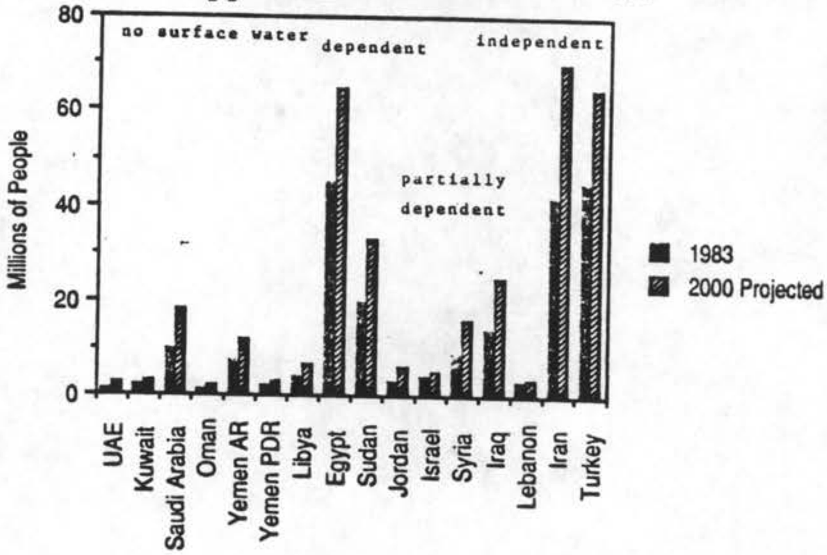
Population and Water in Two Middle East Basins

June 1992 (No commentary on Agricultural needs or plans) J. Kolars

Country	Present Population (ca. 1990) 1000's	Estimated Population (2020) 1000's	Present Available H_2O (Million m^3) (P/C m^3/yr)	Future Available H_2O (Million m^3) (P/C m^3/yr)	Comments
Israel	4,400	6,643	1,950 / *1,600 (443) (364)	2,900 (437)	*drought-1991
Jordan	3,450	9,964	880 (255)	1,018 * (102)	* with Wehdeh Dam
WB/Gaza (Palestine)	1,800	4,200	275 (153)	275 (65)	17% of area's productive capacity
Lebanon	2,500	4,333	3,713 (1,492)	3,713 (857	
Turkey	55,300	83,849	104,430 (1,888)	104,430 (1,245)	unevenly distributed
Syria	10,500	26,094	15,242 (1,630) (a)	8,862 (340) (b)	unevenly distributed (a) 13,000 claimed from Euph. 1,600 Khabour 430 Orontes 212 Others
Iraq	16,000	41,808	66,050 (d) (2,613) (c)	42,500 (1,016) (c)	
					(b) not counting groundwater 42% of 500 cms from Euph. (c) 58% of 500 cms from Euphrates (d) 16,850 mcms Euph. 49,200 " Tigris

John Kolars
University of Michigan

(Pages 1-5 excerpted from:
John Kolars and Wm. A. Mitchell,
The Euphrates River and the Southeast Anatolia Development Project, Southern Illinois University Press (Carbondale: 1991), pp. xxix & 325.

