Prospects for Lebanon 7

The Waters of the Litani in Regional Context

by

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with a commentary by

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Introduction

In October 1991, the Centre for Lebanese Studies in co-operation with the Norwegian Institute of International Affairs, organised a conference on Peace-Keeping, Water and Security in South Lebanon.

This booklet contains the two papers on water presented by Professors Thomas Naff and John Kolars. Dr Khalil Malouf, who was also a participant at the conference, has kindly agreed to write the commentary which follows the two papers.

Israel and the Waters of South Lebanon

*Thomas Naff**

During the last few years of the Likud government's tenure, some Lebanese (and other Arabs), in conversation with visiting water specialists, often expressed a concern that Israel would not yield its self-proclaimed security zone in southern Lebanon without assurances of a guaranteed share of the Litani River despite assurances given by the Israeli negotiators to their Lebanese counterparts in the current peace talks that Israel has no designs on Lebanese waters. Were this assumption proven to be well founded, it would obviously be a harbinger of Israel's negotiating position when the question of withdrawal from Lebanon arises. But, historically and more interestingly, it would be not so much a new posture as an echo from the turn of the century. About that time, Theodor Herzl and other leading Zionist advocates of a Palestinian Jewish homeland began to press seriously for the inclusion of the Awali and Litani Rivers within their territorial conception of what that entity should be.

From 1901 onwards, many schemes were put forward for the distribution and use of the waters of the Jordan system. Those plans that advocated comprehensive system-wide arrangements, most particularly those

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representing the Zionist position, encompassed the Litani, the Awali, and the Hasbani; the inclusion of the latter river, because of its relationship to the Dan and Banias which feed Lake Tiberias (or Lake Kinneret), was always adamantly asserted.[1]

In this context, it should be noted that a conjunctive, multi-use, basin-wide, systemic approach – one that reckons all of the waters in the system across national boundaries – has been widely perceived among experts as the most rational and effective means of solving the problems of scarcity and equitable distribution in the Jordan basin system (incidentally, equitable here does not necessarily connote equality). Thus, from a purely technical stance, such plans, whether by Zionists or others make excellent sense – provided all the riparian actors perceive their interests to be best served by such an approach, and trusted one another sufficiently to produce the co-operation essential to make system-wide schemes work. Unfortunately, the reality on the ground has been one of deeply opposed ideological differences, (inter-riparian, secular and sectarian), with consequent profound mistrust all around, combined with military hostilities which frustrate hope for any ideal solutions in the foreseeable future.

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[1] T. Naff and R. Matson, *Water in the Middle East: Conflict or Cooperation?* Boulder: 1984, pp. 28-32, 65-71; F. Hof, *Galilee Divided: The Israel-Lebanon Frontier, 1816-1984,* 14ff; Frischwasser-Ra'anan, *The Frontiers of a Nation.* London: 1955, pp. 70-72, 85-88, 91-106, 138-41; I.K. Khalifeh, *Lebanon's Southern Border.* Beirut: 1985, 65-67; Doreen Ingrams, *Palestine Papers 1917-1922. Seeds of Conflict.* London: 1972, 18ff; Sana Bardawil, 'Israel's Claims on Lebanese Waters: The Litani River'. Unpublished M.A. thesis, St. Antony's College, Oxford: May 1991, pp. 10-30 (Bardawil has mis-cited Frischwasser-Ra'anan, p. 13, note 12).

