh, Bhutan, China India and Nepal	Treaty of 1977 where India guarantees minimum flow to Bangladesh downstream from the Farakka Dam; dispute after 1982 and new treaty in 1996. India's proposal to divert the Brahmaputraa River across to the Ganges. Pollution in the Ganges. Floodings in Bangladesh	Institutional mechanism
	Jordan/ Yarmouk rivers	Israel, Jordan, Lebanon and Syrian Arab Republic	Israel's current occupation, and use of the waters, of the West Bank and the Golan. Its opposition to Jordan/ Syrian Arab Republic plans to build a dam on the Yarmouk River. No basinwide assessment of water rights. 1994 peace treaty	Diplomatic action/open dispute

[129] A. Wolf and J. Hamner, "Trends in transboundary water disputes and dispute resolution", *Water for Peace in the Middle East and Southern Africa*, Green Cross International (Ruckstuhls SA, Renens, March 2000).

TABLE 16 (*continued*)

Continent	Freshwater body	Countries	Important issues	Conflict intensity
Asia	The Mekong	Cambodia, China, Lao People's Democratic Republic, Myanmar, Thailand and Viet Nam	The dam project (Nam Thuen II) of the Lao People's Democratic Republic; China's intention to build 18 dams upstream; Thailand's project to divert the river upstream	Tension
	Tigris and Euphrates rivers	Iraq, Islamic Republic of Iran, Turkey and Syrian Arab Republic	Anatolia Dam projects in Turkey; downstream opposition	Diplomatic action
Europe	The Danube	Albania , Austria, Bulgaria, former Czechoslovakia, Germany, Hungary, Italy, Poland, Romania, Switzerland, former USSR and Yugoslavia	Gabcikovo/Nagymaros dam project: 1977 agreement between Hungary and Slovakia, but current dispute brought to the International Court of Justice	Tension (frozen)
	The Rhine	Austria, Belgium, France Germany, Liechtenstein Luxembourg, Netherlands and Switzerland	Several commissions created for dealing with navigation, overflow, and pollution issues (1868, 1963, 1968)	Institutional mechanism
North America	Columbia river	Canada and United States	Issues of endangered fish and wildlife, water pollution and hydropower generation, regulated by 1961, 1980 treaties	Institutional mechanism
	Great Lakes	Canada and United States	Agreements to reduce water pollution (1972, 1978)	Institutional mechanism
	Rio Grande river	Mexico and United States	Despite a treaty of 1944, United States accuses Mexico of creating major pollution problems in the basin	Institutional mechanism (tension)
South America	Cenepa river	Ecuador and Peru	Armed skirmishes because of disagreement over headwaters control (1995)	Armed conflict
	Pilcomayo river	Argentina, Bolivia and Paraguay	Several treaties with few results. Major pollution problems derive from industrial activities	Tension

Source: P. Samson and B. Charrier. "International freshwater conflict issues and prevention strategies", Green Cross International (1997). Available at: http://www.gci.ch/GreenCrossPrograms/waterres/gcwater/study.html.

3. *Conflict severity*

Conflicts concerning freshwater vary considerably. Violent conflict is not automatic. On the contrary, a dispute may force a settlement and cooperation rather than escalate conflict. However, treaties and agreements are often incomplete, ignored or outmoded. In short, many so-called resolved issues have the potential to become renewed conflicts, just as many existing conflicts have the potential to be settled. The severities of freshwater conflicts may be classified into the following six categories:

(a) Breakdown of formal (institutional) mechanisms: formal mechanisms exist in numerous cases in many different regions of the world. The Great Lakes Water Quality Agreement of 1972 and renewed in 1978, between Canada and the United States is an example of such a formal mechanism. While such mechanisms are efficient, they are not immune to problems. Indeed, once cooperative water regimes are established through treaty, they turn out to be tremendously resilient over time, even between otherwise hostile riparians and even as conflict is waged over other issues.[130] This is apparent in the cases of the

[130] Ibid.

Mekong Basin and along the Indus where the water regimes continued to function despite the Viet Nam War and the India-Pakistan conflict, respectively. These examples may provide useful models for other regions;

(b) Breakdown of informal mechanisms: informal mechanisms comprise various forms of cooperation ranging from traditional (indigenous practices) to personal contacts between Government personnel or experts. Indeed, cooperation along the banks of the Senegal river was based on traditional management techniques before conflict erupted in 1989. Many other basins are still managed in this way;

(c) Tension leading to a formal conflict: in this type of scenario, low profile governmental dialogue could avert formal action and public attention;

(d) Diplomatic action or other diplomatic measures: Iraq and the Syrian Arab Republic have openly protested the GAP project in Turkey;

(e) Open disputes: open disputes normally incorporate diplomatic action. However, this form of dispute tends to be much more heated and obvious. Furthermore, it could link a conflict over freshwater resources to other disputed issues. Israel's opposition to Jordanian/Syrian plans to build a dam on the Yarmuk river in the late 1950s or the situation between Libyan Arab Jamahiriya and some of its neighbours concerning its planned use of shared fossil groundwater aquifers could fall into this category;

(f) Armed conflict: this is defined here as a form of conflict which, although violent, remains isolated and limited, namely, the conflict related to the Cenepa River basin between Ecuador and Peru.

War represents the highest level of potential conflict. However, it largely remains a theoretical possibility. "War over water is neither strategically rational, hydrographically effective, nor economically viable".[131] In the case of some wars, however, simultaneous dispute over freshwater is an issue, as was the case in the 1967 Six-Day War.

B. PREVENTING FRESHWATER CONFLICT

Preventive international efforts to avert conflicts regarding shared water resources or to develop methods of cooperation have been very modest. So far, very little has been done to analyse water conflict potential or to propose integrated management solutions.[132] However, there have been some well-known cases of mediation, namely, the World Bank intervention between India and Pakistan concerning the Ganges River. In this case, a freshwater dispute was transformed into a mutually beneficial project worth billions of United States dollars.

Indeed, it is the potential benefits of cooperation, rather than the threat of war, that must drive efforts to devise methods of cooperation regarding shared water resources.

While there has been some excellent work on specific international freshwater conflicts, little policy-oriented work has been undertaken to develop a workable framework for conflict prevention in this area. The Convention on the Law of the Non-Navigational Uses of International Watercourses, adopted by the General Assembly of the United Nations on 21 May 1997, was a welcome endeavour in this regard. It provided international freshwater management with a recognized document on specific shared water resources. While there are numerous regional instruments, no comprehensive framework with the exception of the 1966 Helsinki Rules, exists. However, as cited earlier, this was to act as a framework convention. While it was not ratified by the required number of States, it generated more interest on the issues of international freshwater conflict.

Literature on conflict prevention regarding shared water resources identifies the following conflict prevention measures:

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[131] Ibid.

[132] P. Samson and B. Charrier, "International freshwater conflict issues and prevention strategies", Green Cross International (1997). Available at: http://www.gci.ch/GreenCrossPrograms/waterres/gcwater/study.html.

1. *Awareness building*

Awareness building can lead to improved communication among those who determine water policy within and across watersheds. Water shortages are a common problem requiring cooperative solutions. There must be efforts to develop a framework that builds awareness among people in the region concerning important water resources issues and on conflict resolution through data collection and analysis using the methodological design for assessing potential conflict intensity and models of cooperation.

2. *Multisectoral partnerships*

Multisectoral partnerships are essential to understand the multiple dimensions of a specific conflict, to ensure adequate capacity building and to create lasting forms of conflict prevention. Multisectoral partnerships are vital for establishing sustainable solutions. Indeed, it is doubtful that sustainable solutions can be built upon anything but a multisectoral foundation.[133] Multisectoral partnerships can involve Governments, international organizations, NGOs, local and tribal groups, business and industry, academia and other bodies.

3. *Policy reform*

Policy reform to improve management of the scarce water resources in the various basin States and to reflect seriousness in minimizing water wastage and increasing water use efficiency is another important measure for prevention of conflicts, especially when water is scarce.

4. *Integrated assessment/management*

It is essential to manage water resources in an integrated, basin-wide fashion. This would involve balancing the needs of water for agricultural, urban, industrial, and environmental uses. Furthermore, integration means that water management is integrated into socio-economic development. It also means the affected population is involved in the planning and implementation of the programmes. Indeed, the primary feature in integrated assessment/management is that the proposed solutions, which used to be thought of as mainly technical, are today recognized as being largely socio-economic.

Equally, when it comes to setting goals, human water needs, in addition to the maintenance of the required ecosystem balance, must be taken into consideration. These considerations must be ensured at both the level of assessment and management.

Thus, integrated assessment studies must go beyond traditional technical studies. They must integrate various issues, including the physical constraints of water availability and multiple socio-economic dimensions. In other words, they must propose socio-technical options.

5. *Dissemination of information*

Confronting water shortages requires greater water-use efficiency. This can be promoted by disseminating information on the most available technologies (particularly to save irrigation water) and by influencing crop selection, irrigation systems, water cost and other technical and management factors.

6. *Greater use of strategic scenario planning as management and educational tools*

Soft strategic scenarios and hard computer modelling work encourages discussion and strategic planning on integrated water basin issues. In this case, scenarios are educated qualitative forecasts or predictions of what the future may hold. They differ from quantitative forecast modelling in their qualitative and imaginative traits. They are based on understanding the key forces that largely determine future outcomes.

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[133] Ibid.

7. *Project implementation*

Following the above steps, concrete progress can be made towards implementing appropriate mechanisms with a view to conflict prevention and promoting water-related development projects through guides and guidance on viable project proposals.

Implementation of sustainable strategies, including formal agreements, must be carried out with the inclusion of the above components. Once a strategy has been implemented the processes of awareness, partnership building and assessment can continue.

C. SETTLEMENT OF FRESHWATER CONFLICTS[134]

1. *Settlement of disputes: the approach of the United Nations*

Modern international law imposes a basic obligation upon States to seek a peaceful settlement of disputes. The Charter of the United Nations adopted this general principle in article 33. It stipulates the following:

(a) "The parties to any dispute, the continuance of which is likely to endanger the maintenance of international peace and security, shall, first of all, seek a solution by negotiation, enquiry, mediation, conciliation, arbitration, judicial settlement, resort to regional agencies or arrangements, or other peaceful means of their own choice;

(b) "The Security Council shall, when it deems necessary, call upon the parties to settle their dispute by such means."

Peace is very much the heart of the purposes and principles of the Charter of the United Nations. Article 2 paragraph 3 provides that: "All Members shall settle their international disputes by peaceful means in such a manner that international peace and security, and justice, are not endangered".

Paragraph 4 of the same article stipulates that: "All Members shall refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the Purposes of the United Nations".

The Charter of the United Nations urges member States to seek pacific settlement for local disputes by utilizing regional arrangements. Article 52, paragraph 1, of the Charter stipulates the following:

> "Nothing in the present Charter precludes the existence of regional arrangements or agencies for dealing with such matters relating to the maintenance of international peace and security as are appropriate for regional action provided that such arrangements or agencies and their activities are consistent with the Purposes and Principles of the United Nations".

The duty to seek pacific solutions to disputes has been promoted in numerous General Assembly resolutions. The United Nations General Assembly adopted resolution 37/10 in 1982 which approved and attached the Manila Declaration on the Peaceful Settlement of International Disputes. The Manila Declaration reaffirms the Declaration on Principles of International Law Concerning Friendly Relations and Cooperation among States in accordance with the Charter of the United Nations.

The obligation to seek pacific solutions for the settlement of disputes is repeated in many instruments on marine resources and shared natural resources. It is also contained in several texts of soft law, which have covered the use and management of marine and natural resources. The Regional Seas Programme Activity

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[134] Except where otherwise referenced, this section is largely based on S. E. Amer, "Settlement of public international disputes on shared water resources", Expert Group Meeting on Legal Aspects of Management of Shared Water Resources, Sharm El-Sheikh, 8-11 June, 2000.

Center of the United Nations Environment Programme (UNEP/RSPAC), in cooperation with specialized agencies, gave birth to a series of conventions for the protection and development of regional seas, which reinforce the stipulations in article 33 of the United Nations Charter insofar the peaceful settlement of disputes is concerned. First, the Convention for the Protection of the Mediterranean Sea Against Pollution provides that contracting parties "shall seek a settlement of the disputes through negotiation or any other peaceful means of their own choice" (Article 22, paragraph 1).[135]

The same terminology is used in the Kuwait Regional Convention for Cooperation on the Protection of the Marine Environment from Pollution, 1990, article 25 (a); the Abidjan Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region, 1981, Article 24, paragraph 1; and the Cartegena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, 1983, article 23, paragraph 1. The Regional Convention for the Conservation of the Red Sea and the Gulf of Aden Environment, Jeddah Convention, 1982 contains similar ideas.

Finally, the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses of 1997 contains a detailed system of disputes settlement in its article 33 and an annex on arbitration.

2. *Means and procedures of dispute settlement*

Once the principle of peaceful settlement of disputes is established, it must be examined within the framework of public international law. This principle is not an isolated concept; it is supported, supplemented and reinforced by the basic principles of international law in terms of friendly relations, good neighbourliness, and good will and cooperation. The options for dispute settlement are identified as follows:

(a) *Negotiation, good offices and mediation*

Negotiation is the initial method to settle disputes on shared resources. Negotiations may be institutionalised by the establishment of joint commissions or other entities that deal with issues likely to be the source of conflicts and disputes.

Good offices and mediation produce only advisory effects, which are not binding. Good offices attempt only to provide the conditions for the resumption or continuation of negotiation, while the mediator plays a more active role by participating in the negotiation. The purpose of both good offices and mediation is to stimulate, rather than replace, direct negotiations.

(b) *Conciliation and arbitration*

Conciliation is not aggressive in nature. It results in a recommended settlement which must be accepted by the parties, while arbitration contains an element of conflict and produces binding awards.

In many international instruments, special provisions and annexes are devoted to detailed procedures for dispute settlement or conciliation. Some procedures are compulsory and some are optional.

(c) *Judicial settlement*

Judicial settlement is another means for disputes settlement. The International Court of Justice, at the Hague, in the Netherlands, acts as a world court. It presides over disputes of a legal nature submitted to it by States, in accordance with international law. It was set up in 1946 under the charter of the United Nations to be the principal organ of the organization. Furthermore, its basic instrument, the Statute of the Court, forms and integral part of the charter. The Manila Declaration provides that it is desirable for States to "consider the possibility of inserting in treaties, whenever appropriate, clauses providing for the submission to the ICJ of disputes which may arise from the interpretation or application of such treaties".

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[135] Available at: http://sedac.ciesin.org/pidb/texts/mediterranean.pollution.1976.html.

3. *Settlement of disputes according to United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses*

Article 33 of the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses sets an entire mechanism for settlement of disputes by stating the following (see box 5 for full text of annex on Arbitration):[136]

(a) "In the event of a dispute between two or more Parties concerning the interpretation or application of the present Convention, the Parties concerned shall, in the absence of an applicable agreement between them, seek a settlement of the dispute by peaceful means in accordance with the following provisions;

(b) "If the Parties concerned cannot reach agreement by negotiation as requested by one of them, they may jointly seek the good" offices of, or request mediation or conciliation by, a third party, or make use, as appropriate, of any joint watercourse institutions that may have been established by them or agree to submit the dispute to arbitration or to the International Court of Justice;

(c) "Subject to the operation of paragraph 10, "If after six months from the time of the request for negotiations referred to in paragraph 2, the Parties concerned have not been able to settle their dispute through negotiation or any other means referred to in paragraph 2, the dispute shall be submitted, at the request of any of the Parties to impartial fact-finding in accordance with paragraphs 4 to 9, unless the Parties otherwise agree;

(d) "A Fact-finding Commission shall be established, composed of one member nominated by each Party concerned and in addition a member not having the nationality of any of the Parties concerned chosen by the nominated members who shall serve as Chairman;

(e) "If the members nominated by the Parties are unable to agree on a Chairman within three months of the request for the establishment of the Commission, any Party concerned may request the Secretary-General of the United Nations to appoint the Chairman who shall not have the nationality of any of the parties to the dispute or of any riparian State of the watercourse concerned. If one of the Parties fails to nominate a member within three months of the initial request pursuant to paragraph 3, any other Party concerned may request the Secretary-General of the United Nations to appoint a person who shall not have the nationality of any of the parties the dispute or of any riparian State of the watercourse concerned. The person so appointed shall constitute a single-member Commission;

(f) "The Commission shall determine its own procedure;

(g) "The Parties concerned have the obligation to provide the Commission with such information as it may require and, on request, to permit the Commission access to their respective territory and to inspect any facilities, plant, equipment, construction or natural feature relevant for the purpose of its inquiry;

(h) "The Commission shall adopt its report by a majority vote, unless it is a single-member commission, and shall submit that report to the Parties concerned setting forth its findings and the reasons therefore, and such recommendations as it deems appropriate for an equitable solution of the dispute, which the parties concerned shall consider in good faith;

(i) "The expenses of the Commission shall be borne equally by the Parties concerned;

(j) "When ratifying, accepting, approving or acceding to the present Convention, or at any time thereafter, a Party which is not a regional economic integration organization may declare in a written instrument submitted to the Depository that, in respect of any dispute not resolved in accordance with

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[136] United Nations, Convention on the Law of the Non-Navigational Uses of International Watercourses, Report of the Sixth Committee Convening as a Working Group of the Whole, General Assembly, fifty-first session, agenda item 144 (A/51/869), pp. 18-19.

paragraph 2, it recognizes as compulsory *ipso facto* and without special agreement in relation to any Party accepting the same obligation:

(i) "Submission of the dispute to the International Court to Justice;

(ii) "Arbitration by an arbitral tribunal established and operating, unless the parties to the dispute otherwise agreed, in accordance with the procedure laid down in the annex to the present Convention.