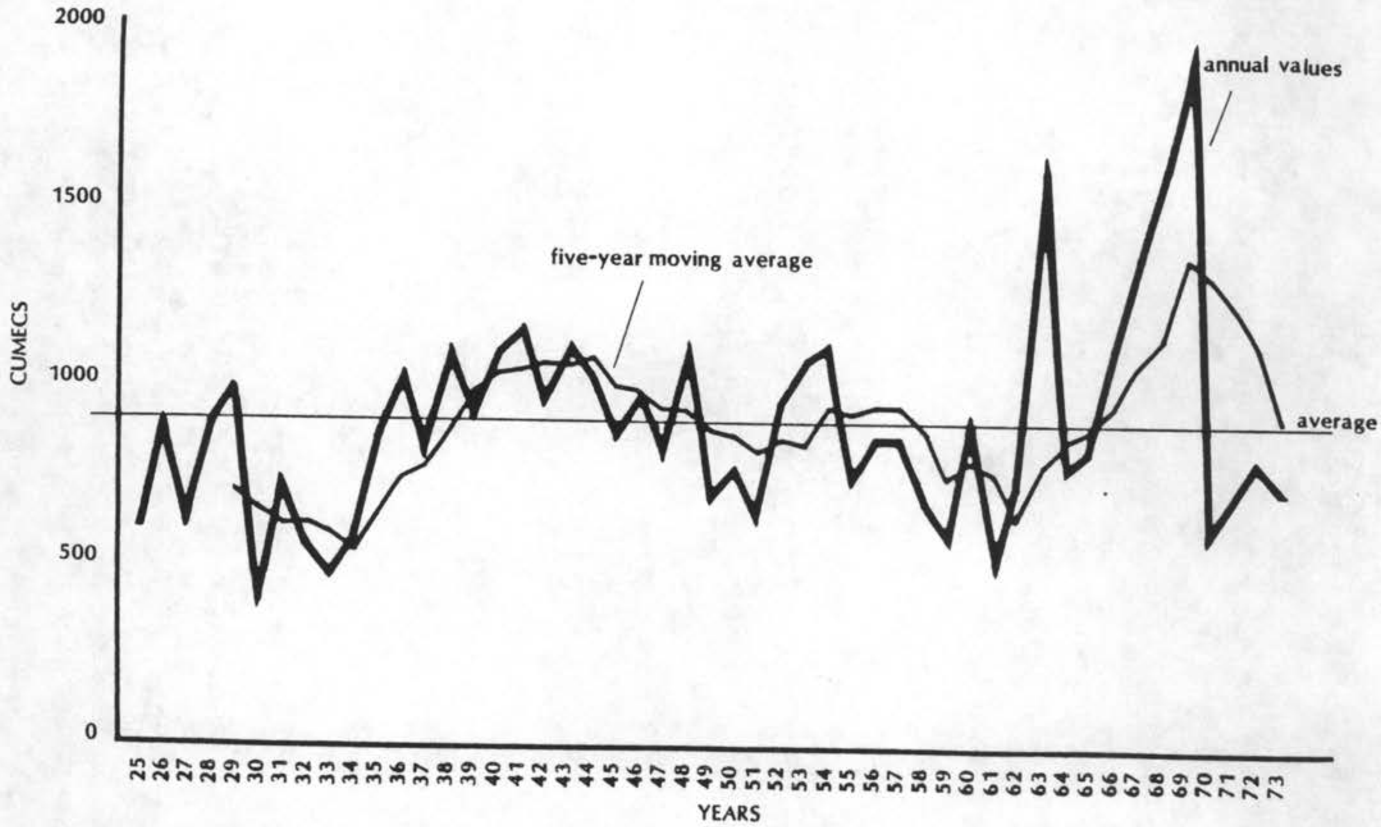


Population in SW Asia and NE Africa, 1983–2000 (estimated). Source: World Bank (1985).

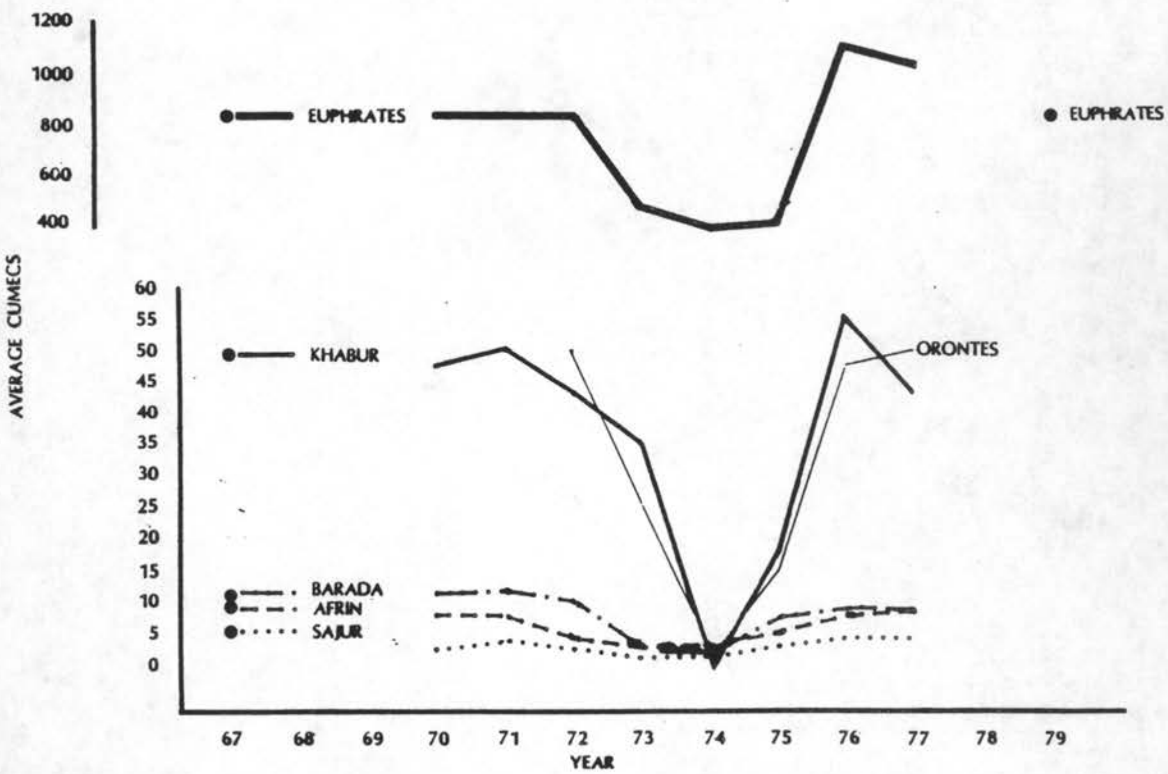
Population Growth in Middle Eastern and Northeast African Countries, 1983–2000 (estimated)