In a water-scarce region the Litani River – which is an entirely sovereign Lebanese body of water whose watershed lies wholly within the border of Lebanon – has always been very tempting to thirsty neighbours because of the quantity, quality, and location of its flow. Allowing for wide annual variations, the natural flow of the Litani averages about 920 Mcm/yr, with an adjusted long-term yearly average of around 750-800 Mcm (taking into account evapotranspiration, infiltration, and run-off). The current reported average is somewhat lower, running at between 600-700 Mcm/yr. The waters of the Litani are particularly sweet, averaging about 220 ppm salinity, making its water usable for irrigation of any kind of crop and for drinking.[2]

Given the pace of past development – until the early 1970s the government in Beirut neglected to develop the southern part of the country – and the fact that the river was used mainly for the production of hydro-electricity, the high quality of the river was easily maintained. If future development in the upper and lower reaches of the river emphasise agricultural development, then the river's sweetness will be much more difficult to assure. Because the Litani has never been entirely developed or used to its full potential, there has been a constant but variable surplus that has flowed unused into the Mediterranean. This has become more so since the dislocations in southern Lebanon caused by civil war and the

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[2] Naff and Matson, *Water in the Middle East*, pp. 63-65; John Kolars, 'The Litani River in the Context of Middle Eastern Water Resources', courtesy of the author, pp. 3-5; Steven Lonergan, *Climate Warming, Water Resources, and Geopolitical Conflict: A Study of Nations Dependent on the Nile, Litani, and Jordan River Systems*, Operational and Research and Analysis Establishment. Ottawa: March 1991, pp. 17-18. Ppm – parts per million – is a volumetric measurement. When applied to liquids, it means that there is so much salt per a given volume of water – in this case a million units of water.

Israeli invasions. It has been this combination of purity and surplus that has attracted the designs of Israel which developed its national Water Carrier System principally for potable rather than irrigation quality water.

Although the Litani has never been fully developed, it has not been for lack of development schemes put forward by a variety of interested parties. The most persistent plans have involved Zionists prior to 1948 and the Israeli government since that year. The traditional Zionist/Israeli position has been that the Litani is integral to the Jordan River system. This is the premise of all plans from that quarter. As indicated, from the outset of this century Zionists campaigned for the inclusion of the lower stem of the Litani, or beyond, in the Palestine Mandate. In the 1950s Israel advocated diverting Litani water into the upper Jordan to produce hydro-electricity and for flushing salinity from Lake Tiberias (Lake Kinneret) making it available for further uses. The three best known plans that consider the Litani to be a part of the Jordan system are the Lowdermilk Plan of 1944, the 1948 Hays-Savage Plan, and the Cotton Plan of 1985. All three plans required regional co-operation. Those of Lowdermilk and Hays-Savage called for using about half the flow of the Litani to augment the Jordan and to generate hydro-electricity for Israel and Lebanon. The Cotton Plan, commissioned by the Israeli government, proved to be the most elaborate of the three. It based its proposals on the assumption of an annual potential surplus in the Litani of some 500 Mcm which was to be utilised in 100 km diversion using channels, tunnels, and aqueducts to supply irrigation and electrical power in northern Israel.[3] The notion of using half

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[3] These and other plans are detailed in Naff and Matson, *Water in the Middle East*, 28ff; S.N. Saliba, *The Jordan River Dispute*. The Hague: 1968, pp. 99-112; Miriam Lowi, 'The Politics of Water Under Conditions of Scarcity and

the flow or more of the Litani was not accepted by the American negotiators of the Unified (or Johnston) Plan of 1955, the most important and comprehensive of all the schemes for sharing the waters of the Jordan basin (and the one that came closest to succeeding), although Israel continued to press claims to Litani water throughout the negotiations. (See Table 1, p.18).

The Lebanese authorities of the newly created Republic of Lebanon were no less aware of the importance to the future of the nation of the Litani as a hydrological asset. Planning began during the Second World War. In 1943, the harnessing of the Litani for hydro-electric power and irrigation was foreseen in the Bekaa Valley Survey. At the war's end, the Council of Ministers commissioned a Six Year Master Water Plan which encompassed the Litani, Orontes ('Asi), Yarmuk, 'Qasimiyah, and Akkar sectors of the country.