"A Party which is a regional economic integration organization may make a declaration with like effect in relation to arbitration in accordance with subparagraph (b)".

Box 5. The arbitration system proposed in the United Nations Convention on the Non-Navigational Uses of International Watercourses

Article 1. Unless the parties to the dispute otherwise agree, the arbitration pursuant to article 33 of the Convention shall take place in accordance with article 2 to 14 of the present annex.

Article 2. The claimant party shall notify the respondent party that it is referring a dispute to arbitration pursuant to Article 33 of the Convention. The notification shall state the subject matter of arbitration and include, in particular, the articles of the Convention, the interpretation or application of which are at issue. If the parties do not agree on the subject matter of the dispute, the arbitral tribunal shall determine the subject matter.

Article 3. 1. In disputes between two parties, the arbitral tribunal shall consist of three members. Each of the parties to the dispute shall appoint an arbitrator and the two arbitrators so appointed shall designate by common agreement the third arbitrator, who shall be the Chairman of the tribunal. The latter shall not be a national of one of the parties to the dispute or of any riparian State of the watercourse concerned, nor have his or her usual place of residence in the territory of one of these parties or such riparian State, nor have dealt with the case in may other capacity; 2. In disputes between more than two parties, parties in the same interest shall appoint one arbitrator jointly by agreement; 3. Any vacancy shall be filled in the manner prescribed form the initial appointment.

Article 4. 1. If the Chairman of the arbitral tribunal has not been designated within two months of the appointment of the second arbitrator, the President of the International Court of Justice shall, at the request of a party, designate the Chairman with a further two-month period; 2. If one of the parties to the dispute does not appoint an arbitrator within two months of the receipt of the request, the other party may inform the President of the International Court of Justice, who shall make the designation within a further two-month period.

Article 5. The arbitral tribunal shall render its decisions in accordance with the provisions of this Convention and international law.

Article 6. Unless the parties to the dispute otherwise agree, the arbitral tribunal shall determine its own rules of procedure.

Article 7. The arbitral tribunal may, at the request of one of the Parties, recommend essential interim measures protection.

Article 8. 1. The parties to the dispute shall facilitate the work of the arbitral tribunal and, in particular, using all means at their disposal, shall (a) Provide it with all relevant documents, information and facilities; and (b) Enable it, when necessary, to call witnesses or experts and receive their evidence; 2. The parties and the arbitrators are under an obligation to protect the confidentiality of any information they receive in confidence during the proceedings of the arbitral tribunal.

Article 9. Unless the arbitral tribunal determines otherwise because of the particular circumstances of the case, the costs of the tribunal shall be borne by the parties to the dispute in equal shares. The tribunal shall keep a record of all its costs, and shall furnish a final statement thereof to the parties.

Article 10. Any Party that has an interest of a legal nature in the subject matter of the dispute which may be affected by the decisions in the case, may intervene in the proceedings with the consent of the tribunal.

Box 5 (*continued*)

Article 11. The tribunal may hear and determine counterclaims arising directly out of the subject matter of the dispute.

Article 12. Decisions both on procedure and substance of the arbitral tribunal shall be taken by a majority vote of its members.

Article 13. If one of the parties to the dispute does not appear before the arbitral tribunal or fails to defend its case, the other party may request the tribunal to continue the proceedings and to make its award. Absence of a party or failure of a party to defend its case shall not constitute a bar to the proceedings. Before rendering its final decision, the arbitral tribunal must satisfy itself that the claim is well founded in fact and law.

Article 14. 1. The tribunal shall render its final decision within five months of the date on which it is fully constituted unless it finds it necessary to extend the time limit for a period which should not exceed five more months. 2. The final decision of the arbitral tribunal shall be confined to the subject matter of the dispute and shall state the reasons on which it is based. It shall contain the names of the members who have participated and the date of the final decision. Any member of the tribunal may attach a separate or dissenting opinion to the final decision; 3. The award shall be binding on the parties to the dispute. It shall be without appeal unless the parties to the dispute have agreed in advance to an appellate procedure; 4. Any controversy which may arise between the parties to the dispute as regards the interpretation or manner of implementation of the final decision may be submitted by either party for decision to the arbitral tribunal which rendered it".

Source: United Nations, Convention on the Law of the Non-Navigational Uses of International Watercourses, Report of the Sixth Committee Convening as a Working Group of the Whole, General Assembly, fifty-first session, agenda item 144 (A/51/869), pp. 21-24.

IX. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

(a) The ESCWA region will continue to face a growing water deficit. This will reach an estimated 69 bm^3 per year by 2025, or some 35 per cent of the estimated renewable plus non-conventional supplies. This takes into account the expected increase in the utilization of non-conventional resources;

(b) It is postulated that this water deficit will increase the pressure on fossil groundwater aquifers, which are mostly shared regional aquifers. Consequently, competition over these resources, could trigger or increase tensions, especially in cases where there are no agreements between riparian States;

(c) To potentially diffuse tensions and optimize the utilization and management of shared water resources in general, and shared aquifers in particular, the region must develop a cooperation mechanism regarding these important resources. Such a mechanism, which is to be developed in close coordination with the ESCWA body, the Committee on Water Resources, can be referred to by member States. This study highlights the main components of this mechanism and suggests a two-phase approach for implementation as follows:

(i) *Phase I: mechanism development*. During this phase, a framework for enhanced groundwater cooperation is developed. It would comprise: (a) a Charter on Groundwater Management; (b) a Draft Agreement; and (c) an action plan;

(ii) *Phase II: implementation phase*. This phase comprises the following: (a) identification; (b) development; and (c) implementation of pilot projects;

(d) Any legal arrangement to strengthen cooperation among ESCWA member States regarding shared aquifers must be founded on the following three principles:

(i) First, States are entitled to "a reasonable and equitable share of the beneficial uses of the waters";

(ii) Second, States are obligated not to cause each other substantial injury with regard to water quantity or quality;

(iii) Third, States have a duty to inform, consult and participate in negotiations with each other regarding development plans and projects affecting shared water resources.

These principles constitute the internationally recognized legal norms which apply to surface water. Nevertheless, it is widely recognized that they could be applied to groundwater. However, additional efforts are needed on national, regional and international levels to refine these rules and to make them suitable for shared aquifers;

(e) The disadvantages of the lack of cooperation and potential benefits of cooperation far outweigh the possible constraints or difficulties of developing the necessary cooperation regime. Therefore, it is in the interest of member States to pursue cooperation enhancement measures;

(f) Notably, previous efforts by ESCWA and other regional organizations have resulted in a number of cases of positive groundwater cooperation in the region. Examples include studies of the Hamad Basin, Gulf region, the basalt aquifer between Jordan and the Syrian Arab Republic, the Paleogene carbonate aquifers, and the Nubian sandstone aquifer system. These cases of cooperation must be assessed and utilized;

(g) If the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses is considered a codification, rather than a development, of international water law, then even if

it is not ratified by the required number of States, the legal norms that it promotes with respect to shared aquifers will still hold. Hence, States can still cite them;

(h) Advantageously, the Convention on the Law of the Non-Navigational Uses of International Watercourses recognizes the interrelationship of surface and groundwater resources. However, this recognition is then used to draw the fine lines or interfaces between these two types of water resources, namely, to determine when subsurface water becomes subject to the provisions on surface water. In essence, therefore, the provisions on groundwater are secondary or a by-product of the main thrust of the Convention, namely, the surface water provisions;

(i) The 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses distinguishes three types of aquifers according to their relation to surface water. These are defined as follows:

(i) Deep confined aquifers are labelled as "unrelated to surface water" and are excluded from the 1997 United Nations Convention on the Law of Non-Navigational Uses of International Watercourses. Strictly speaking, these aquifers, are directly or indirectly related, to surface water, depending on field conditions. Therefore, these aquifers were labelled wrongly as a result of a misuse of terminology;

(ii) Directly related aquifers are those that have a direct link to a recharging surface water system, namely, to the international watercourse. They are subject to the provisions of the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses only if they flow to the same outlet as the surface water. Otherwise they are excluded;

(iii) Indirectly related aquifers are those that receive water from a surface recharging system, in an indirect manner. They are excluded from the provisions of the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses.

To summarize, the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses basically applies only to groundwater which is directly connected to surface waters and provided that it flows to the same outlet as the stream water;

(j) It would seem that the 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses indirectly states that groundwater which is not, directly or indirectly, related to surface waters may be utilized without regard to the impact of this use across borders. While such a statement may be necessary and sufficient from the perspective of the impact from the watercourse, it is not sufficient from the perspective of the impact on the aquifer in another State;

(k) In essence, there is a need for coordination to regulate abstractions and minimize mutual harms arising from competitive pumping of shared aquifers, regardless of the magnitude of recharge to an aquifer. In other words, this need is the same in the case of recharge from a deep confined aquifer in an arid zone—where the recharge could be negligible—or from a shallow unconfined aquifer in a wet area with considerable direct or indirect recharge;

(l) The need to enhance current cooperation in the region regarding shared aquifers stems from political, socio-economic and environmental drives. Political drives comprise dispute aversion and the need to elaborate agreeable dispute management procedures. Socio-economic drives comprise meeting the growing demand, protecting the interests of sharing States and creating or expanding opportunities for broader economic cooperation. Environmental drives comprise resource conservation and enhanced resource planning and management;

(m) The potential benefits of cooperation include the following: avoidance of potential disputes; reduction of uncertainty in the planning of socio-economic development activities that depend on the shared aquifer; securing growing water demands; protection of the water rights of the parties involved; creation of

new opportunities for broader socio-economic cooperation; conservation of the resource and reduction of adverse mutual impacts; in addition to improvement the management of the resource and hence sustainability of economic growth;

(n) Technical, political, institutional and legal difficulties hinder the development of a cooperation regime. Technical difficulties are related to securing and harmonizing the data needed to properly assess the storage of water and to develop an equitable allocation and use. It can be the case that political relations in the region are liable to become a constraint on water cooperation. However, it is arguable whether water stresses combined with the opportunities that water cooperation can create, will encourage dialogues leading to favourable relations. Legal difficulties stem from the fact that States consider groundwater as a sovereign resource. Laws emphasize a State's sovereign right to exercise control over its own resources. The same treatment is sometimes reflected on a national level where the law grants absolute ownership of groundwater. Hence, legal reforms will be required to accommodate the international dimension of this resource. The principle institutional difficulty is the weakness of the institutional arrangements for management of water resources on national levels. However, over the past decade or so, the water sector in many ESCWA countries has undergone extensive institutional and legal reforms to overcome the problem of fragmentation. In fact, many the institutional weakness have been overcome.

B. RECOMMENDATIONS

Increasing utilization of shared water resources is a potential source of tension among States. It is argued, however, that the vital importance of these resources could overcome the constraints on cooperation and lead to equitable sharing agreements. In addition, these resources can also become a medium for cooperation beyond the mere allocation of water. Indeed, they can help to build broader socio-economic interests among member States. Therefore:

(a) Member States are strongly encouraged to openly address the issue of water sharing, assess their cooperation needs and develop the necessary policies in this regard, if none exist. The mandate of the Committee on Water Resources, makes it the suitable forum for enhancing cooperation in this regard;

(b) The region must have a cooperation mechanism regarding shared aquifers. The starting point in the process of initiating the proposed mechanism for cooperation regarding shared aquifers is to prepare a Framework for Enhanced Groundwater Cooperation. This would be presented to the Committee on Water Resources for ratification. ESCWA can provide the support needed for the development of the desired cooperation mechanism. Member States are encouraged to join this process;

(c) Water professionals and managers are strongly encouraged to assume a proactive role that will aim to raise awareness among decision makers in member States concerning the need for cooperation. Furthermore, it will highlight the necessity for a cooperation mechanism to achieve the optimum sustained yield of a shared aquifer. More importantly, water professionals must become involved in legislative efforts whenever water issues arise, both in the domestic and the international context;

(d) The region suffers a considerable shortage in expertise on legal aspects of water resources in general, and shared water resources in particular. Member States, donors and regional funding agencies are urged to develop plans and allocate funds to build national capacities in this important field.

Annex I

CURRENT SITUATION OF WATER AVAILABILITY AND DEMAND IN THE ESCWA REGION

The limited availability of freshwater resources is one of the key, if not the most important challenges, for the socio-economic development of ESCWA members. This is because water shortages in the next decade will affect virtually all sectors that consume water.

While ESCWA countries share the common problem of water scarcity, they have different categories of sources and varying quantities of conventional water, namely, river or aquifer. Moreover, the levels of development of these waters and overall water availability is not the same. Nevertheless, it is possible to divide these countries—on the basis of conventional sources of water—into the following two subregions:

(a) *Arabian peninsula subregion: Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Yemen*

Countries of this subregion are situated in arid zones. However, some, namely Oman and Yemen receive relatively more rain. This generates limited surface waters, namely, irregular, sporadic and unpredictable floods.

Groundwater and non-conventional water resources, namely, desalinated water and treated wastewater, are the major sources of water supply in this subregion. The main producing aquifers are Palaeozoic sands, Mesozoic sands/carbonates, Tertiary carbonates/volcanics, and Quaternary alluvium. Many of these aquifers are shared among countries of the region. Groundwater quality generally deteriorates as one moves from the recharge areas along mountain ranges towards the inland basins or the coast.

The main water resources problem for these countries includes the depletion of aquifers and deteriorating quality in major withdrawal zones.

(b) *The northern and north-eastern subregion: Egypt, Iraq, Jordan, Lebanon, Palestine, and Syrian Arab Republic*

These countries are situated in semi-arid zones. They have predominant to appreciable surface water resources that are delivered through major rivers, namely, the Euphrates, Nile, Tigris, Jordan and its tributaries, Orontes, Barada and Litani. Efforts to regulate and develop surface water resources in this subregion have been remarkable, as evidenced by the many major water reservoirs in Egypt, Iraq, Jordan, Lebanon and the Syrian Arab Republic.

Furthermore, groundwater resources are well developed in some areas of this subregion. Producing aquifers occur in Palaeozoic sandstones, Jurassic-Cretaceous-Palaeogenic carbonates, Tertiary volcanics and Quaternary alluvia. Water quality ranges from excellent to brackish.

The main water resource problem in this subregion is the weak legal arrangements regarding the utilization of the bulk of their surface water which is shared among themselves and with neighbouring non-ESCWA countries. The other problem is that countries in this group are now, or are about to become soon, at a critical point of equilibrium between the total water demand and the estimated available resources.

A. WATER AVAILABILITY

The water resources of the ESCWA region have been assessed by ESCWA[137] and other regional organizations.[138] Variations among member countries, regarding their water availabilities from conventional and non-conventional sources are clear from the findings of the various assessments made by ESCWA.

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[137] ESCWA, "Updating the assessment of water resources in ESCWA member States", Expert Group Meeting on Updating the Assessment of Water Resources in ESCWA Member States, Beirut, 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

[138] ACSAD, "Water resources and their utilization in the Arab world" (in Arabic), a paper presented at the Second Symposium on Water Resources in the Arab World held in Kuwait from 8 to 10 March 1997, in cooperation with the Arab Fund for Economic and Social Development (AFESD) and the Kuwait Fund for Arab Economic Development (KFAED).