Country	Population 1983 1×10^6	Est. Population 2000 1×10^6	% Change
UAE	1.2	2.0	67
Kuwait	1.7	3.0	76
Saudi Arabia	10.4	19.1	83
Oman	1.1	2.0	82
Yemen AR	7.6	12.0	58
Yemen PDR	2.0	3.0	50
(Libya)	(3.4)	(7.0)	(106)
(Egypt)	(45.2)	(63.0)	(39)
(Sudan)	(20.8)	(33.0)	(59)
Jordan	3.2	6.0	87
Israel	4.1	5.0	22
Syria	9.6	17.0	77
Iraq	14.7	26.0	77
Lebanon	2.6	3.0	15
Iran	42.5	71.0	67
Turkey	45.0	65.0	44
Total (less L/E/S)	145.7	234.0	60.6
Total (including L/E/S)	215.1	337.0	56.7

Source: World Bank (1985).



Discharge of the Euphrates River at Hit, Iraq, 1924–25/1972–73. Source: Hadithi, Appendix E (Ministry of Irrigation); five-year averages computed for present study.



Annual discharge of selected Syrian rivers. Source: USAID (1980, Tables 3 and 4); SAR (1980).

Characteristics of Middle East River System Use

Streams in the Middle East are largely "exotic" by nature; that is, they rise in well-watered areas but before reaching the sea or some inland sink they flow into an arid zone where no more water is added and they actually diminish in volume through evaporation and seepage, not to mention human use. The basic characteristic of such streams is that they have seasonal periods of high water followed by periods of extremely reduced flow. For example, whereas the St. Lawrence River has only twice as much water at high flow as at low flow, the Nile has more than eight times as much water in September as in May, the Euphrates 28 times its minimum amount, and the Tigris nearly 80 times as much. Such flows are the result of winter rains in higher areas, the melting of the mountain snow pack, or, in the case of the Nile, the onslaught of the monsoon onto the Ethiopian highlands.

There are at least six uses for such rivers. In approximate diminishing order of importance these are: irrigation, domestic use, hydropower, industrial use, navigation, and fisheries. The latter two uses are eclipsed by the first four, of which hydropower is the least demanding; use of river waters to generate power usually does not deplete or change them. There are two exceptions to this general rule. Where spawning runs of fish are concerned, prevention of the breeding stock's progress upstream may reduce fish populations, while the destruction of fingerlings on their way downstream passing through penstocks and turbines can also be a problem. In the case of the Euphrates and Tigris rivers, spawning fish do not present a problem.

A second complication may result from river-borne silt settling in the reservoirs behind dams, whether these dams are intended for hydropower generation or irrigation or both. Excessive quantities of alluvium may fill in reservoirs and reduce their useful lifespan; silt-free waters downstream from such reservoirs may have increased erosive power with subsequent channel changes and/or the undermining of man-made structures. In the case of the Nile, water-borne silt had, before the High Dam, also restored fertility to flooded fields, but this was not true downstream on the Euphrates in Syria. This subject, vis-a-vis Iraq, is not considered here.