The centrepiece of the plan was the Litani River project which was based on a 1954 set of recommendations by the US Bureau of Reclamation. USBR planners, taking into account Lebanon's plentiful rainfall, concluded that it made more economic sense to use the river's water to generate electrical power than to irrigate. Thus the plan envisaged a storage dam at the southern end of the Bekaa Valley near Qir'awn, and two hydro-electric systems, one of which required a substantial diversion of Litani water into the Awali River. By 1966 the major features of the Six Year Plan were in place. The Qir'awn dam with a storage capacity of 220 Mcm and the Awali power system began operation. Irrigation schemes and a power system for the lower sections of the river remained as future goals.

Conflict'. Unpublished Ph.D dissertation, Princeton University: Oct. 1990, chs. 3-5; S. Bardawil, 'Israeli Claims on Lebanese Waters', pp. 31-58.

The dam and diversion of the Litani not only enlarged the Awali's flow, but redistributed the waters of southern Lebanon significantly, a circumstance that was to become strategically important both as a domestic issue and as regards Israel's international hydropolitics.

In the same year that the first stage of the Six Year Plan was implemented (1966), domestic competition among Lebanon's agricultural, industrial, and municipal sectors began to increase. Municipal use was stimulated by the rapid growth of the country's urban centres in the post-war era. Urban life was controlled politically, and thus dominated economically and culturally as well, by Christians and Sunni Muslims. This situation was created in part by the use of the Litani to generate hydro-electricity which made possible the rapid development of industry and business, but at the expense of agriculture in southern Lebanon. Thus, during the decade of the 1960s, the high living standards of Lebanon's urban population was tied directly to the policy decisions made for the use of the Litani River. The ensuing sectoral competition quickly melded with growing social and interconfessional tensions.[4]

Meanwhile, the Israelis continued tenaciously to argue for a share of the Litani or the right to purchase its water, insisting that the drop from the Litani into the Jordan would produce more and cheaper electricity than the drop from the Litani into the Awali. Lebanon and other Arab League members responded that Israel consistently underestimated Lebanon's need of the Litani if its development plans were to be achieved. In 1964, the Arab League crystallised its plans for denying Israel water for its newly completed National Water Carrier and for counteracting Israel's out-of-basin transfers of Jordan River water into the Negev: the flow of the Hasbani would be rechannelled into the Litani or Yarmuk Rivers. This

[4] Naff and Matson, *Water in the Middle East*, pp. 72-73.

prospect brought immediate and real threats of military retaliation from Israel and opposition from the US. These factors plus prohibitive costs, put off implementation of the plan.[5]

Throughout this period, Lebanon tried to navigate a course away from international conflict. The Lebanese government, concerned with internal religious factionalism which was increasingly complicated by the impact of external rival Arab nationalisms, did not want to be drawn directly into the vortex of the Arab-Israeli struggle, but the Arab diversion plan appeared to make that prospect unavoidable. Moreover, selling Litani water to Israel, as Israel had long proposed (and which was perfectly feasible), would have depleted the supply in the southern region of the country where farmers were already receiving inadequate amounts for irrigation and would have fomented even more resentment towards the traditional leadership in Beirut. In 1973 and 1974, which were drought-stricken years, rumours circulated in the South that more of the Litani River would be siphoned off to Beirut to ease water shortages there, further depleting the supply in the South.

Arab nationalist politics and the Palestinian problem foreclosed any consideration of seeking a formal bilateral accommodation between Lebanon and Israel over water or any other issue. The Lebanese and other Arabs feared (with reason) that any concessions on water would be transformed into further Israeli territorial expansion. In the face of these combined domestic and foreign hazards, and because of its own

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[5] BBC, 'Israeli Press Comment on the Arab Summit Conference', no. 1458, 21/1/64, pp. A/1-2; 'Eshkol's Statement on the Cairo Conference', no. 1459, 21/1/64, pp. A/1-2; Nimrod Noram, 'The Unquiet Waters', *New Outlook*, Vol. 8, no. 4, June 1965; 'Conflict over the Jordan – last strategy', *New Outlook*, Vol. 8, no. 6, Sept. 1965.