1. *Conventional water resources*

Conventional water resources in the ESCWA region consist of surface water available from river flow and flash floods and groundwater from both shallow and deep aquifers. ESCWA's recent assessment of the water resources of the region[139] indicates that the magnitude of renewable (conventional) water sources for all ESCWA member States combined is estimated at 169 bm^3, with surface water volume estimated at 150.7 bm^3. The remaining 18.5 bm^3 represents sustainable groundwater withdrawals or renewable recharge (see annex table 1). Therefore, the average annual water availability per capita, based on the current population of the region, 168 million, is barely above the 1000 m^3 water poverty threshold.[140]

ANNEX TABLE 1. RENEWABLE WATER RESOURCES AND PROJECTED POPULATION IN THE ESCWA REGION

	Population (million)[a/]			Annual renewable water (conventional water resource) (bm^3)			Availability (m^3 per person per year)		
Country/area	2000	2010	2025	Surf. wat.	GW	Total	2000	2010	2025
Bahrain	0.613	0.689	0.789	0.002	0.100	0.102	163	145	127
Egypt	68.523	80.368	96.463	55 500	4 100	59.600	870	742	618
Iraq	23.280	31.071	43.482	70 370[b/]	2 000	72.370	3 109	2 329	1 664
Jordan	5.003	6.747	9.620	350	277	0.627	125	93	65
Kuwait	2.165	2.339	2.721	0.1	160	0.160	74	68	59
Lebanon	3.282	3.723	4.400	2 500	600	3.100	945	833	705
Oman	2.518	3.423	5.019	918	550	1.468	583	429	292
Palestine	2.859	3.972	5.987	30	185	0.215	371	271	276
Qatar	0.579	0.793	0.779	1.4	85	0.086	30	22	14
Saudi Arabia	21.930	31.363	54.029	2 230	3 850	6.080	277	194	113
Syrian Arab Republic	16.125	20.464	26.292	16 375[b/]	5 100	21.475	1 332	1049	817
United Arab Emirates	2.442	2.851	3.284	185	130	0.315	129	110	96
Yemen	18.654	28.661	44.036	2 250	1 400	3.650	196	127	83
Totals/averages	167.973	216.464	296.901	150.71	18.54	169.247	1 008	782	570

Source: ESCWA, "Updating the assessment of water resources in ESCWA member States", Expert Group Meeting on Updating the Assessment of Water Resources in ESCWA Member States, Beirut, 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

a/ Based on United Nations Secretariat, Department of Economic and Socila Affairs, Population Division, *World Population Prospects: The 1996 Revision* (ESA/P/WP.138), later republished as (ST/ESA/SER.A/167).

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

On the one hand, this per capita availability is a gross average for the region. The more critical issue is that the per capita availability has fallen below the 500 m^3 line of absolute water scarcity in eight ESCWA countries, namely, Bahrain, Jordan, Kuwait, Palestine, Qatar, Saudi Arabia, United Arab Emirates and Yemen and to less than 200 m^3 in all of these countries except Palestine and Saudi Arabia.

On the other hand, two countries, Egypt and Lebanon, which are endowed with important surface water resources, have already crossed the water poverty threshold. Egypt has 870 m^3 and Lebanon, 945 m^3. Only two other countries, namely, Iraq and the Syrian Arab Republic are still above this threshold.[141]

Furthermore, per capita water availability from renewable water sources is expected to decline as a result of high population growth in the region, which is estimated at 3.7 per cent in comparison with a world

[139] ESCWA, "Updating the assessment of water resources in ESCWA member States", Expert Group Meeting on Updating the Assessment of Water Resources in ESCWA Member States, Beirut, 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

[140] The ESCWA region has a smaller per capita of renewable water resources than other regions of the world (the 1997 estimate for the ESCWA region is 1,064 m^3, while it is 5,500 m^3 for Africa and 3,520 m^3 for Asia).

[141] With regard to Egypt, Iraq and the Syrian Arab Republic, per capita shares are based on natural, unrestricted flows from upstream. The use of dams can significantly reduce flows.

average of 1.7 per cent, and 0.7 percent in the industrialized countries (ACSAD).[142] Indeed, this trend of population growth has persisted in most ESCWA countries for several decades and it will lead to a further decline of the per capita water availability. By 2025 the population of the region will be approximately 297 million. Therefore, the regional per capita availability will decrease by nearly one half to some 570 m^3.

Water shortages have therefore, become acute in the ESCWA region, with the exception of countries that have major rivers. The Nile, Tigris, Euphrates, Orontes and Litani are major rivers that still provide water to Egypt, Iraq, Lebanon and the Syrian Arab Republic in the short run. However, Egypt, Iraq and the Syrian Arab Republic could face difficulties in this regard.

As a result of water stress, countries in the region are often forced to overcome their water supply shortages through groundwater mining. This applies to Jordan, the GCC countries and Yemen. Some use desalination, namely the GCC countries while others resort to the harvesting of sporadic floods, namely, Yemen, Jordan and most of GCC countries and more often, strict and painfall water rationing.

Groundwater mining for domestic and more significantly, for irrigation uses, is a common phenomenon in the ESCWA region. In addition to groundwater, flood waters from wadis are often captured and used in Saudi Arabia, Yemen and several other countries in the region for irrigation use. Furthermore, huge impoundment structures are built to retain flood water for direct use or for groundwater recharge.

This trend of declining water sources makes it necessary to implement strategies and policies that focus on economically viable supply and demand management schemes. Such schemes could include: increasing the reuse of treated waste and drainage water, rainfall management, artificial recharge, rehabilitation of water infrastructure to reduce leakage, desalination and demand management schemes that include effective pricing policies and the use of water-saving technology.

2. *Non-conventional water resources*

Non-conventional water resources, comprising desalinated water, treated wastewater and irrigation drainage water are utilized to varying degrees to supplement conventional sources for domestic, industrial and agricultural uses in the ESCWA region. Annex table 2 summarizes these resources.

ANNEX TABLE 2. USE OF NON-CONVENTIONAL WATER RESOURCES IN THE ESCWA REGION
(*Millions of cubic metres*)

Country/area	Non-conventional resources			
	Desalination	Wastewater	Drainage water reuse	Total
Bahrain	75	17.5	3	96
Egypt	6.6	4 920	3 800	8 727
Iraq	7.4	1 500	-	1 507
Jordan	2.5	61	-	64
Kuwait	388	30	-	418
Lebanon	1.7	2	-	4
Oman	51	23	-	74
Palestinian Authority	0.5	2	-	3
Qatar	131	28	-	159
Saudi Arabia	795	131	24	950
Syrian Arab Republic	2	1 447	1 270	2 719
United Arab Emirates	455	108	-	563
Yemen	9	52	-	61
Total, bm^3	1 925	8 322	5 097	15 344

Source: ESCWA, "Updating the assessment of water resources in ESCWA member States," Expert Group Meeting on Updating the Assessment of Water Resources in ESCWA Member States, Beirut, 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

[142] ACSAD, "Water resources and their utilization in the Arab world" (in Arabic), a paper presented at the Second Symposium on Water Resources in the Arab World, held in Kuwait from 8 to 10 March 1997, in cooperation with the Arab Fund for Economic and Social Development (AFESD) and the Kuwait Fund for Arab Economic Development (KFAED).

(a) *Desalinated water*

The ESCWA region has become a world leader in sea and brackish water desalination. As of 1997, there were more than 1,600 desalination plants in the GCC countries. The total capacity of currently operating desalination plants in the ESCWA region represented 56 per cent of worldwide capacity. A large number of these plants produce water at a rate of more than 100,000 m^3 per day. Plants with the most extensive capacities in the ESCWA region are located in Kuwait, Saudi Arabia and the United Arab Emirates. The remaining ESCWA member States produce limited volumes of desalinated water, mainly through private sector involvement in the tourism and industry sectors and for remote areas.

In 1997, the total output of desalinated water in the region amounted to 1.86 bm^3, equivalent to some 1.2 per cent of the annual renewable water resources of the region. Some 1.81 bm^3 is produced in the GCC countries. This equals more than 21 per cent of their annual renewable resources and meets more than 70 per cent of their domestic water requirements.

Favourable financial resources and energy supplies have enabled most GCC countries to build large desalination facilities that satisfy the majority of urban demands. Some large inland cities in Saudi Arabia, located far from the coastal zones, receive water from these desalination centres.

The GCC countries, in anticipation of increased demand for domestic supplies are installing excess desalination capacities. In Kuwait, Qatar and the United Arab Emirates, the installed capacities as of 1996 were 960, 1,000 and 1,140 litres per person per day, respectively.[143] The per capita consumption in most GCC countries exceeds 300 litres per day. The GCC countries have already taken steps to expand their desalination facilities to keep pace with the expected rise in demand.

As a result of the shortage of adequate water quantity and quality, desalinated water will continue to be the main source of domestic water in the GCC countries, despite the high cost of production. In the GCC region, desalination capacity is expected to increase from its current level of 2.1 bm^3 to more than 3 bm^3 by 2010. Desalination infrastructure in the GCC countries will require large financial investments, estimated at US$ 14.5 billion by 2010, to cover the cost of desalination and distribution facilities.[144]

The major obstacle to reliance on desalination as a main source of water in the ESCWA region is its high cost of production and transportation. The cost of producing one m^3 of desalinated water is substantially higher than that of surface or groundwater. The major cost element is still the initial capital investment for construction of the plant (30 to 60 per cent of the total cost), while operation and maintenance costs account for 40 to 70 per cent, and energy costs range between 20 to 70 per cent. Labour and material account for 10 to 30 per cent and membrane replacement accounts for 10 to 20 per cent, depending on the size and type of plant.

Construction costs assessed for the 1992-1997 period have ranged between US$ 1,047 and 1,774 per m^3 of installed capacity per day. Typical capital costs for plants of different capacities within and outside the ESCWA region are shown in table 3. The cost of production using different desalination processes depends on the following factors: technology, namely, multi-stage flash (MSF) or reverse osmosis (RO), size and expected life of the plant, whether the plant is dual purpose (water and power generation), quality of source water, plant location, interest rate, spare parts and other maintenance costs, energy cost, labour costs and the plant factor load.

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[143] In Egypt and Yemen, the desalination capacities in 1990 ranged from 1 to 8 litres per person per day in 1996.

[144] Dabbagh and A. Farj, "Importance of desalination technique development and its role in meeting water shortages in the Arab world" (in Arabic), a paper presented at the Second Symposium on Water Resources in the Arab World, held in Kuwait from 8 to 10 March 1997, in cooperation with AFESD and KFAED.

ANNEX TABLE 3. TYPICAL CAPITAL COSTS FOR SEAWATER DESALINATION PLANTS

Year	Type	Location	Capacity (m^3 per day)	Capital cost (US$ per m^3 per day)
1979	MSF[a/]	Jeddah III	88 000	3 936
1982	MSF	Jeddah IV	220 000	2 471
1985	MSF	Las Palmas, Canary Island	27 727	1 267
1986	MSF	Assir, Saudi Arabia	116 128	1 102
1987	MSF	Al-Khobar, Saudi Arabia	240 000	1 209
1989	MSF	Al Gubrah, Oman	45 454	2 970
1992	MSF	Medina – Yanbu II	144 000	1 364
1993	MSF	Al-Khobar III	240 000	1 417
1993	MSF	Al-Shuaibah	454 000	1 047
1981	MED[b/]	St. Croix	14 200	1 056
1985	MED	Las Palmas, Canary Island	22 727	1 505
1985	MED	Curacao, North America	10 000	1 300
1989	MED	Curacao, North America	10 000	2 100
1978	SWRO[c/]	Jeddah, Saudi Arabia	12 000	2 497
1981	SWRO	Key West, Florida	11 360	702
1984	SWRO	Al Dur, Bahrain	45 450	1 080
1985	SWRO	Las Palmas, Canary Island	22 727	1 117
1985	SWRO	Jeddah I Rehab, Saudi Arabia	56 800	758
1987	SWRO	Jubail III, Saudi Arabia	113 636	993
1988	SWRO	Jubail IV, Saudi Arabia	90 910	1 695
1989	SWRO	Fujairah, United Arab Emirates	9 090	1 650
1992	SWRO	Medina – Yanbu II	128 020	1 774
1992	SWRO	Al-Jubail III	90 000	1 522
1995	SWRO	Dhekelia, Cyprus	20 000	1 250

Source: A. Bushnak, "Non-conventional water resources", a background document presented at the Expert Group Meeting on Development of Non-Conventional Water Resources and Appropriate Technologies for Groundwater Management in the ESCWA Member Countries, Manama, 27-30 October 1997 (E/ESCWA/ENR/1997/WG.3/), p. 8.

a/ Multi-stage flash.
b/ Multiple effect distillation.
c/ Seawater reverse osmosis.

The relatively high cost of energy has been one of the most limiting factors with regard to desalinated-water production. However, the availability of abundant subsidized fuel in the GCC countries has mitigated the impact of this factor and allowed the GCC countries to expand the production of desalinated water and rely more heavily on this source.

Given subsidized energy costs in the GCC countries, desalination costs reported by these countries are usually less than those elsewhere. They range from US$ 0.4 to 2.5 per m^3 for sea water and between US$ 0.4 to 1.5 per m^3 for brackish water, depending on the size of the plant. Recent cost reports for 20 major desalination plants in Saudi Arabia show that the average cost ranges from US$ 0.5 to 0.75 per m^3.[145] When the cost of energy is figured in at international prices, the cost rises to more than US$ 1 per m^3 for large-scale desalination plants and it may reach US$ 1.9 per m^3 for small plants. In Bahrain, the cost is US$ 0.56. In Kuwait, costs are estimated at US$ 0.94, with an additional US$ 0.72 per m^3 for distribution. In Qatar, the range is US $ 1.14 to 1.64. In the United Arab Emirates, water costs range from US$ 1 to 1.45. In other parts of the world, where the energy costs are not subsidized, production costs are somewhat higher. For example,

[145] A. Bushnak, "Non-conventional water resources", a background document presented at the Expert Group Meeting on Development of Non-Conventional Water Resources and Appropriate Technologies for Groundwater Management in the ESCWA Member Countries, Manama, 27-30 October 1997 (E/ESCWA/ENR/1997/WG.3/), p. 8.

in Florida and the United States Virgin Islands the costs range from US$ 2.06 to 2.60. In Malta the cost is US$ 1.18, and in the Canary Islands it is US$ 1.62.

A recent review indicated that the unit cost for water production in the GCC countries ranges from US$ 1 to 1.5 per m^3 for desalination plants with capacities of 20,000 m^3 (based on international energy costs). For plants with capacities in excess of 100,000 m^3 per day, costs can be reduced from US$ 0.7 to 0.8. For brackish water with salinity of less than 10,000 ppm, costs range from US$ 0.4 to US$ 0.5 for larger plants.[146]

The total cost for water from desalination usually reflects the cost of its production at the plant. The cost of transporting desalinated water depends on the distance to the distribution points. The transportation cost from large desalination plants located in the Gulf city of Jubail, Saudi Arabia, to the capital of Riyadh (460 km away and 620 m above sea level) was estimated at US$ 0.2 per m^3.

The high cost of desalination technology is expected to be offset, in the near future, by the promise of innovative hybrid processes, namely, chemical separation processes (absorption or ion exchange) in combination with physical processes such as membrane filtering. In addition, such technology may result in nearly 100 per cent water recovery. This is expected to improve plant efficiency and reduce or eliminate waste. Furthermore, the use of electrically charged membranes to filter out impurities also appears to be promising.

(b) *Treated wastewater and irrigation drainage water*

Treated wastewater and irrigation drainage waters are two other non-conventional sources that are utilized at different rates by countries of the ESCWA region.

To meet future water requirements, many countries will have to increase the use of treated wastewater. At present, the produced volumes of treated wastewater and drainage water varies among the ESCWA countries.[147] The average production of wastewater in the ESCWA region ranges from 30 to 100 litres per person per day, depending on the type and number of water-using household appliances. In situations where water from storm drainage or from shallow aquifers enters the sewerage system, the rate could reach 300 litres.

In some countries, wastewater is used directly for irrigation without treatment, while in others it receives advance treatment prior to reuse. In Egypt, the GCC countries, Jordan and Yemen, wastewater receives either primary or secondary treatment prior to use in irrigation, according to established national water reuse standards. Treatment levels in the GCC countries are mainly secondary and in some cases, tertiary.

The cost of wastewater treatment depends on the process used and the level of treatment required for a particular use. Based on the prior cost index, prices for treated wastewater range from US$ 0.15 to US$ 0.75 per m^3, for different levels of treatment. In 1997, treatment cost estimates were available for Oman and the United Arab Emirates. The cost of a tertiary wastewater treatment system in Oman, including collection and distribution, ranged between US$ 1.53 to 1.74 per m^3. In the United Arab Emirates, the cost of collection and treatment was estimated at US$ 0.13 per m^3, while for reuse it was estimated at US$ 0.40 per m^3. Wastewater treatment costs for reuse in the agricultural sector were estimated at US$ 0.13 per m^3, while distribution costs were estimated at US$ 0.04 per m^3.[148]

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[146] T. Dabagh and A. Farj, "Importance of desalination technique development and its role in meeting water shortages in the Arab World" (in Arabic), a paper presented at the Second Symposium on Water Resources in the Arab World held in Kuwait from 8 to 10 March 1997, in cooperation with AFESD and KFAED.

[147] I. Mahmoud and A. Sadik, "Reuse of treated wastewater" (in Arabic), a paper presented at the Second Symposium on Water Resources Development in the Arab World, held in Kuwait from 8 to 10 March 1997, in cooperation with AFESD and KFAED.

[148] ESCWA, "Review of the impact of pricing policy on water demand in the ESCWA region with a case study on Jordan", 1997 (E/ESCWA/ENR/1997/6).

The magnitude of wastewater reuse remains small in the ESCWA region compared to the available amount of treated effluent. The volume of recycled wastewater and irrigation drainage water was estimated at 8.2 bm^3 in 1997. The majority of this was in Egypt, Iraq, Saudi Arabia and Syrian Arab Republic.

Reuse of treated wastewater is being adopted and practised mainly for urban landscaping and irrigation, with the remaining unused wastewater disposed into the sea or into dry wadi channels. The magnitude of reuse in Egypt reached 0.9 bm^3 in 1997, and is expected to reach 5.8 bm^3 by 2007.