Of the six listed uses, irrigation is the most demanding and potentially destructive. For example, it has been estimated that in Egypt agricultural water use represents 92.5 percent of all water extracted from the Nile (interview with John Alan, 1984). A further concern where irrigation is a factor is the quality of the water returned to the main stream after passing through the fields. Heavy loads of fertilizers, insecticides, herbicides, and dissolved natural salts can make water unpalatable and even unusable for further irrigation. (This topic is treated more fully in Chapter 10, "Sedimentation and Water Quality.") Pollution from domestic and industrial use can also be a problem, although the low level of such use in the GAP area (see Chapter 3, Industry and Potable Water for Domestic Use) diminishes this as an issue. As mentioned elsewhere, navigation is essentially out of the question on the upstream portions of the Euphrates and Tigris rivers, and fishing is of little consequence.

Another source of water, which may be independent of stream flow but which may play an important part in determining the quantity and quality of available water, is pumping from underground reservoirs or aquifers. In the case of the Euphrates-Tigris river basin, the aquifers which supply the Khabur River in northern Syria are for the most part located north of the border in Turkey. As will be shown in Chapter 9, although the conventional view is that the Khabur and its tributaries provide up to 12 percent of the flow of the Euphrates, the sources of these streams, and also those of the Balikh farther west, are springs rising just inside Syria south of the Turkish border. These springs receive most of their water, in turn, from large pervious catchments to the north in Turkey which are areas of higher rainfall. Prior to new development plans in Turkey, these springs and the streams dependent upon them represented an inviolate Syrian resource. Now, however, the Turks plan to pump large quantities of water from these aquifers in their own territory. The issue of underground water rights is extremely complicated, and certainly Turkey as well as Syria should benefit from this resource. Nevertheless, this is another possible source of international conflict unless it is understood and resolved by negotiation.

Furthermore, while depletion of underground waters is a major consideration, there is also the question of return flow to streambeds and to underground conduits or aquifers. If the quality of the water running off the fields and/or seepage back into the aquifers is significantly lowered, this can seriously affect downstream use. If any group is to suffer from this phenomenon along the Euphrates, it will be the Iraqis who are farthest downstream.

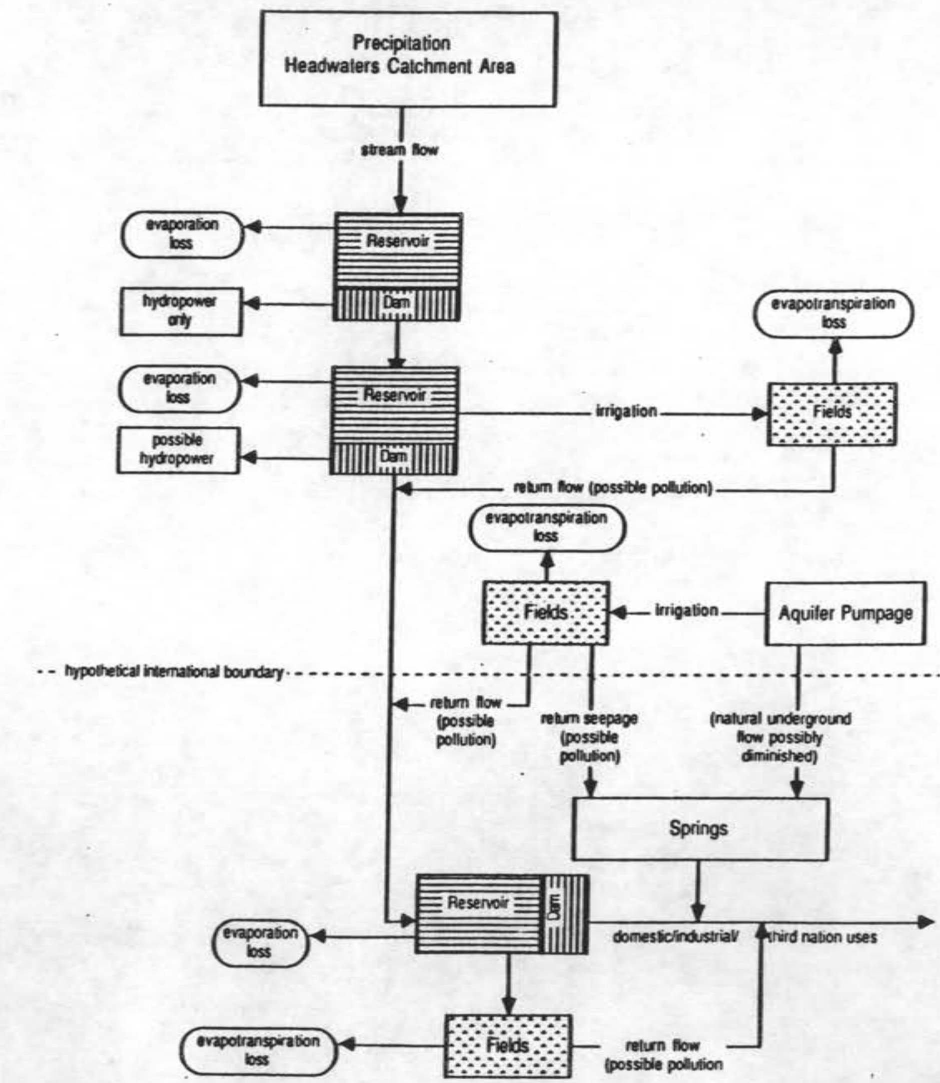
It should also be noted that return flow from irrigated fields will be reduced in quantity because of inefficient use of the delivery system (canals, storage depots, pumping stations) and through similar inefficient use and application of water on the farms themselves. System efficiency in Turkey and Syria is discussed in Appendix A. Another source of water depletion is the amount used by plants (crops and weeds) to maintain their metabolisms (transpiration), and also the water evaporated from surfaces (soil, stalks, leaves, etc.). These two losses to the atmosphere are subsumed under the term evapotranspiration. Thus a large part of the water removed from rivers and reservoirs for irrigation will not find its way back into the river. Return flow as such has been estimated for the purposes of this study to be approximately 35 percent of the water withdrawn from the system (see Appendix A). (For a more complete discussion of the characteristics of Middle East river system use, see Kolars [1988].)