developmental needs, Lebanon simply could not agree to the transfer of Litani water into the Jordan. Since the time of these developments, published evidence has come to light in the form of the diaries of former prime ministers David Ben Gurion and Moshe Sharett which underscore Lebanon's apprehension of Israel's motives. Apparently, annexation of southern Lebanon and seizure of the Litani were frequent subjects of Israeli cabinet debate but political restraints forestalled action on the idea until 1982.[6]

In the end, the Six Day War resulted in making Israel the controlling, hegemonic upper riparian in the Jordan basin, and the upshot of this combination of events has been the militarisation of water throughout the Jordan system since the early 1960s. Water has long been a central factor in the strategic considerations of all the system's actors, and much of their hydro-political planning has focused on the waters of southern Lebanon, a region characterised by a protracted, festering discontent among the local inhabitants.

The 1971 implantation of the PLO in southern Lebanon and the ensuing Israeli-Palestinian hostilities during the remainder of the decade, displaced the suffering peasant population of the South several times. Their migration northward revealed, by comparison with other communities, the extent of their own underdevelopment. Their previous resentment turned to bitter anger directed against the government, the Israelis and the PLO, all of whom they perceived as exploiters. They formed their own Amal militia and made alliances of convenience with other armed groups, including the PLO. As conditions in southern Lebanon degenerated, water in the region became a more salient issue. Much needed hydro-development projects either ceased or staggered along, subsidies for agriculture stopped, and the

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[6] Naff and Matson, *Water in the Middle East*, pp. 70-71.

irrigated cultivation of such cash crops as tobacco decreased by 60 per cent. The income of many farmers fell to little more than 10 to 15 per cent of their 1960s level, fuelling the anger of the local population even further, particularly that of the Shi'as.

The chaos of southern Lebanon was disquieting to Israel and stimulated further Israeli incursions. With the invasion of 1978, Israel used its consolidated control over the Wazzani-Hasbani springs to increase the flow of water into the Jordan and to lay pipelines to capture the runoff.[7] The larger invasion of 1982 gained for Israel control of the lower Litani and Qir'awn reservoir, and produced the current Israeli 'security zone'. There is good evidence that fairly early in the current occupation, Israeli engineers took seismic soundings, surveyed, and even put in some equipment, all with a view to establishing the feasibility of diverting some of the waters of southern Lebanon, chiefly the Awali and Litani Rivers.

However, that evidence, including the Kahan Commission Report on the Beirut massacres, does not support a conclusion that the primary motive of the 1982 invasion was to seize Lebanon's southern waters, although the possibility of diversion of the Awali, Hasbani, or Litani was discussed in the Israeli cabinet and in its principal water planning agency, Tahal. In denying the charge concerning the hydrological objectives of the invasion, Israel offers several countervailing arguments: The political unpopularity and cost of its occupation; the fact that the lower Litani yields only about 100 Mcm/yr; the amount of water left in the Litani after Lebanese extractions would not justify diversion; and finally, the fact that in 1982 Israel's water supply was sufficient for its needs and additional water from the Litani was unnecessary. Indeed, Israel's water supply was adequate in 1982, and even until 1985 when deficits began to mount more rapidly.

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[7] *Ibid.*, pp. 70-75.

However, supply and demand projections for the next two decades indicated potential serious shortages, even before the unanticipated influx of Soviet Jewry. In this connection it must be pointed out that control of the upper Litani Valley would provide 500-600 Mcm more water, if the Qir'awn Dam and the Markabe diversion tunnel to the Awali were removed; but that would require taking all of the Bekaa Valley south of the Damascus road, a military venture that would be opposed by most of the Israeli public and the international community, including the United States.

Whatever Israel's basic aims were in 1982, its intentions with regard to the water of southern Lebanon continue to be viewed with deep suspicion by Lebanon and its riparian Arab neighbours, and it is these perceptions that influence the formulation of their policies. Arab mistrust of Israel's ambitions is reinforced by a number of factors: Israel's seizure of hydrological data when its troops entered Beirut; the fact that the Israeli army withdrew to the Awali River – into which most of the Litani has been transferred – rather than the Zahrani which would have reduced the area it had to defend; Israel's continued insistence that the Litani's average annual surplus or unutilised water is at least 300 Mcm despite Lebanese evidence to the contrary; the introduction of water restrictions on Lebanese farmers in the 'security zone' similar to those imposed on Palestinians in the Occupied Territories, such as prohibiting the drilling of new wells and the capping of others; and continued Israeli discussions of plans for the transfer of Litani water to the Jordan.