Reuse volume in the GCC countries reached 305 million m^3, which is approximately 40 per cent of the total volume of wastewater generated. Reuse volumes vary among the GCC countries. They are estimated at 14.5 million m^3 in Bahrain, 30 million m^3 in Kuwait, 21.5 million m^3 in Oman, 25 million m^3 in Qatar, 107 million m^3 in Saudi Arabia, and 108 million m^3 in the United Arab Emirates.

Estimates suggest that in Jordan, reuse of treated wastewater will reach 200 million m^3 in 2020. This will largely be provided by the irrigation sector.

Reuse of drainage water from irrigation has been practised in some of the ESCWA member countries. Reuse of drainage water in Egypt, Iraq and the Syrian Arab Republic in 1997 reached 3.8 bm^3, 1.3 bm^3 and 1.5 bm^3 respectively. Reuse of drainage water is also practised in Bahrain and Saudi Arabia, at magnitudes of 3 million m^3, and 24 million m^3, respectively.

Increased use of treated wastewater that meets the World Health Organization (WHO) standards contributed to remedying the supply-demand gap. The reuse of treated wastewater and drainage water is gaining momentum as a viable alternative to supplement conventional water sources for the agricultural sector and to a limited extent, in the industrial sector.

B. WATER DEMAND

Annex table 4 illustrates previous and projected water demands in the ESCWA region for 1990, 2000 and 2025. The data in this table were compiled by ESCWA from country papers, regional and international sources and a questionnaire administered by ESCWA to member States.

ANNEX TABLE 4. WATER USE AND PROJECTED DEMAND IN THE ESCWA REGION
(*Millions of cubic metres*)

Country/area	1990				2000				2025			
	Dom.	Agric.	Ind.	Total	Dom.	Agric.	Ind.	Total	Dom.	Agric.	Ind.	Total
Bahrain	112	120	17	249	132	124	26	282	169	271	169	609
Egypt	2 700	49 700	4 600	57 000	2 950	59 900	5 350	68 200	6300	69 100	10 900	86 300
Iraq	3 800	45 200	1 450	50 450	4 300	52 000	9 700	66 000	8 000	90 000	10 000	108 000
Jordan	190	650	43	883	388	791	63	1 242	700	900	160	1 760
Kuwait	295	80	8	383	375	110	105	590	1 100	140	160	1 400
Lebanon	271	875	65	1 211	312	950	150	1 412	1 100	2 300	450	3 850
Oman	117	1 150	5	1 272	262	1 500	85	1 847	630	1 500	350	2 480
Qatar	107	109	9	225	147	185	15	347	230	205	50	485
Saudi Arabia	1 508	14 600	192	16 300	2350	15 000	415	17 765	6 450	16 300	1 450	24 200
Syrian Arab Republic	650	6 930	146	7 726	1280	15 370	480	17 130	2 825	19 430	1 300	23 555
United Arab Emirates	513	950	27	1 490	750	1 400	30	2 180	1100	2 050	50	3 200
Palestine	78	140	7	225	260	217	18	495	800	420	70	1290
Yemen	168	2 700	31	2 899	360	3 150	61	3 571	840	3 650	134	4624
Total	10 509	123 204	6 600	140 313	13 866	150 697	16 498	181 061	30 244	206 266	25 243	261 753

Source: ESCWA, "Updating the assessment of water resources in ESCWA member States", Expert Group Meeting on Updating the Assessment of Water Resources in the ESCWA Member States. Beirut, 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

The data in the above table clearly demonstrate that the total water demand during the past decade has increased dramatically, as a result of high population growth, rapid urbanization, improved quality of life, industrial development and perhaps most importantly, tremendous expansion in irrigated agriculture driven by intensified efforts to attain self sufficiency in food. This has made agriculture the largest water user. It accounts for more than 85 per cent of total use.

1. *Agricultural demand*

The agricultural sector in the region relies on both irrigation and rain-fed farming. However in most member countries irrigation water requirements account for the majority of water use. Demand reached some 123 bm^3 in 1990, it increased to 136.5 bm^3 in 1997 and is expected to reach 206 bm^3 by 2025 (see annex table 4).

Low water use efficiency in the irrigation sector contributes to considerable waste of the limited water resources in the region. The water requirement to irrigate one hectare of land is estimated at 10,000 to 18,000 m^3 in Egypt, Iraq, Jordan and the Syrian Arab Republic, and 5,000 to 10,000 m^3 in Lebanon, Oman and Saudi Arabia, depending on the type of irrigation method and crop. The average requirement per hectare for the ESCWA member States is estimated at 11,500 m^3. Egypt, Iraq and Syrian Arab Republic have relied mainly on surface irrigation methods, with efficiencies ranging between 30 and 60 per cent. The remaining ESCWA member States, especially the GCC countries, have introduced modern sprinkler and drip irrigation systems, which are more efficient for water use than surface methods.

The agricultural sector, as a major water consumer, has contributed only a relatively small proportion to gross domestic product. However, this sector absorbs the majority of the work force in most countries of the region.

In the Arabian Peninsula, where renewable water resources are only able to meet a small portion of water demand, aspirations to attain food security have increased the agricultural water demand substantially over the past decade, leading to extensive mining of fossil groundwater. In Saudi Arabia water use for agriculture rose from 2 bm^3 in 1980 to 14.58 bm^3 in 1995. By 2000, it was expected to reach 17.8 bm^3.[149] This caused a depletion of some 35 per cent of the non-renewable groundwater resources estimated at 500 bm^3. In Bahrain, Oman and the United Arab Emirates, agricultural water use has also sharply increased as a result of Government policies aimed at achieving a high degree of food self sufficiency.[150] In Qatar, over-pumping has resulted in a continuous decline of the potentiometric surface and sea water intrusion estimated at 80 m per year. The amount of water abstracted from storage during the period 1971-1993 was estimated at 944 million m^3.[151]

The continuation of current agricultural practices in the ESCWA region will exert substantial pressure on already limited water resources. The goal of achieving self-sufficiency in food production in many of the ESCWA member States will lead to increased agricultural water demand and expansion of irrigated land. Vast improvements in irrigation efficiency, increased reuse of waste and drainage waters and the cultivation of low-water-consuming crops with high cash value must be initiated.

2. *Domestic demand*

Domestic water requirements represent only a small fraction of the total water utilized, particularly when compared to the agricultural sector. Bahrain, Kuwait, Qatar and Palestine are exceptions. Domestic

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[149] A. S. Al-Turbak, "Future water supply and demand predictions in Saudi Arabia", *Fourth Gulf Water Conference* held in Bahrain from 13 to 17 February 1999.

[150] J. Al-Alawi and M. Abdulrazzak, "Water in the Arabian Peninsula: problems and perspective", *Water in the Arab World*, Rogers and Peter Lydon, eds. (Harvard University Press, 1994), pp. 171-202.

[151] M. A. Al-Sulaiti, "A new vision to the water resources planning in Qatar", *Fourth Gulf Water Conference* held in Bahrain from 13 to 17 February 1999.

water demand has risen as a result of increases in per capita consumption for domestic and sanitation purposes, improvement in delivery services and urban migration.

Domestic water demand in ESCWA countries reached 10.5 bm^3 in 1990, 13.1 bm^3 in 1997 and is expected to reach 30 bm^3 by 2025 (see annex table 4).

The major problem with providing adequate water supplies to the domestic sector is wastage, encouraged by low water charges and high losses in the distribution systems. Leakages from the water distribution system range from 40 to 60 per cent.

The quality of drinking water and sanitation services in the majority of ESCWA countries has considerably improved over the past years, with the exception of Iraq, Lebanon and Yemen.

Adequate water quantity and quality are essential for the development and enhancement of economic and social development and for continued improvement in the quality of life.

Water is necessary to meet basic human (physiological), sanitary and comfort needs. Quality of life largely determines water consumption. A grown adult consumes, on average, 25 litres per person per day of freshwater to meet basic needs, another 25 litres per person per day for sanitary and health related comfort needs. Annex table 5 illustrates the typical household water consumption patterns. Most GCC countries follow such a water pattern.

ANNEX TABLE 5. TYPICAL DOMESTIC WATER USE
(Based on 300 litres per person per day consumption)

Kitchen	Toilet leaks	Baths	Faucets	Shower	Washing machines	Toilets
9	15	27	36	63	66	84

The per capita daily water consumptions in the region ranges from less than 50 litres in Yemen to 590 litres in Kuwait, with consumptions of 275 litres per day in Bahrain, 140 litres per day in Egypt, 206 litres per day in Iraq, 345 litres per day in Jordan, 118 litres per day in Lebanon, 495 litres per day in Qatar, 440 litres per day in Saudi Arabia and 219 litres per day in the Syrian Arab Republic.

3. *Industrial demand*

Industrial activities in most of the ESCWA member States have contributed to increases in total water requirements, albeit not as dramatically as in the agricultural sector. The topic of water use by industry is complex and has been studied by engineers and scientists (see annex box 1). Total industrial demand was some 6.6 bm^3 in 1990, it reached 6.7 bm^3 in 1993 and 8.6 bm^3 in 1997. It was estimated at 16.5 bm^3 in 2000 and is expected to reach 25 bm^3 by 2025 (see annex table 4).

The industrial production structures in most of the ESCWA member States are geared to consumer goods and petroleum refinement. Many industries in the region, especially in Egypt, Iraq, Jordan, Saudi Arabia and the Syrian Arab Republic, rely on raw materials derived from agricultural products. Major industries in Egypt, Iraq and the Syrian Arab Republic include: mining, cement, basic metals, textiles and food and beverage production. Industries in Oman, Saudi Arabia and the United Arab Emirates consist of petrochemicals, cement and limited food and beverage production. Most industrial activities are close to major urban centres, leading to competition with the domestic sector to satisfy water requirements. In urban areas with concentrated industrial activities, industrial water requirements represent the major water consumer in relation to domestic requirements. In most of the GCC countries, field development and petrochemical industries are considered to be water-use-intensive. Industries in Egypt and Iraq utilize surface water from major rivers, while the remaining countries rely on groundwater supplemented with surface water, desalination and a limited amount of recycled water.

Annex box 1. Industrial water use

Data on this type of water use are sometimes based on direct measurement, if the system is metered. However, estimates are commonly made on the basis of prior studies, using coefficients, namely, water per unit of production or per person employed by the industry. This method is not always reliable because of wide variations in labour force, plant processes and associated water technologies.

Selected date on industrial water consumption pattern are presented in the table below. Some water intensive industries such as the paper industry are not suitable for countries that have water problems. Another example is the power production industry. This requires huge amount of water for cooling. It is evident that inland located thermal power plants could not be operated with water cooling and that less efficient air cooling is the possible alternative. The table below reveals that 200 litres of cooling water are required to generate one kilowatt hour of electricity, while a steam condenser system will operate on only 5 litres of cooling water consumption.

TABLE. INDUSTRIAL WATER CONSUMPTION

Industry, product	Unit of product	Water required per unit m^3
Bread	-	4
Sugar	Tonne of sugar beets	6
Fruits and vegetables	-	> 5[a/]
Citrus fruits	Tonne of raw citrus	1 205
Slaughtering	Tonne of carcass	10
Beverages, aerated	Kilolitre (including cleaning of bottles)	22
Paper, industry, United States	Tonne of pulp and paper	90
Paper, industry, France (including cooling water)	Tonne of pulp and paper	150
Oil refineries, China	Tonne of crude petroleum	35.5
Oil refineries, Sweden	-	10
Caustic soda and chlorine, Canada	-	125
Caustic soda and chlorine, China	-	200
Textile, industry average	-	180
Portland cement	-	2.5
Electricity	Kilowatt-hour (consumptive use)	5 litres
Electricity, United States	Kilowatt hour	0.2
Laundry	Tonne of washed goods	45

Source: Compiled by ESCWA from various sources.

a/ Greater than.

Most industrial water is used for disposal of heat or other waste. It is returned to the water body (stream or lake). A small amount of water is actually consumed by industry. Hence, industrial use of water primarily affects the water quality. Furthermore, it is true that consumptive water use by industry is generall low. Some exceptions are water used in cooling towers, where approximately half of the cooling water can be lost to the atmosphere through evaporation.

C. SUPPLY-DEMAND IMBALANCES

1. *Water stresses in the region*

Water resource limitations are probably more significant in the ESCWA region than in any other region in the world. When the 1997 water requirements for all purposes, along with those projected for 2000 and 2025, are compared with the annually renewed groundwater and surface water sources, serious questions arise concerning the long-term economic and environmental sustainability of existing water resources and the pace of water resource development and utilization. Under existing conditions, it is unlikely that the expansion of irrigated agriculture will proceed without major water shortage problems. This is an emerging reality in some ESCWA member States.

If current consumption patterns continue unaltered, especially in the agricultural and domestic sectors, the majority of countries in the ESCWA region will be required to allocate financial resources to the construction of hydraulic structures, distribution systems and new desalination plants and support facilities with capacities capable of handling the increase in demand. This huge investment may result in considerable economic strain, especially in those countries with limited financial resources.

A further insight into the stresses on water resources in the region can be gained by examining the estimated ratio of water withdrawals or demand to water availability from renewable sources; commonly termed the Water Stress Index, WSI (see annex box 2).

Annex box 2. Water stress index

The WSI is the ratio of water withdrawal or use to water availability, calculated on an annual basis. The WSI is used to evaluate the current status of water resources.

The United Nations Economic and Social Council report on "Comprehensive assessment of freshwater resources of the world" (E/CN.17/1997/9) distinguished four levels of water stress as shown in table 1.

TABLE 1. LEVELS OF WSI

Low	WSI[a/] < 10 per cent: withdrawals are less than 10 per cent of the available freshwater resources.
Moderate	10 per cent < WSI < 20 per cent: withdrawals are between 10 to 20 per cent of the available water.
Medium-high	20 per cent < WSI < 40 per cent: withdrawals are between 20 to 40 per cent of the available water resources.
High	WSI[b/] > 40 per cent: withdrawals are more than 40 per cent of the available water (serious scarcity). Most ESCWA member countries fall in this category if proven economically feasible water resources are taken into account.

Typically, a WSI exceeding 40 per cent indicates high water stress and serious scarcity. Approximately one-third of the population of the world live in countries with moderate-to-high water stress. This is partly as a result of increasing demands from growing populations. By 2025, two-thirds of the world population could be under stress conditions. This will limit development, especially in poor societies.

The above classification assumes that, on average, a country will only capture approximately one-third of its annual flow of water. This limitation arises from economic, social and environmental considerations. These often force elimination of some sources on economic grounds, or prevent withdrawals or lead to flow reductions by dams in excess of certain thresholds on social or environmental grounds. However, this latter limitation does not seem to apply to ephemeral streams, namely, wadi flows, which are the main hydrologic units in arid and semi-arid zones.

Consequently, the above ranges for classification of water stresses can be modified for the ESCWA region to reflect these region-specific characteristics. Indeed, the findings of analyses by several member countries indicate a higher ratio of exploitable to available water resources, namely, Egypt. In this case, surface flow is concentrated in one river channel and water resources with the potential to be developed reach as much as 98 per cent. In other countries, namely, Oman, Saudi Arabia and Yemen, where water is more dispersed in a large numbers of wadis or aquifers, accessible water resources are more limited. Table 2 illustrates the adopted ratios of exploitable to available resources in some countries within and outside the region.

The data below indicates that it is safe to state that countries relying on groundwater resources can use as much as 90 per cent of their available resources. Furthermore, the available amount from both surface and groundwater sources is 70 to 80 per cent. Therefore, it can be concluded that in the ESCWA countries the threshold for high water stress is between 70 and 80 per cent, instead of 40 per cent.*

TABLE 2. AVAILABLE AND EXPLOITABLE WATER RESOURCES IN SELECTED ARAB COUNTRIES

	Available water resources	Exploitable resources	
	(Million m^3 per year)	(Million m^3 per year)	(Percentage)
Egypt	59 670	58 900	98
Morocco	30 000	21 000	70
Oman	2 387	1 910	80
Tunisia	4 800	3 800	79
United Arab Emirates	305	275	90
Yemen	3 860	3 060	79

Source: ESCWA, "Development of freshwater resources in the rural areas of the ESCWA region by using non-conventional techniques", 1999. (E/ESCWA/ENR/1999/16), p. 83.

a/ < less than.

b/ > greater than.

* ESCWA, "Development of freshwater resources in the rural areas of the ESCWA region by using non-conventional techniques", 1999. (E/ESCWA/ENR/1999/16), p. 83.

Annex table 6 illustrates that current values of the WSI in the region range from 46 in Lebanon to nearly 700 in the United Arab Emirates. Furthermore, based on the modified criteria for the WSI (see annex box 2), all countries of the region currently face high or serious water stress, except for Lebanon which is currently experiencing medium stress. However, this is set to become more acute in the near future. However, as demand increases, the present situation will deteriorate for all countries.