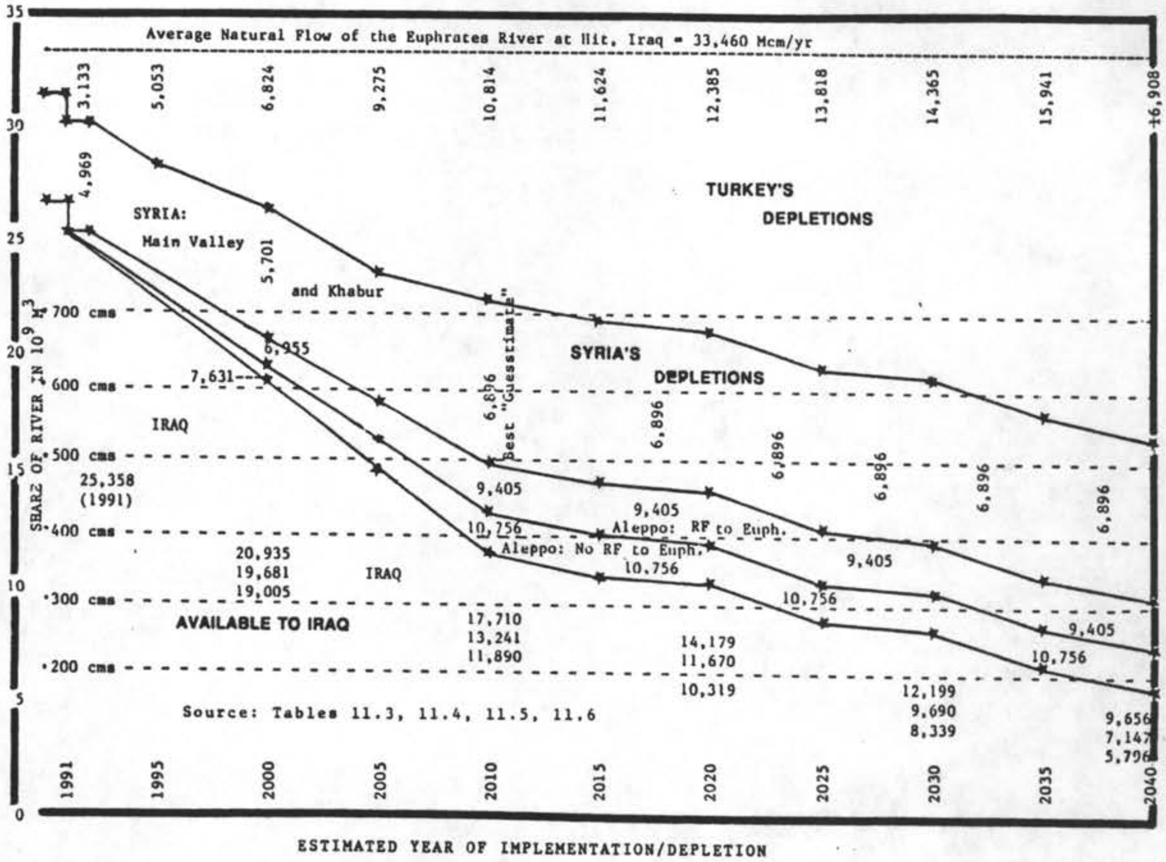
River Systems—An Overview

Let us now take an overview of the systems which have briefly been described. Figure 4.1 illustrates elements Middle Eastern rivers have in common. The diagram is simplified so that it can be applied to numerous examples throughout the region. Stream flow begins with natural precipitation at the headwaters of country number one. Water may be impounded for the generation of hydropower, with some possible loss through evaporation off reservoir surfaces. Water then continues downstream to the next reservoir, which not only is used to generate electricity but also serves to irrigate fields. Evaporation losses occur from the surface of the second reservoir; losses also occur from fields through evapotranspiration and through system inefficiencies (leakage from ditches, evaporation from open channels, etc.). Return flows may or may not be unacceptably polluted.

Farther downstream, pumpage from independent aquifers irrigates additional fields and provides some return flow, which may increase downstream quantities but may also increase their salinity. Losses also occur through local evapotranspiration. Return seepage from fields may restore some portion of the water removed through pumping but may also pollute spring waters. Excessive pumping may diminish spring flow "downstream" on the aquifer and even across the international frontier. (Lag time because of storage capacity of the aquifer as well as difficulty of observation may make cause and effect difficult to establish in this case.) In country number two similar patterns are repeated, all of which can have implications for countries farther downstream. At all points along the river, changes in the amounts and quality of water may affect domestic and industrial use. These situations can and do occur in numerous permutations and combinations. At the same time, it should be kept in mind that aridity and water need increase as you move from the headwaters downstream, just as, conversely, precipitation diminishes in the same direction.

Elements of a hypothetical international river use system.





Projected sequential depletion of the Euphrates River, 1990–2040.

This figure summarizes the analysis described by the foregoing text. Each value has been carefully derived. The timing of these events is more speculative than the data themselves and represents, at best, informed opinion and not fact. Nevertheless, the combination of data, analysis, and opinion presented here gives a unique view of impact of the developments proposed and underway along the Euphrates River in both Turkey and Syria.