Several questions surround the current situation in southern Lebanon: Does Israel intend to transfer significant amounts of water across the Green Line? Is Israel presently doing so? Will Israel link eventual withdrawal from the 'security zone' to an allocation of Lebanese water, or will the need to control the water supplies of south Lebanon determine Israel not to

withdraw? Is there unused excess water in the amounts claimed by Israel? Will Lebanese recovery and development plans if fully implemented consume 80 per cent or more of the southern region's waters as claimed?

Answers must proceed from the issue of Israel's present and projected water requirements. Israel normally has available from surface, ground, and marginal sources about 1950 Mcm of renewable water per year. Owing to drought conditions that prevailed until the winter rains of 1991-92, Israel could count on only about 1600 Mcm/yr. Consumption in Israel for all purposes (including Jewish settlements in the Occupied Territories and the Golan) has been about 2100 Mcm/per year (per capita domestic consumption is 280-300 litres/day–l/c/d). This produces an annual deficit of 150-200 Mcm/yr, or using Tahal's figures of 1820 Mcm/yr of pre-1992 consumption and 1600 Mcm/yr of supply, a deficit of 220 Mcm/yr results. Current consumption rates are expected to rise to about 2500 Mcm/yr sometime between 2015-2020 (some estimates are as high as 2800-2900 Mcm/yr). Israel is presently using about 108-110 per cent of its available stock and its accumulated water deficit is equivalent to somewhat more than a full year's supply. (See Table 2, p.19).

Israel satisfies up to 40 per cent of its total national water budget from the Occupied Territories which under normal climatic conditions have a productive capacity of about 650 Mcm/yr, but the supply is now diminished to some 450-550 Mcm because of drought. Almost all of this water is produced by aquifers. It should be noted that Tahal's estimate for water production in the Territories is 200 Mcm/yr (110 in the West Bank and 90 in Gaza). The discrepancy lies in the fact that Israelis do not recognise as Territory water any sources that flow from the West Bank across the Green Line into Israel. Thus, the 200 Mcm Tahal figure

represents only ground water supplies that do not flow into Israel proper.[8] Although Israel has a right to and has long used water that originates in the West Bank and flows across its borders, 83 per cent of the Territories water is now consumed by Israelis on both sides of the Green Line, and, under conditions of the occupation, no part of the water is controlled by the Palestinians. By limiting the Palestinians to a minimum of consumption – for example, they have been held to what they were consuming for irrigation in 1967 when their numbers were fewer than half of what they are now – the Israeli authorities ensure that as much water from the Occupied Territories is available to Israelis in such quantities as they choose to supply.

The meaning of these data is that about 70 per cent of the ground water on which Israel is dependant and more than one third of its sustainable annual water yield originate in the Occupied Territories. These facts have major implications for Lebanon, because, in the circumstances, it is inconceivable that an Israeli government would ever relinquish the Occupied Territories without an effective plan, replete with a full array of guarantees and inducements, that would give Israel secure and permanent access to sufficient quantities of the Territories' waters or guaranteed access

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[8] My data on Israel's and the Occupied Territories' water supplies are drawn from the following sources: communications from Jehoshua Schwarz of Tahal in June and July 1991; data supplied by the Water Research and Study Center (WRSC) of Jordan University; the US Army Corps of Engineers, *Water in the Sand. A Survey of Middle Eastern Water Issues.* Washington, DC: June 1991, pp. 1-13; Meron Benvenisti and Shlomo Khayat, *The West Bank and Gaza Atlas*. Jerusalem: 1988; Hisham Zarour and Jad Isaac, 'The Water Crisis in the Occupied Territories'. Unpublished paper presented to the VII World Congress on Water, Rabat, Morocco, May 12-16, 1991; and the AMER database.

to other comparable sources in the area: that means the Litani and Awali Rivers.