ANNEX TABLE 6. RENEWABLE WATER RESOURCES IN THE ESCWA REGION

Country/area	Total renewable water resources (million m^3)	Water demand (million m^3)		WSI[b/]	
	Total	2000	2025	2000	2025
Bahrain	100.2	282	609	281	508
Egypt	59 600	68 200	86 300	114	145
Iraq	72 370[a/]	66 000	108 000	91	149
Jordan	627	1 242	1 760	198	281
Kuwait	160.1	590	1 400	369	874
Lebanon	3 100	1 412	3 850	46	124
Oman	1 468	1 847	2 480	126	169
Palestine	215	495	1 290	230	600
Qatar	86.4	347	485	402	561
Saudi Arabia	6 080	17 765	24 200	292	398
Syrian Arab Republic	21 475[a/]	17 130	23 555	80	110
United Arab Emirates	315	2 180	3 200	692	1 016
Yemen	3 650	3 571	4 624	98	127
Total (BCM)	169.25	181 061	261 753	107	154

Source: ESCWA, "Updating the assessment of water resources in ESCWA member States", Expert Group Meeting on Updating the Assessment of Water Resources in the ESCWA Member States, Beirut 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

a/ The flow of rivers may be lower due to upstream abstractions.

b/ Water use/available water.

High water stresses are met with extensive desalination and varying degrees of groundwater depletion. This is a process which is likely to be exacerbated with time, according to the WSI.[152]

2. *The water deficit*

The data in annex table 6 indicates that the water demand of some 140 bm^3 in 1990 was expected to reach 181 bm^3 in 2000. Therefore, the average annual rate of increase in water demand during 1990-2000 was some 2.6 per cent. This rate is predicted to fall to an average of some 1.5 per cent per year during the next 25 years. This fall can be attributed to several reasons, including changing agricultural policies in the region.

Nevertheless, even with policy changes, total demand will reach some 262 bm^3 by 2025. This exceeds the renewable resources of 169 bm^3 by some 93 bm^3, a deficit of more than 55 per cent. If supply from non-conventional sources continues to grow at the same pace as demand, namely, a 55 per cent increase by 2025, then the non-conventional sources, namely, desalination plus treated wastewater and drainage water, according to annex table 2, will grow from the current 15.3 bm^3 per year to 24 bm^3. Hence, the water deficit will be reduced to 69 bm^3 (93 - 24 = 69 bm^3, as shown in annex table 7). It is envisaged that the bulk of this deficit will have to come from groundwater mining.

Annex table 7 illustrates the projected water deficit for the north-eastern and Arabian Peninsula subregions. The deficit to supply ratio in the surface water dependent subregion is some 55/177 or 33 per cent. The ratio for the groundwater dependent subregion is some 23/14 or 165 per cent. This indicates that countries of the Arabian Peninsula subregion will face a relatively more challenging task in meeting demand.

[152] ESCWA, "Updating the assessment of water resources in ESCWA member States", Expert Group Meeting on Updating the Assessment of Water Resources in the ESCWA Member States, Beirut, 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

ANNEX TABLE 7. ESTIMATED WATER DEFICIT IN ESCWA SUBREGIONS BY 2025

Subregion	Total supply (bm^3)			Total demand (bm^3)	Deficit (bm^3)
	Renewable[a/]	Non-conventional[a/]	Total		
North eastern subregion	157.4	13	170	225	55
Arabian Peninsula subregion	11.9	2.3	14	37	23
Total deficit by 2025 (bm^3)					78
Minus an estimated increase of 9 bm^3 in non-conventional supplies (from 15.3 to 24 bm^3)					69

Source: Compiled by ESCWA from various sources.

a/ Water resources.

3. *Groundwater use and dependency of the region on groundwater resources*

Annex table 8 illustrates that the annual renewable groundwater in the ESCWA region or groundwater recharge, which amonts to 18.5 bm^3, represents some 11 per cent of the total annual renewable water resources of some 169 bm^3. This figure of 11 per cent reflects the supply dependency on groundwater on a regional level.

On a country level, however, groundwater becomes much more significant, in terms of percentage contribution to the total annual replenishment. Annex table 8 reveals that this contribution, or supply dependency on groundwater, varies from nearly 100 per cent in Kuwait to less than 3 per cent in Iraq. Figure 1 illustrates this dependency ratio in a graphical form. It shows the declining per capita share of water availability.

On the demand side, groundwater reserves from renewable shallow and non-renewable deep aquifers are currently the main source of water in the Gaza Strip, the GCC countries, Jordan and Yemen. They are being exploited to meet domestic and agricultural water requirements.

ANNEX TABLE 8. RENEWABLE WATER AVAILABILITY AND GROUNDWATER USE IN THE ESCWA REGION

Country/area	Renewable water resources (million m^3)			Groundwater use (million m^3)[b/]	GW significance, in terms of:	
	Surface water	Groundwater	Total		Renewable GW to total renewable water	GW use to total demand, 2000
Bahrain	0.2	100	100.2	258	99.80	91.49
Egypt	55 500	4 100	59 600	4 850	6.88	7.11
Iraq	70 370[a/]	2 000	72 370	513	2.76	0.78
Jordan	350	277	627	486	44.18	39.13
Kuwait	0.1	160	160.1	405	99.94	68.64
Lebanon	2 500	600	3 100	240	19.35	17.00
Oman	918	550	1 468	1 644	37.47	89.01
Palestine	30	185	215	200	86.05	40.40
Qatar	1.4	85	86.4	185	98.38	53.31
Saudi Arabia	2 230	3 850	6 080	14 430	63.32	81.23
Syrian Arab Republic	16 375[a/]	5 100	21 475	3 500	23.75	20.43
United Arab Emirates	185	130	315	900	41.27	41.28
Yemen	2 250	1 400	3 650	2 200	38.36	61.61
Total (bm^3)	150.71	18.54	169.25	29 811	10.95	16.46

Source: ESCWA, "Updating the assessment of water resources in ESCWA member countries", Expert Group Meeting on Updating the Assessment of Water Resources in the ESCWA Member States, Beirut, 20-23 April 1999 (E/ESCWA/ENR/1999/WG.1/7).

a/ The flow of rivers may be lower due to upstream abstractions.

b/ Groundwater.

Groundwater utilization in the ESCWA region as of 1996 reached 28.3 bm^3, compared to 18.5 bm^3 of groundwater recharge. This is considerably beyond the level of safe yield. In fact, 67 per cent of withdrawal took place in the GCC countries and Yemen.

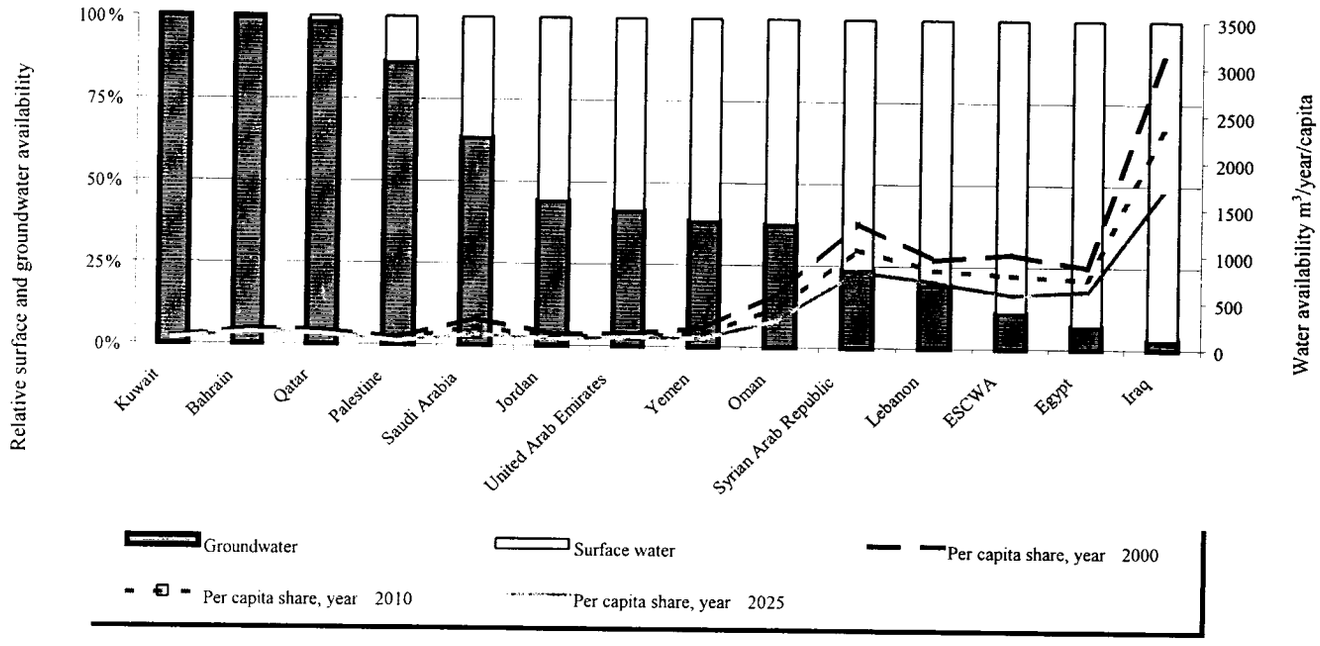
Groundwater withdrawal in 1996, in relation to the magnitude of the aquifer's safe yield, was twofold in Bahrain, Jordan and Yemen, threefold in Kuwait and Qatar, fourfold in Saudi Arabia, and sevenfold in the United Arab Emirates.[153] Additional withdrawal in excess of 1996 rates was observed in 1997. In the remaining ESCWA member States, groundwater utilization is much less than the replenishment rate. Groundwater has been mainly utilized for irrigation. This ranges from 49 per cent in Jordan to more than 70 per cent in Yemen and most GCC countries.

Current groundwater use data (see annex table 8) generally indicate that the present level of abstractions stands at some 29.8 bm^3 per year. This exceeds the annual replenishment of approximately 18.5 bm^3 by some 11 bm^3 per year, or by some 60 per cent of the annual replenishment. Therefore, considerable mining of groundwater in the region continues.

Furthermore, as a result of groundwater mining, the actual contribution of groundwater to the total demand or use in the region is more than 16 per cent (see annex table 8). This is on a regional level. On a country level, however, groundwater abstractions from renewable shallow and non-renewable deep aquifers are currently the main source of water in the GCC countries, Jordan and Yemen. In quantitative terms, groundwater contribution to total demand ranges from less than 1 per cent in Iraq to more than 90 per cent in Bahrain.

In conclusion, the above analysis clearly indicates that the region will face a considerable water deficit which amounts to as much as 69 bm^3 per year or approximately 36 per cent of renewable plus non-conventional supplies. It is postulated that this deficit will have to be met largely from fossil groundwater in deep shared aquifers.

Annex figure. Groundwater versus surface water contributions to annual renewable water resources in the ESCWA region and per capita shares during 2000, 2010 and 2025



Source: Compiled by ESCWA from various sources.

[153] See the country papers presented at ESCWA's Expert Group Meeting on Development of Non-Conventional Water Resources and Appropriate Technologies for Groundwater Management in the ESCWA Member States, held in Manama from 27 to 30 October 1997.

Annex II

PHYSIOGRAPHY OF THE MAJOR SURFACE WATER SYSTEMS IN THE ESCWA REGION

The status of surface water resources in the ESCWA region has received an increasing amount of attention. This is because the process of socio-economic development depends on these crucial but easily degraded resources.

An important issue in the management of shared surface water resources in the region is that more than 75 per cent of this resource is derived from outside the region (see annex table 9).

ANNEX TABLE 9. SURFACE WATER RESOURCES IN THE ESCWA REGION

ESCWA countries	Internal yield (bm^3)	Yield from outside the ESCWA region (bm^3)	Total (bm^3)
Iraq, Jordan, Lebanon, Palestine and Syrian Arab Republic	30.8	81	111.8
Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, United Arab Emirates and Yemen	9 (from seasonal wadis)	-	9
Egypt		55.5	55.5
Total	39.8	136.5	176.3

Source: M. A. Abu-Zeid, *Evaluation of Existing Status for Water Resources in Arab Nations*, ACSAD, Damascus, June, 1993.

This annex focuses on the four major river basins of the region: the Nile, the Tigris, Euphrates, and the Jordan (see annex table 10).

ANNEX TABLE 10. AVERAGE ANNUAL DISCHARGE RATES OF MAJOR RIVERS IN THE ESCWA REGION

River	Average annual discharge (million m^3)
Euphrates	31 820
Jordan	1 287
Nile	84 000
Tigris	42 230

Source: Compiled by ESCWA from various sources.

A. THE NILE RIVER

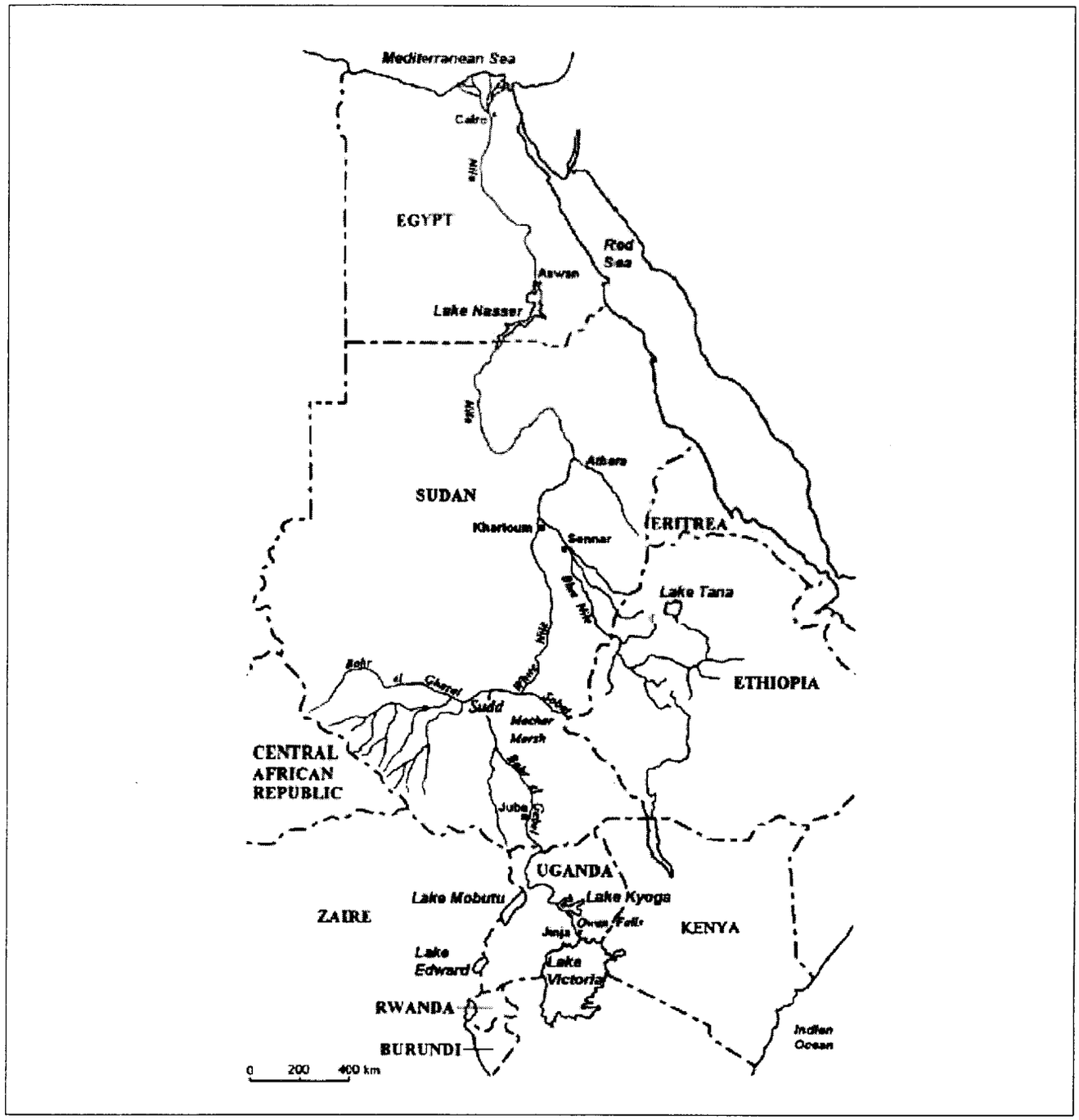
The Nile is unique in several respects. With a total drainage area of some 3.03 million km^2 (see annex table 11), it is the longest river in the world. It drains approximately one-tenth of the African continent and flows across nine countries before it empties into the Mediterranean Sea (see annex figure II). Its average annual discharge is approximately 84 bm^3. Nevertheless, the drainage basin of the Nile is only the fourth largest after the Amazon, Mississippi and Congo. At least 32 other major rivers carry more water during one year than the Nile.

ANNEX TABLE 11. NILE BASIN DRAINAGE

Country	Nile drainage area (km^2)	Percentage of total area of the Nile basin
Burundi	14 500	0.5
Egypt	300 000	9.9
Ethiopia and Eritrea	368 000	12.1
Kenya	55 000	1.8
Rwanda	21 500	0.7
Sudan	1 900 000	62.7
Uganda	232 000	7.7
United Republic of Tanzania	116 000	3.8
Zaire	23 000	0.8
Total	3 030 000	100

Source: Compiled by ESCWA from various sources.