This representation may be considered predictive in two ways. First, the increasing depletion of the Euphrates' waters can be read from left to right. Second, the intersections of the m^3/s measures (shown by dashed lines labeled "cms"), with lines representing removals, indicate the year in which certain levels of flow may be reached. If 500 m^3/s entering either Syria or Iraq from its upstream neighbor is taken as the minimum flow acceptable to either country, it can be seen that under the circumstances postulated here, Syria should not be shorted by Turkey. (Bear in mind, however, that the pattern of flow—either by the mainstream or via the Urfa tunnels—will have much to do with whether or not conditions remain felicitous for Syria.) On the other hand, Iraq may feel the pinch as early as 2005 if the Aleppo project without RF were to occur—or around 2010 if only the main valley and Khabur projects are realized.

Values relating to the Aleppo project need further explanation. As mentioned earlier, hectarage between 180,000 and 212,000 has recently been proposed for the area north and south of Aleppo. (This new development has not been considered in any detail in the preceding chapters but is included here for the sake of completeness.) Water for these fields would be taken from Lake Assad. For simplicity, a round figure of 200,000 ha has been used to compute depletion and RF from this project if fully implemented. Depletion of 12,545 m^3/ha and 6,755 m^3/ha RF are based upon values computed for similar areas nearby which are used elsewhere in this text. Such removals and returns are assumed to begin about 1991 and to increase steadily until the full 200,000 ha are under irrigation in 2010. Two lines are used to depict such a situation. The one showing depletions amounting to 9,405 Mm^3/yr represents what would happen if RF from these fields reaches the main stream of the Euphrates—thus restoring some of the water removed. That this may happen is uncertain. The area around Aleppo is essentially a basin of interior drainage which might trap drainage preventing its return to the main stream. In this case, the RF lost to evapotranspiration or seepage would be a net loss to the Euphrates system, which along with regular evapotranspiration losses would amount to about 10,756 Mm^3/yr as shown by the lowest of the three lines depicting Syrian removals. It should be further noted that Syrian removals are expected to stabilize about 2010 with no increase or decrease thereafter. (This overlooks possible future loses of land resulting from poor drainage and soil salinization.)

It is unlikely that the worst-case scenario shown for 2040 will ever be reached. But if it were to be realized, Iraq might expect less than 200 m^3/s to enter across its border from Syria.

Needless to say, the reader must keep in mind the highly conjectural nature of all these speculations.