Israel's water needs have been potentially exacerbated by the massive influx of Soviet Jews who also consume water at the rate of 280-300 l/c/d for domestic purposes. The necessary new supplies of water that Israel will need in the near future if it is to meet its developmental goals and provide an adequate livelihood for both the new immigrants and native born Israeli Jews and Arabs are not known to exist within Israel. A massive crash effort at desalination of sea water would not only be very costly (in addition to the $27 billion Israelis estimate it will cost to settle a million new immigrants), but would still produce no more than a marginal supply, albeit an important one, perhaps enough drinking water for domestic use. In these circumstances, accessible sources of water outside Israel – such as the waters of southern Lebanon or the costly and vulnerable importation of water from Turkey – take on very serious economic, strategic, and legal implications.

We are now left with the questions of whether Israel has been taking water out of the Litani or other southern Lebanese waters and what are Israel's future intentions?

The answer that emerges from the smoke of charges and denials that surrounds the first question is yes, Israel is taking water out of Lebanon, but, as available evidence indicates, not in any significant amounts, and mostly from feeder streams and springs such as those associated with the Wazani and Hasbani on the grounds that these flow towards or across the Green Line. There is great uncertainty about the more politically sensitive issue of withdrawals from the Litani. Most reports concerning Israeli extractions from the Litani have turned out to be dubious, or inaccurate, or unprovable, or confused with withdrawals from proximate sources.

However, in the spring of 1990, there were reliable eye witness reports of Israelis trucking water out of the Litani across the border into Israel. More recent (winter 1991) equally reliable evidence gathered by witnesses on the ground has helped to clarify the charge. Indeed, the original eye witnesses who observed and reported that Israelis were trucking water out of the Litani appear to have been correct in their observation but wrong in concluding that the water was being trucked across the border into Israel. The water, it seems, was instead trucked to units of the Israeli-supported Lebanese Army of South Lebanon in the 'security zone' and, perhaps, to some Shi'i villages in the same area as a reward for their co-operation.[9]

The amounts cannot have been significant, and trucking is an inefficient and expensive means of moving large quantities of water. However, sporadic reports persist that trucking water from the Litani continues. Despite seismic soundings and surveys, the weight of evidence indicates that Israel has not yet laid pipelines or dug tunnels for the diversion of large amounts of Litani water; and even if there were such conveyances, the average flow of the lower Litani cannot exceed by much 100 Mcm, hardly worth the political dust-up that would ensue. Altogether, Israel appears to be taking only insignificant amounts of water from southern Lebanon mainly, as stated, from streams and feeder springs close to its border that flow in its direction.[10]

Although the quantity being taken by Israel may be relatively unimportant, the *act* of extraction by Israel cannot be dismissed as trivial. Whatever the actual amount, it is sovereign Lebanese water and as such is

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[9] This information came to the author as a private communication from expert witnesses in the 'security zone' in whose objectivity and accuracy the author has confidence and who were asked by the author to investigate the allegation.

[10] Kolars, *The Litani River*, p. 31.

being taken in violation of Lebanon's rights under international law. As John Kolars and others have demonstrated, whatever happens to the Litani and other south Lebanon waters will have an impact on the hydrological interests of all the riperians in the Jordan system: Syria will be vitally interested in anything that it perceives as affecting the Orontes and Amman will be concerned with anything that threatens to reduce supply to the northern stem of the Jordan.[11] Lebanon's recovery will require the availability of all the water that the country's southern region has to offer. The current extractions engender this thought in the minds of Israel's neighbours: If Israel is allowed to take this water with impunity, what is to keep it from claiming and taking more? Thus, the issue is not so much hydrologic as it is intensely hydro-political and attitudinal, and it focuses on Israel's intentions.