Annex figure II. Nile basin



More importantly, no other river flows through so many climatic regions. The Nile rises in a rain forest near the Equator and runs for almost half of its length through semi-arid, arid and desert lands without receiving water from any perennial tributaries. As a result, no other river has such a complex hydrological regime.

The Nile flows 6,695 km from Burundi to the Delta in Egypt. It traverses 5,611 km from its source in Lake Victoria and 4,500 km from its source in Lake Tana in Ethiopia to the Mediterranean.

Lake Victoria is fed by the Kuja, Awach (or Kiboun), Miriu (or Sondu), Nyando, Nzoia, Sio and Yala rivers of Kenya and the Mara and the Kagera rivers to the south in the United Republic of Tanzania. The Kagera river drains the territories of Rwanda and Burundi and therefore, these countries are included within the Nile basin.

The Nile in Uganda provides the drainage outlet to Lake Victoria. The discharge passes through the Owen Falls Dam, built in 1954 and flows through Ugandan territory to Lake Kyoga and then westward to Lake Albert. From this lake, the river traverses to the north as the Albert Nile. In the Sudds of southern Sudan the river is known as Bahr el Gebel and beyond Malakal, as the White Nile. At Khartoum, it is joined by the Blue Nile, which drains Lake Tana in Ethiopia, and 174 km further north of Khartoum it is joined by the Atbara River, from Ethiopia. The Nile then makes a southwesterly loop in Sudan, flows in a northerly direction and crosses into Egypt at Wadi Halfa, finally discharging in the Mediterranean (see annex table 12).

ANNEX TABLE 12. AVERAGE ANNUAL RIVER FLOWS IN THE NILE SYSTEM

River	Annual discharge (million m^3)
Bahr El Gebel	26 000
Bahr El Ghazal	15 000
Sobat at Malakal	13 000
Total	54 000
Losses in swamps	(27 000)
White Nile at Malakal	26 000
Blue Nile at Junction	53 000
Atbara	11 600
Losses along river	(7 700)
Net available at Aswan	84 000

Source: Compiled by ESCWA from various sources.

As the Nile enters Egypt, its average annual discharge is approximately 84 bm^3. Of this, 24 bm^3 is derived from the main stream—the White Nile with its headwaters in Sudan and Uganda—and its two major tributaries rising in Ethiopia - 50 bm^3 from the Blue Nile and 10 bm^3 from the Atbara.

Varying estimates have been proposed with regard to the contribution of water to the Nile by various riparians. One Egyptian authority,[154] suggests that 84 per cent of the total annual discharge of the Nile derives from Ethiopia and only 16 percent from Burundi, Kenya, Rwanda, Uganda, United Republic of Tanzania, and Zaire.[155] In the opinion of J. Waterbury, the 12-month water year Ethiopia contributes 86 per cent and Lake Plateau 14 per cent to the Nile, whereas during the flood period, Ethiopia's contribution rises to 95 per cent. The Sudan and Egypt contribute no water to the Nile.

The annual flow entering Egypt is estimated at 84 bm^3. This flow was used as the figure for the mean annual discharge for the 1959 Agreement between Egypt and the Sudan. This figure, in turn, was based on the flow data for the period 1900-1959. Waterbury (1979) points out that this mean annual discharge is too modest when compared to the data for 1880-1980.[156] He indicates that the period 1900-1959 was marked by a series of low floods and that there is some evidence, although very weak, of a new rise in 1960. Thus, Waterbury maintains that the mean annual flow for the 100 years up to 1980 is 89.7 bm^3 (see annex table 13).

ANNEX TABLE 13. MEAN ANNUAL DISCHARGE OF THE NILE

Period	Number of years	Mean annual discharge (million m^3)
1870-1900	30	110 000
1900-1959	60	84 500
1870-1959	90	92 600
1880-1980	100	89 700

Source: J. Waterbury, *Hydropolitics of the Nile Valley* (New York, Syracuse University Press, 1979).

[154] G. M. Badr, "The Nile waters question: background and recent development", *Revue Egyptienne de Droit International* (1959), No. 15.

[155] J. Waterbury, *Hydropolitics of the Nile Valley* (New York, Syracuse University Press, 1979).

[156] Ibid.

Annex table 13 illustrates the periodical mean annual Nile flow for the past 110 years. It indicates that the average flow slightly varies if shorter durations are considered.

B. EUPHRATES

The Euphrates is often thought of as essentially an Iraqi river. This is because of its close associations with the history of the Mesopotamian plain. However, a long middle reach of the river flows through the Syrian Arab Republic and its upper course is wholly in Turkey (see annex figure II).

The Euphrates has its source on the Armenian Plateau in Turkey. Its Turkish name Firat and its Arabic name, al-Furat derive from successive distortions of the Sumerian name of Buranunu, which became Purati in Assyrian.

The Euphrates Basin covers some 444,000 km^2, 40 per cent in Iraq, 15 per cent in Saudi Arabia, 17 per cent in the Syrian Arab Republic and 28 per cent of which is situated in Turkey. Approximately 88 per cent of the Euphrates' water potential comes from the part of the basin situated in Turkey, the remaining 12 per cent comes from the Syrian basin.[157]

Some 2,300 km long, the Euphrates is the result of the joining the western Euphrates (or Furat Su) and the eastern Euphrates (or Murat Su). These unite on Turkish territory, near Kemar.

Flowing further north-east, the Euphrates cuts through the Taurus Massif. It receives the Tohma on its left, waters the Birecek and then, after having flowed through Turkey for over 420 km, penetrates into the Syrian Arab Republic at Djerablus.

In the Syrian Arab Republic, it receives the Koveik and the Jaghjagh, feeds Lake Assad and then receives two tributaries from the north, the Belikh and the Khabur. The Euphrates flows towards the south-east across the Syrian plateau. It flows for some 680 km across the Syrian Arab Republic and enters Iraq at the village of Abou Kamal.

The Euphrates splits into an eastern and a western branch in Baghdad. Subsequently, it rejoins the Tigris at Al Kurnah to form the Shatt al Arab. Annex table 14 illustrates the average flow of the Euphrates at various points. The flow reaches 7,000 m^3 per second during the months of thaw and decreases to some 100 m^3per seconds in the summer. Approximately 89 per cent of the Euphrates water potential and 52 per cent of that of the Tigris derives from Turkey.[158]

ANNEX TABLE 14. SOURCES OF THE EUPHRATES RIVER
(Millions of cubic metres per year)

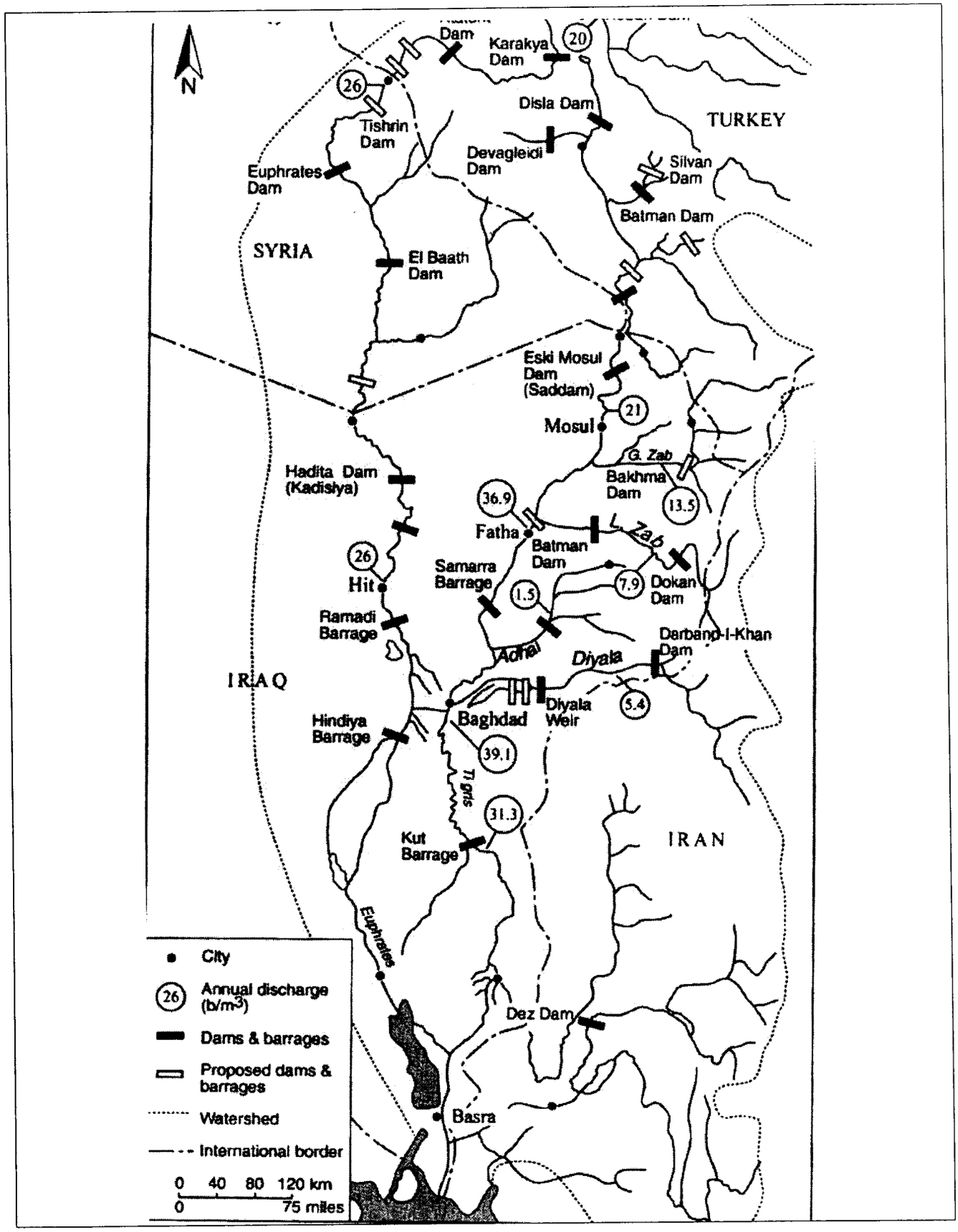
Euphrates		Natural flow
Flow from	Turkey	+ 30 670
Entering	Syrian Arab Republic	30 670
	Sajour	+ 125
	Belikh	+ 150
	Khabour	+ 1 500
	Other	+ 275
Entering	Iraq	32 720
Total: Shatt al Arab		32 720

Source: Compiled by ESCWA from various sources.

[157] T. Naff and R. C. Matson, "Water in the Middle East: conflict or cooperation? (Boulder, Westview Press, 1984).

[158] Government of Turkey, "Turkey and the question of water in the Middle East", Embassy of Turkey in Paris, Department of Information, 1992, pp. 3-4 (in French).

Annex figure III. Euphrates and Tigris basins



C. TIGRIS

The Tigris river rises in Lake Golcuk, some 24 km southeast of Elazig, in the Kurdistan area of east-central Turkey, not far from the Euphrates river. However, much of the potential drainage basin of the upper Tigris is cut off by the trellis development of the upper Euphrates.

The Tigris flows southeast across the southwestern edge of the mountains of the Armenian knot. It flows through a barren area to form, for approximately 32 km, the frontier between Turkey and the Syrian Arab Republic. It then runs steeply southeast into Iraq to Nineweh and Mosul. The Tigris acquires most of its discharge from Turkey and the Islamic Republic of Iran. Contributions to its discharge from within Iraq are limited to the flow of the streams that enter the middle stretch of the Tigris from the western slopes of the Zagros. It receives flow from a number of important left bank tributaries, however, most notably from the Kharun, a major river that provides the main portion of the Iranian input.

Below Mosul, the Tigris is joined from the northeast by the Great Zab and the Little Zab rivers which rise in the barren highlands of Kurdistan near the Iranian frontier.

Below Samarra, the Tigris receives the Adhaim, the Diyala and many smaller streams that drain the west slopes of the Taurus-Zagros Mountain system. It meanders east-south-east and then south to Baghdad.

Below the Kut barrage, the river, already rather unstable in its course, loses a main branch, the Shatt al Gharraf, which falls away south-southeast to the barrage at Akkaika and then joins the Euphrates.

The Tigris itself flows east and then swings round southeast to join the Euphrates at Al Kurnah, some 64 km above Basra. The combined river is known as the Shatt al Arab. This flows southeast through Basra and on for approximately 194 km through marshy country to the Gulf.

The Tigris carries a mean annual discharge of 1,339 m^3 per second, equivalent to 42.23 bm^3 per year (see annex table 15). Minimum instantaneous discharge is 163 m^3 per second, equivalent to 5.14 bm^3 per year; maximum instantaneous discharge has been 14,000 m^3 per second, equivalent to 44 bm^3 per year. The Tigris in its lower reaches is more subject to sudden destructive flooding than the lower Euphrates. This is because it lies much closer to sources of discharge. Floods in the lower Tigris Valley are particularly destructive when two or more of the left-bank tributaries are in flood concurrently. The lower Tigris carries more silt than the lower Euphrates. This is because this stretch of river is closest to the sediment source.[159] The Tigris annually moves 40 million m^3 of sediment past Baghdad, of which only a tenth reaches the Gulf.

ANNEX TABLE 15. SOURCES OF THE TIGRIS
(Millions of cubic metres per year)

Tigris		Natural flow
Flow from	Turkey	+ 18 500
Entering	Syrian Arab Republic	18 500
Entering	Iraq	18 500
	Inflows to Mosul	+ 2 000
	Greater Zab	+ 13 100
	Lesser Zab	+ 7 200
	Adhaim	+ 800
	Diyala	+ 5 400
	Other	+ 2 200
Total: Shatt al Arab		49 200

Source: Compiled by ESCWA from various sources.

[159] During floods, the Tigris carries up to 20,000 ppm silt by weight, five times the maximum flood load of the Nile.

Owing to the fact that Iraq, the Syrian Arab Republic and Turkey are aligned geographically in linear fashion for both rivers (Tigris and Euphrates), water quantity and quality is of great significance.

Return flow from irrigation drainage tends to have higher salinity, particularly given the high rates of evaporation in the region. Deteriorating water quality and decreasing water quantities will be dominant points of controversy for Arab-Turkish relations in the near future if current patterns of consumption are not radically altered.

D. THE JORDAN

The Jordan is a perennial river whose tributaries run through Israel, Jordan, Lebanon, Palestine and Syria Arab Republic (see annex table 16). It is divided into two main parts: the Upper Jordan—the headwaters—the Lower Jordan comprising the section between Lake Tiberia and the Dead Sea.

ANNEX TABLE 16. JORDAN BASIN BREAKDOWN

Country	Drainage basin (km^2)	Percentage of drainage basin
Israel (pre-1967)	1 925	10.61
Jordan	7 216	39.78
Lebanon	712	3.93
Palestine (occupied West Bank)	1 842	10.15
Syrian Arab Republic	6 445	35.53
Total	18 140	100

Source: Compiled by ESCWA from various sources.

Compared with the other rivers in the ESCWA region, it may be likened to a stream stretching no more than 200 km.

In the 1960s, prior to the implementation of different national water projects, the annual discharge from the lower Jordan was 474 million m^3. This roughly corresponded to 19 hours of natural discharge from the Nile at Aswan on a normal September day. However, in such an arid area, its water resources are valuable.

The headwaters of the Jordan originate from three main springs: Dan, in Israel; Hasbani, in Lebanon and Banias, in the Syrian Golan Heights presently under Israeli occupation (see annex table 17). The three streams join 6 km inside Israel to form the Upper Jordan River. The surface catchments of the springs do not alone account for the large quantities of water discharged from them; therefore, their undergroundwatershed must extend further to the north, northeast and eventually northwest, beyond the surface catchments and into Lebanon and the Syrian Arab Republic.

The Upper Jordan once flowed into Lake Hula. In the 1950s, however, Lake Hula and the surrounding area were drained and dried. Since then, the water has flowed through the so called Hula valley, joining Lake Tiberias further south, at 210 m below sea level.

Downstream of Tiberias is the onset of the Lower Jordan, where additional streams join the main river course. The biggest of these are the Yarmouk and Zarka rivers. These join the Lower Jordan from its eastern side. The Yarmouk flows from Jordan's borders with the Syrian Arab Republic, along its upper reaches and Jordan's borders with Israel in its lower reaches. The Zarka river lies within Jordan. The lower Jordan then flows into the Dead Sea at 395 m below sea level.[160]

The total discharge of the Jordan River into the Dead Sea—prior to the implementation of the different water projects in Israel, Jordan and the Syrian Arab Republic—was 1371 million m^3 per year. The discharge of the Yarmouk River into the Jordan River was approximately 392 million m^3 per year prior to the use of the water by various riparians.

[160] Saline levels of the Dead Sea range between 250,000-300,000 ppm. This is seven times as saline as the waters of the Mediterranean. The Dead Sea embodies the world's richest reserves of potassium and borax.

ANNEX TABLE 17. SUBDIVISIONS AND WATER BALANCE OF THE JORDAN RIVER SYSTEM PRIOR TO THE IMPLEMENTATION OF VARIOUS NATIONAL WATER PROJECTS

Source	Country	Flow (million m^3 per year)		
		Gain	Loss	Total
1. Upper Jordan				
(a) Dan	Israel	245		
(b) Hasbani	Lebanon	138		
(c) Banias	Syrian Arab Republic	121		
2. Total Jordan flow in Hula Valley				504
3. Irrigation in Hula Valley	Israel		(100)	
4. Local runoff Hula to Jisr Banat Yaqub	Israel/Syrian Arab Republic	140		
5. Total flow into Lake Tiberias (or Sea of Galilee)				544
6. In Lake Tiberias				
(a) Local runoff	Israel/Syrian Arab Republic	70		
(b) Rainfall over Lake	Israel	65		
(c) Springs in and around Lake	Israel	65		
7. Evaporation over Lake Tiberias	Israel		(270)	
8. Total outflow to lower Jordan				474
9. Yarmouk	Syrian Arab Republic/Jordan	392		
10. Wadis and springs in Ghor	Jordan/Israel	505		
11. Total discharge of the Jordan into the Dead Sea				1 371

Source: Adapted from T. Naff and R. C. Matson, "*Water in the Middle East: conflict or cooperation*?" Boulder, Westview Press, 1984, p. 29.

Israel uses all the water of the Upper Jordan, so that no fresh water flows downstream of Lake Tiberias from the Upper into the Lower Jordan.

The Syrian Arab Republic extracts 160 to 170 million m^3 per year, Jordan 100 to 110 million m^3 per year and Israel some 100 million m^3 per year, from the Yarmouk River.

Saline springs in the immediate surroundings of Lake Tiberias and at its end are channelled downstream of Tiberias into the headwaters of the Lower Jordan River.

The other wadis and springs on both sides of the Jordan Valley are dammed or captured by other constructions. That which remains—runoffs due to rains over areas downstream of water collection constructions, return flows or saltwater discharges—then joins the river.

In the past few years, the total discharge of the Jordan River into the Dead Sea has gradually declined to a mere 250 to 300 million m^3 per year, mostly as irrigation return flow, inter-catchment runoffs or saline spring discharges.

Before 1960, 1371 million m^3 of fresh water on average, used to flow annually to the Dead Sea. There used to be no change in the level of water because evaporation was balanced by the inflow of fresh water. However, today, because of extensive utilization of the waters of the Jordan, considerably less water feeds into the Dead Sea and consequently the water level is as low as 10 m. This change has affected the groundwater table around the Dead Sea.

While Lebanon and the Syrian Arab Republic are riparian States, it is Israel, Jordan and Palestine that have the most acute need for water from the Jordan and are most dependent on this river system. In fact, Jordan and Palestine are in an even more desperate situation than Israel. During recent decades, population growth, urbanization and economic expansion in both countries have increased the need for water. The river supplies Jordan with some 75 per cent of all the water it consumes.

Annex III

BIBLIOGRAPHY OF ESCWA'S MOST RECENT PUBLICATIONS ON THE LEGAL ASPECTS OF WATER RESOURCES

The most recent publications of ESCWA on the legal aspects of water resources are listed below:

Symbol	Title
E/ESCWA/42/Rev.1	"Report of the ECWA regional preparatory meeting for the United Nations water conference", held at Baghdad from 11 to 16 December 1976
E/ESCWA/NR/1990/2	*Identification and assessment of shared groundwater potential in two basins within ESCWA region* (March 1990)
E/ESCWA/ENR/1996/7	"Water resources assessment in the ESCWA region using remote sensing and GIS techniques", final report
E/ESCWA/ENR/1996/11	*Investigation of the regional basalt aquifer system in Jordan and the Syrian Arab Republic* (Amman, 1996)
E/ESCWA/ENR/1997/2	*Water legislation in selected ESCWA member countries* (United Nations publication, New York, 1997)
E/ESCWA/ENR/1997/7	*Transboundary water resources in the ESCWA region: utilization, management and cooperation* (United Nations publication, New York, 1998)
E/ESCWA/ENR/1999/6	*Groundwater resources in palegoene carbonate aquifers in the ESCWA region: preliminary evaluation*, (United Nations publication, New York, 1999)
E/ESCWA/NR/1990	Proceedings of ad hoc Expert Group Meeting on Water Security, held in Damascus from 13 to 16 November 1989
E/ESCWA/NR/89/WG.3/WP.5	"Working paper on towards establishment of Water Security in Western Asia", ad hoc Expert Group Meeting on Water Security in the ESCWA Region, held in Damascus from 13 to 16 November
E/ESCWA/NR/1993/WG.1/6	"Use of saline water for irrigation", paper prepared by the Arab Centre for the Studies of Arid Zones (ACSAD), Regional Symposium on Water Use and Conservation held in Amman from 28 November to 2 December 1993
E/ESCWA/NR/1993/WG.1/WP.1	التشريع المائي والجوانب التشريعية المرتبطة بالموارد المائية المشتركة Expert Group Meeting on Water Legislation in the ESCWA Region held in Amman from 24 to 26 November 1996
E/ESCWA/ENR/1996/WG.1/WP.1	Caponera, A. 1996. "Requirements for drafting a modern water code and water legislation in the ESCWA region" a paper prepared for the Expert Group Meeting on Water Legislation in the ESCWA Region, Amman, 24-26 November 1996

Symbol	Title
E/ESCWA/ENR/1996/WG.1/WP.2	"Water resources agreements and practices in selected water-sheds in the ESCWA region", a paper prepared for the Expert Group Meeting on Water Legislation in the ESCWA Region, Amman, 24-26 November 1996
E/ESCWA/ENR/1996/WG.1/WP.3	"Water legislation in selected ESCWA countries", a paper prepared for the Expert Group Meeting on Water Legislation in the ESCWA Region, Amman, 24-26 November 1996
E/ESCWA/ENR/1996/WG.1/WP.4	قانون المياه في الإسلام
E/ESCWA/ENR/1996/WG.1/WP.5	"International law and shared rivers", a paper prepared for the Expert Group Meeting on Water Legislation in the ESCWA Region, Amman, 24-26 November 1996
E/ESCWA/ENR/1996/WG.1/WP.6	"Water sector management, legislation and enforcement in the ESCWA region", a paper prepared for the Expert Group Meeting on Water Legislation in the ESCWA Region, Amman, 24-26 November 1996
E/ESCWA/ENR/1996/WG.1/WP.9	"Legal aspects of basin authorities as effective means for sustainable water management", a paper prepared for the Expert Group Meeting on Water Legislation in the ESCWA Region, Amman, 24-26 November 1996

Annex IV

INTERNET SOURCES ON INTERNATIONAL WATER LAW

(a) *Water law and policy resources*

(i) Transboundary Freshwater Dispute Database, Oregon State University Department of Geosciences, in collaboration with other agencies and individuals. Available at: http://terra.geo.orst.edu/users/tfdd/.

(ii) The International Boundary and Water Commission, United States and Mexico. Available at: http://www.ibwc.state.gov/.

(iii) International Joint Commission (United States and Canada). Available at: http://www.cec.org/.

(iv) North American Commission on Environmental Co-operation (CEC). Available at: http://www.cec.org/.

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(vi) American Society for International Law - Environmental Law Interest Group.

(vii) American Bar Association - International Environmental Law Committee. Available at: http://www.asil.org/RESOURCE/Treaty2.htm. http://www.abanet.org/intlaw/divisions/public/intl_env.html.

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(xiii) Environmental Information Resources, "International environmental resources by country", The George Washington University, Green University Initiative. Available at: http://www.gwu.edu/~greenu/inter.html.

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(xvi) Water and Conflict, Israeli Palestinian water conflict and the Jordan river basin. Available at: http://waternet.rug.ac.be/.

(b) *Treaty web sites*

(i) Environmental Treaties and Resource Indicators (ENTRI). Available at: http://sedac.ciesin.org/entri/.

(ii) Pace Virtual Environmental Law Library. Available at: http://www.pace.edu/lawschool/env/fullusa.html.

(iii) Fletcher School, Tufts University, "Multilaterals Project". Available at: http://www.tufts.edu/flether/multilaterals.html.

(iv) United Nations Treaty Collection. Available at: http://untreaty.un.org.

(v) United Nations Environmental Programme. Available at: http://www.unep.org/.

(vi) UN/ECE Task Force on Monitoring and Assessment under the Convention on Protection and Use of Transboundary Watercourses and International Lakes. Available at: http://www.waterland.net/riza/imac-water/.

(c) *Other useful web sites*

(i) International Water Resources Association, "Water Resources and the Internet", *Water International* vol. 24, No. 2 (1999). Available at: http://www.iwra.siu.edu/win/internet.html.

(ii) The World's Water, Pacific Institute for Studies in Development, Environment and Security. Available at: http://www.worldwater.org/.

(iii) World Resources Guide 1998-1999. Available at: http://www.wri/wr-98-99/.

(iv) The World Conservation Union. Available at: http://www.iucn.org/themes/wani/.

(v) International Union for the Conservation of Nature (IUCN). Available at: http://www.iucn.org/.

(vi) Euro-Mediterranean Information System. Available at: http://www.emwis.org/.

(vii) Hydrology Web: http://terrassa.pnl.gov:2080/EESC/resourcelist/hydrology.html.

(viii) International Association of Hydrogeologists. Available at: http://www.iah.org/.

(ix) United States Geological Survey: http://water.usg.gov/.

(d) *Water-related discussion lists*

(i) The Water Forum
Nickname: waterforum
Purpose: discussion of water resources issues, including both groundwater and surface water, in addition to drinking water, wastewater and any other relevant water resources and or sanitation topics.
To subscribe: send a blank e-mail to: waterforum-subscribe@eGroups.com.

(ii) Water Policies
Nickname: AGUA-ES
Purpose: Spanish-language list including discussion of water law and environmental protection.
Available at: http://www.rediris.es/list/info/agua-es.html.

(iii) World Commission on Dams
Nickname: irn-wcd
Purpose: To update interested parties on general dam issues and the progress of the Commission, namely, hearings and press releases. The World Commission on Dams is maintained by the International Rivers Network.
To subscribe: Send the command "subscribe irn-wcd" in the body of the message to Majordomo@igc.org.

(iv) International Environmental Law
Nickname: INTENVIRON
Purpose: Discussion of issues related to international environmental law
To subscribe: Send the command "subscribe INTEVIRON" in the body of the message to LISTSERV@ABANET.ORG.

Annex V

THE HELSINKI RULES ON THE USES OF THE WATERS OF INTERNATIONAL RIVERS

Adopted by the International Law Association at the fifty-second conference, held at Helsinki in August 1966. Report of the Committee on the Uses of the Waters of International Rivers (London, ILA, 1967). Available at: http://www.internationalwaterlaw.org/IntlDocs/Helsinki_Rules.htm.

CHAPTER 1. GENERAL

Article I

The general rules of international law as set forth in these chapters are applicable to the use of the waters of an international drainage basin except as may be provided otherwise by convention, agreement or binding custom among the basin States.

Article II

An international drainage basin is a geographical area extending over two or more States determined by the watershed limits of the system of waters, including surface and underground waters, flowing into a common terminus.

Article III

A "basin State" is a State the territory of which includes a portion of an international drainage basin.

CHAPTER 2. EQUITABLE UTILIZATION OF THE WATERS OF AN INTERNATIONAL DRAINAGE BASIN

Article IV

Each basin State is entitled, within its territory, to a reasonable and equitable share in the beneficial uses of the waters of an international drainage basin.

Article V

I. What is a reasonable and equitable share within the meaning of article IV to be determined in the light of all the relevant factors in each particular case.

II. Relevant factors which are to be considered include, but are not limited to:

1. The geography of the basin, including in particular the extent of the drainage area in the territory of each basin State;

2. The hydrology of the basin, including in particular the contribution of water by each basin State;

3. The climate affecting the basin;

4. The past utilization of the waters of the basin, including in particular existing utilization;

5. The economic and social needs of each basin State;

6. The population dependent on the waters of the basin in each basin State;

7. The comparative costs of alternative means of satisfying the economic and social needs of each basin State;

8. The availability of other resources;

9. The avoidance of unnecessary waste in the utilization of waters of the basin;

10. The practicability of compensation to one or more of the co-basin States as a means of adjusting conflicts among uses; and

11. The degree to which the needs of a basin State may be satisfied, without causing substantial injury to a co-basin State.

III. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is reasonable and equitable share, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

Article VI

A use or category of uses is not entitled to any inherent preference over any other use or category of uses.

Article VII

A basin State may not be denied the present reasonable use of the waters of an international drainage basin to reserve for a co-basin State a future use of such waters.

Article VIII

1. An existing reasonable use may continue in operation unless the factors justifying its continuance are outweighed by other factors leading to the conclusion that it be modified or terminated so as to accommodate a competing incompatible use.

2. (a) A use that is in fact operational is deemed to have been an existing use from the time of the initiation of construction directly related to the use or, where such construction is not required, the undertaking of comparable acts of actual implementation;

(b) Such a use continues to be an existing use until such time as it is discontinued with the intention that it be abandoned.

3. A use will not be deemed an existing use if at the time of becoming operational it is incompatible with an already existing reasonable use.

CHAPTER 3. POLLUTION

Article IX

As used in this chapter, the term "water pollution" refers to any detrimental change resulting from human conduct in the natural composition, content, or quality of the waters of an international drainage basin.

Article X

1. Consistent with the principle of equitable utilization of the waters of an international drainage basin, a State:

(a) Must prevent any new form of water pollution or any increase in the degree of existing water pollution in an international drainage basin which would cause substantial injury in the territory of a co-basin State;

(b) Should take all reasonable measures to abate existing water pollution in an international drainage basin to such an extent that no substantial damage is caused in the territory of a co-basin State.

2. The rule stated in paragraph 1 of this article applies to water pollution originating:

(a) Within a territory of the State; or
(b) Outside the territory of the State, if it is caused by the State's conduct.

Article XI

1. In the case of a violation of the rule stated in paragraph 1 (a) of article X of this chapter, the State responsible shall be required to cease the wrongful conduct and compensate the injured co-basin State for the injury that has been caused to it.

2. In a case falling under the rule stated in paragraph 1 (b) of article X, if a State fails to take reasonable measures, it shall be required promptly to enter into negotiations with the injured State with a view towards reaching a settlement equitable under the circumstances.

CHAPTER 4 . NAVIGATION (Articles XII-XX)

CHAPTER 5. TIMBER FLOATING (Articles XXI-XXV)

CHAPTER 6. PROCEDURES FOR THE PREVENTION AND SETTLEMENT OF DISPUTES

Article XXVI

This chapter relates to procedures for the prevention and settlement of international disputes as to the legal rights or other interests of basin States and of other States in the waters of an international drainage basin.

Article XXVII

Consistently with the Charter of the United Nations, States are under an obligation to settle international disputes as to their legal rights or other interests by peaceful means in such a manner that international peace and security and justice are not endangered.

It is recommended that States resort progressively to the means of prevention and settlement of disputes stipulated in articles XXIX to XXXIV of this chapter.

Article XXVIII

1. States are under a primary obligation to resort to means of prevention and settlement of disputes stipulated in the applicable treaties binding upon them.

2. States are limited to the means of prevention and settlement of disputes stipulated in treaties binding upon them only to the extent provided by the applicable treaties.

Article XXIX

1. With a view to preventing disputes from arising between basin States as to their legal rights or other interest, it is recommended that each basin State furnish relevant and reasonably available information to the other basin States concerning the waters of a drainage basin within its territory and its use of, and activities with respect to, such waters.

2. A State, regardless of its location in a drainage basin, should in particular furnish to any other basin State, the interests of which may be substantially affected, notice of any proposed construction or installation which would alter the regime of the basin in a way which might give rise to a dispute as defined in article XXVI. The notice should include such essential facts as will permit the recipient to make an assessment of the probable effect of the proposed alteration.

3. A State providing the notice referred to in paragraph 2 of this article should afford the recipient a reasonable period of time to make an assessment of the probable effect of the proposed construction or installation and to submit its views thereon to the State furnishing the notice.

4. If a State has failed to give the notice referred to in paragraph 2 of this article, the alteration by the State in the regime of the drainage basin shall not be given the weight normally accorded to temporal priority in use in the event of a determination of what is a reasonable and equitable share of the waters of the basin.

Article XXX

In case of a dispute between States as to their legal rights or other interests, as defined in article XXVI, they should seek a solution by negotiation.

Article XXXI

1. If a question or dispute arises which relates to the present or future utilization of the waters of an international drainage basin, it is recommended that the basin States refer the question or dispute to a joint agency and that they request the agency to survey the international drainage basin and to formulate plans or recommendations for the fullest and most efficient use thereof in the interests of all such States.

2. It is recommended that the joint agency be instructed to submit reports on all matters within its competence to the appropriate authorities of the member States concerned.

3. It is recommended that the member States of the joint agency in appropriate cases invite non-basin States which by treaty enjoy a right in the use of the waters of an international drainage basin to associate themselves with the work of the joint agency or that they be permitted to appear before the agency.

Article XXXII

If a question or a dispute is one which is considered by the States concerned to be incapable of resolution in the manner set forth in article XXXI, it is recommended that they seek the good offices, or jointly request the mediation of a third State, of a qualified international organization or of a qualified person.

Article XXXIII

1. If the States concerned have not been able to resolve their dispute through negotiation or have been unable to agree on the measures described in articles XXXI and XXXII, it is recommended that they form a commission of inquiry or an *ad hoc* conciliation commission, which shall endeavor to find a solution, likely to be accepted by the States concerned, of any dispute as to their legal rights.

2. It is recommended that the conciliation commission be constituted in the manner set forth in the annex.

Article XXXIV

It is recommended that the States concerned agree to submit their legal disputes to an ad hoc arbitral tribunal, to a permanent arbitral tribunal or to the International Court of Justice if:

(a) A commission has not been formed as provided in article XXXIII; or
(b) The commission has not been able to find a solution to be recommended; or
(c) A solution recommended has not been accepted by the States concerned; and
(d) An agreement has not been otherwise arrived at.

Article XXXV

It is recommended that in the event of arbitration the States concerned have recourse to the Model Rules on Arbitral Procedure prepared by the International Law Commission of the United Nations at its tenth session b/in 1958.

Article XXXVI

Recourse to arbitration implies the undertaking by the States concerned to consider the award to be given as final and to submit in good faith to its execution.

Article XXXVII

The means of settlement referred to in the preceding articles of this chapter are without prejudice to the utilization of means of settlement recommended to, or required of, members of regional arrangements or agencies and of other international organizations.

Annex VI

GLOSSARY OF LEGAL TERMS AND MAXIMS*

The Glossary is intended to provide *prima facie* information on legal terms and maxims, relevant to the study of international law on shared water resources. It is not its purpose to give exhaustive definitions. Many terms have been omitted to keep the glossary within reasonable limits.

Absolute responsibility: as distinguished from the doctrine of culpability, according to this doctrine State responsibility may arise even in the absence of guilt (intent or negligence) imputable to a subject of international law.

Absolute territorial integrity: according to this doctrine, a riparian State may not use waters flowing within its lands in a way that could have unfavourable consequences on other riparian States. This doctrine is rejected by all upstream countries (either absolute or relative). See under absolute territorial sovereignty, community co-riparian States, limited territorial sovereignty and riparian.

Absolute territorial sovereignty: according to this doctrine, a riparian State has the absolute freedom to utilize the water flowing in its territories regardless of any effects upon other riparian States. See under absolute territorial integrity, community co-riparian States, limited territorial sovereignty and riparian. This doctrine has been rejected by international customary law on the basis that it is too extreme.

Absolute right: (a) right which may be exercised against everyone and (b) right which may be exercised irrespective of equitable considerations to the contrary. See under abuse of rights.

Abuse of rights: according to this doctrine an unmotivated or unreasonable exercise of a right amounts to an illegal act. See under absolute rights and estoppel.

Accession: (a) acquisition of title to additional territory through natural causes and (b) equivalent to adherence.

Acquired right: right gained through the influence of elapsing time, or inherited from ancient times. The possession may well have existed before the now generally accepted criteria developed. See under historic rights.

Adherence: acceptance of a treaty by a third State with the consent of the original parties.

Adoption: according to this doctrine international law is incorporated into municipal law by custom or statute. It does not become automatically part of municipal law. See under dualism and monism.

Aequo et bono, decision ex: equitable settlement of a dispute in disregard, if necessary, of existing law. See also under equity.

Arbitration: (a) in its wider sense: binding settlement of a dispute by a third party and (b) in its narrower sense: settlement on a legal basis by a third party.

Arbitration clause: stipulation in a treaty providing for the settlement by arbitration of disputes arising from the interpretation or application of the treaty.

Authoritative interpretation: interpretation of a treaty by the parties in a subsequent treaty.

Auto-interpretation: determination by an interested party of its own legal duties.

Border river: a river separating two States.

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* Main sources of glossary include: H. Campbell Black, *Black's Law Dictionary* (St. Paul, Minnesota, West Publishing Co., 1933), third edition; George Schwarzenberger, *A Manual of International Law* (Steven & Sons Limited, London, 1967), fifth edition and Webster's New World Dictionary.

Boundary river (see border river).

Clause compromissoire: arbitration clause.

Clausula rebus sic stantibus: according to this doctrine, a treaty is intended by the parties to be binding only as long as there is no vital change in the circumstances which, at the time of the conclusion of the treaty, all the parties had assumed.

Codification: (a) restatement or reform of law in written form and with binding effect and (b) synonym of restatement of law.

Co-imperium: joint exercise of supreme jurisdiction by two or more subjects of international law over territory which they refrain from subjecting to their own sovereignty. See under *condominium.*

Community co-riparian States: this doctrine favours ignoring political divisions to achieve maximum utilization of international water courses. This requires the existence of a high level of integration between the riparian States. Although the doctrine is highly tentative, the doctrine's application difficulties are increased by the absence of a rational measure to determine the maximum utilization of a given water resource. The doctrine is not yet considered as a part of the basis of present international water customary law. The doctrine is only applied in a few parts of the world. See under absolute territorial integrity, absolute territorial sovereignty, limited territorial sovereignty and riparian.

Compensation: substitute for restitution by way of monetary payment.

Compulsory jurisdiction: misnomer for limited jurisdiction.

Compulsory rules: legal rules which apply irrespective of consent. See also under optional rules.

Conciliation: mediation by a collective body, namely, the Security Council of the United Nations.

Condominium: joint exercise of sovereignty over territory by two or more subjects of international law. See also under *co-imperium.*

Consent: one of the fundamental principles of international law. Any change in the existing state of affairs requires the agreement of the parties legally concerned.

Continuity of States: maintenance of identity of international personality. See under State succession and succession of States.

Customary international law: See under international customary law.

Damage: injury suffered from an illegal act.

Damages: indemnity for injury suffered from an illegal act.

Declaration: (a) synonymous with a treaty, such as the Paris Declaration of 1856 and (b) a unilateral act, namely, a declaration made by a party before an international court.

Declaratory judgment: Recognition of a situation at law, once and for all and with binding force as between the Parties.

Desuetude: doctrine that states that a treaty falls into disuse if it has been disregarded for a long time.

Diligentia quam in suis: degree of care which is usually employed in one's own affairs.

Dispositif: the part of a judgment containing the decision.

Dissenting opinion: individual opinion of a member of the International Court of Justice who disagrees with the operative part of a judgment or advisory opinion of the Court. See under individual opinion.

Domain of International Law: its range.

Dualism: the doctrine according to which international law and municipal law are, in principle, unrelated legal orders. See under adoption and monism.

Ejus est interpretari legem cujus est condere: he who has the power to make a law has the power to interpret it.

Equity: rules of natural justice and equity are moral precepts which can be received into international law only through one of the three recognised law-creating processes.

Erga omnes: against everybody. See under absolute right.

Error: mistake, including error produced by fraud, may invalidate a treaty or an international award.

Estoppel: according to this doctrine a subject of international law is precluded from denying the truth of a statement made earlier by a duly authorised representative or the existence of a fact in which such representative has by word or conduct led others to believe. See under good faith and *res judicata.*

Ex aequo et bono: judgment: see under *aequo et bono.*

Ex gratia: act of grace without acknowledgment of a legal obligation.

Exceptio rei judicatae: the plea by a party before an international judicial institution that, owing to the existence of a judgment between the same parties in the same case, proceedings should be discontinued. See under judgment and *res judicata.*

Final act: instrument summarising the work of, and agreement reached at, an international conference.

Force majeure: event beyond human control. See also under Necessity.

General principles of law: principles of law which are common to the main systems of law applied by civilised nations.

General succession: succession of a State to all rights and duties of another State in a particular territory. See also under continuity of States, State succession and succession of States.

Good faith: exercise of legal rights in accordance with moral minimum standards received into international law. One of the fundamental principles of international law. See under abuse of rights and estoppel.

Good neighbourliness: application of community standards.

Good offices: endeavour by a third State to bring together States in dispute and to induce them to settle the question at issue. See also under conciliation and mediation.

Harmon Doctrine: an anachronistic principle stating that an upstream country has the unrestricted right to use the waters of an international river irrespective of downstream consequences.

Helsinki Rules: a set of principles setting the basis for international law regarding the equitable allocation and use of international rivers, promulgated by the ILC.

Historic rights: rights which have occured on the basis of historic title and prescription. See under acquired rights and prior appropriation.

Illegal act: act or omission amounting to a breach of international obligations.

Incorporation: see under adoption.

Indeterminate damages: damages the amount of which has yet to be ascertained. Synonymous with unliquidated damages.

Individual opinion: covering both dissenting and separate opinions.

International customary law: State practice accepted as legally binding by the subjects of international law.

International law: legal system governing relations between entities endowed with international personality. Sources of international law include international treaties, international customs, general principles of law, judicial decisions and opinions of writers (doctrine).

International morality: rules of conduct which States consider themselves ethically, but not legally, bound to observe.

International order: doctrine that some basic legal rules cannot be abrogated by individual subjects of international law. See under international public policy, international quasi-order, *jus cogens* and *jus dispositivum*.

International personality: status of an entity with rights and duties under international law.

International public policy: doctrine that there are basic rules of international law which override treaties incompatible with them. See also under international order, international quasi-order, *jus cogens* and *jus dispositivum*.

International quasi-order: rules of international public policy of a consensual and precarious character. See also under international order, *jus cogens* and *jus dispositivum*.

International river: (a) river which is internationalised by treaty and (b) river which traverses the territories of more than one sovereign State. See under border river.

International river community: (a) functional, not necessarily legal unit formed by States situated in the same river basin and (b) the legal association created by arrangements regarding an international river. International watercourses. See under international river.

International water law: this regulates the rights and obligations of riparian States to international rivers (or watercourses). This law does not cover international groundwater resources (especially confined groundwater).

Interpretation (a) of judgment: construction by a court, if authorised to do so, of the meaning or scope of one of its judgments upon the request of a party to the dispute and (b) of treaty: elimination of ambiguity in a treaty by examination of the intention of the parties at the time of the conclusion of the treaty.

Judgment: binding settlement of a dispute by a judicial international institution. See under interpretation and revision.

Jus cogens: law binding irrespective of will of individual parties. See under international order, international public policy, international quasi-order and *jus dispositivum*.

Jus dispositivum: law capable of being modified by contrary consensual engagements See under *jus cogens*.

Jus erga omnes: See under absolute right.

Jus imperii: activities of a State in a sovereign capacity.

Justiciable disputes: disputes which the parties consider to be suitable for settlement by reference to international law. See under legal, political and non-justiciable disputes.

Lacunae: gaps in international law.

Law-making treaties: these lay down general rules for the guidance of the State. The law-making treaties form the basis of international law. See under treaties and treaty-contracts.

Legal disputes: disputes as to rights. See under justiciable, political and non-justiciable disputes.

Lex lata: the law that is in force.

Lex posterior derogat priori: a subsequent statute overrules a previous statute on the same subject.

Lex specialis derogat generali: a special statute overrules a general statute.

Liability: see under absolute responsibility.

Limitations of State jurisdiction: restrictions imposed on a State's freedom of action by international law.

Limited territorial sovereignty: according to this doctrine, a riparian State is not allowed to utilize the water of an international river in a way which causes significant harm to the reasonable utilization by other riparian States. See under absolute territorial integrity, absolute territorial sovereignty, community co-riparian States and riparian.

Maxims: *prima facie* suspect epitomes of alleged legal principles and rules.

Mediation: reconciliation of the claims of States by a third Power. See under conciliation and good offices.

Monism: according to this doctrine both international law and municipal law form part of one and the same legal order. In this view international law is either inferior or superior to municipal law. See under adoption and dualism.

Municipal law: law operating within the State, as distinct from international law.

Natural law: rules derived from God, reason or nature, as distinct from man-made law. See under equity and international morality.

Necessity: exceptional circumstances which exclude the voluntary character of an illegal act or, in equity, excuse the breach of an international obligation. See under *force majeure*.

Negotiation: discussion, intended to lead to a settlement, of international questions through ordinary diplomatic channels.

Non-justiciable disputes: disputes which the parties consider unsuitable for settlement by reference to international law. See under justiciable, legal and political disputes.

Norm: rule of conduct.

Obiter dictum: any opinion expressed in a judgment which is not essential for the decision in the case before the court. See under operative part.

Obscuritas pacti nocet ei qui apertius loqui potuit: ambiguity in a contract (treaty) works against the party who could have expressed himself more clearly.

Operative part of judgment: the part of a judgment giving the court's decision. See under *obiter dictum.*

Opposable: a statement, act or situation which a subject of international law may not treat as *res inter alios acta.* See under estoppel.

Optional rules: legal rules which apply only by the consent of the party which subjects itself to them. See under consent.

Pacta sunt servanda: contracts (treaties) are to be kept.

Pacta tertiis nec nocent nec prosunt: contracts (treaties) do not impose any burden, nor confer any benefits, upon third parties.

Political dispute: dispute which the parties consider tbe unsuitable for legal settlement. See under justiciable, legal and non-justiciable disputes.

Political: meaning: (a) discretionary; (b) non-legal; (c) denoting specific qualities of a social phenomenon; (d) unverifiable; (e) objectionable on undisclosed grounds.

Preamble: introductory part of a treaty.

Prior appropriation: this doctrine asserts that water in its natural course is public property and is not susceptible to private ownership. The right to its use may be acquired by appropriation and application to beneficial use. The first appropriator establishes a prior right to the use of the water, always provided that this water is put to beneficial use. If this doctrine was to be applied within an international context, it would certainly not favour the position of newly created States. On the contrary, it would benefit States which existed before. See also under acquired rights and historic rights.

Ratification: (a) International confirmation of the acceptance of a treaty, namely, by the exchange of instruments of ratification; (b) municipal: agreement to a treaty by the competent constitutional authority; (c) instrument of ratification; and (d) acceptance of a draft convention, namely, an international labour convention, without prior signature.

Rebus sic stantibus: see under *clausula rebus sic stantibus.*

Reparation: redress of an illegal act. See under damages.

Res inter alios acta: a matter which, in law, exclusively concerns others.

Res judicata: decided issue. See under judgment.

Res nullius: an ownerless thing.

Reservation: (a) an articulate statement by which a subject of international law prevents his rights from becoming prejudiced by silence. See under protest; and (b) a clause whereby a party restricts its acceptance of a treaty or a particular treaty provision.

Responsibility: subjects of international law must make reparation for their own illegal acts. One of the fundamental principles of international law.

Revision: reconsideration of, namely, international judgment or modification of a treaty.

Riparian: of, on, river-bank. See under riparian rights and rival.

Riparian rights: according to this doctrine, the owners of lands abutting on a river have an equal right to the use of the waters of that river, as long as they do not interfere with the rights of their co-riparians. Each

riparian owner has a right to have the water flow pass his land undiminished in quantity and unimpaired in quality. This doctrine has never been accepted as a basis for the solution of international water law disputes. In fact, if applied, it would prevent States sharing an international river to use the river's waters beyond a quantity limited, namely, to the satisfaction of domestic water needs.

Rival: the root of the word is the Latin *rivalis* which meant using the same *rivus* or stream.

Sic utere tuo ut alienum non laedas: so use your own as not to injure another's property. See under abuse of rights and absolute right.

State succession: the doctrine that a State which succeeds another in the same territory is legally bound to subrogate itself for its predecessor regarding all, or some, of the latter's obligations. See under continuity of States and succession of States.

Subrogation: succession as to rights and duties. See under continuity of States, State succession and succession of States.

Succession of States: the replacement of one territorial sovereign by another. See under continuity of States, subrogation and State succession.

Uni generis: Latin expression meaning a thing which is a class of its own, unique.

Suspension of Treaty: temporary abeyance.

Suspensive condition: future event on the happening of which a right will arise.

Tacit consent: agreement by silence in circumstances in which disagreement may be expected to be expressly voiced. See under reservation.

Territorial jurisdiction: the competence of a State within its territory.

Thalweg: may be presumed to mean the middle of the main navigable channel. If a river is a border river, jurisdiction over it is usually divided between the two riparian States in the main navigable channel (thalweg), and each half of the river is under the exclusive control of one or the other of the neighbouring States. See under border river.

Tort, international: unjustified act or omission which consists in the breach of an international obligation.

Travaux préparatoires: preparatory work.

Treaties: consensual engagements between subjects of international law. In modern times, treaties form the most important source of international law. Treaties may be divided into two categories: law-making treaties and treaty-contracts. See under law-making treaties and treaty-contracts.

Treaty-contracts: deal with a special matter between the contracting States only. See under treaties and law-making treaties.

Water: used here with regard to perennial watercourses. This evasive nature of water means that exclusive property rights are hard to establish and enforce. See under absolute territorial integrity, absolute territorial sovereignty, community co-riparian States, limited territorial sovereignty.

Water (watershed) divide: line of separation between waters flowing into different rivers or seas.

Watershed: a land area draining into a common watercourse or waterbody. Often called a catchment area, a drainage basin, or a river basin.

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