There is no disputing Israel's interest in the Litani, just as there is no disputing that Israel is perceived as the most persistent threat to Lebanon's rights over the entire flow of the river. All of Israel's neighbours believe that if Israel's water shortage becomes critical enough, Israel would resort to unilateral, arbitrary actions to divert the Litani without regard to international law or censure by the world community. There is no conclusive evidence to that effect, but Israeli behaviour has not discouraged such perceptions.

Israel has three options for dealing with its water crisis each of which would, if adopted, affect what happens in southern Lebanon. Firstly, Israel could restructure its economy away from heavily consumptive irrigated agriculture to light industrial and service activities that would produce surplus capital with which to import food. (In 1991 Israel temporarily reduced the supply of irrigation water by 37 per cent). The yield from light

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[11] *Ibid*, pp. 31-31; Lonergan, *Climate Warming*, p. 51.

industry to GNP is about 30 times greater per unit of water used than the yield from agriculture. Even so, such a move would be politically extremely difficult, run counter to Israel's security policy of food self-sufficiency, and be impossible without massive financial aid to cushion the hardships involved; the cost of settling the new immigrants thus complicates the restructuring option. Secondly, Israel could enter into a negotiated agreement with Lebanon for shared use of the Litani, but given the living history of mutual mistrust and animosity and the likely political fragility of Lebanon in the foreseeable future, this option is extremely unlikely. Thirdly, Israel could use its long-standing claim that the Litani is part of the Jordan River system to justify a forcible diversion, using whatever military action it deems necessary. Militarisation of water conflicts in the Jordan basin has already occurred so this would not be a radical new departure from policy.[12]

Despite the fact that such a step is part of Israel's military contingency planning, there is no hard, non-circumstantial evidence that Israel is presently contemplating such an action. However, given that the negotiated agreement option is a virtual non-starter, and if for any reason Israel does not pursue the first and most rational option, the only course left is the military one, even if that means little more than Israel using its dominant military power to maintain the status quo. That would be politically destabilising to Lebanon and ensure a continued Syrian presence.

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[12] T. Naff, 'The Jordan Basin: Political, Economic, and Institutional Issues', International Workshop on Water Resources Management, The World Bank. Washington, DC: June 24-28, 1991; Lonergan, *Climate Warming*, p. 80; Naff and Matson, *Water in the Middle East*, p.79-80.

Thus, it is highly probable that Israel will continue to make a determined effort to share or control the waters of southern Lebanon, principally the Litani (or possibly the Awali) in one way or another. The validity of this statement is rooted in the history of Israel's claims and actions in this direction, in the projected supply and demand picture, and in the fact that there is no other body of water so proximate, with so much flow and such purity. Israel has made clear that it would react with extreme hostility should Lebanon or Syria adopt measures that would pre-empt future Israeli use of the waters of southern Lebanon.[13]

Consequently, it is by no means irrational to conclude that Israel would not be expected to agree to depart its 'security zone' in Lebanon without taking away in return as large an allocation of water as possible.

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[13] Naff and Matson, *Water in the Middle East*, p. 79.

***Table 1: Development Schemes and Reports for Jordan River System (Naff and Matson,* Water In The Middle East)**

Year	Plan	Sponsor
1913	Franghia Plan	Ottoman Empire
1922	Mavromatis Plan	Great Britain
1928	Henriques Report	Great Britain
1935	Palestine Land Development Company	World Zionist Organisation
1939	Ionides Survey	Transjordan
1944	Lowdermilk Plan	USA
1946	Survey of Palestine	Anglo-American Commission of Inquiry
1948	Hays-Savage Plan	World Zionist Organisation
1950	MacDonald Report	Jordan
1951	All Israel Plan	Israel
1952	Bunger Plan	Jordan/USA
1953	Main Plan	UNWRA
1953	Israel 7-Year Plan	Israel
1954	Cotton Plan	Israel
1954	Arab Plan	Arab League
1955	Baker-Harza Plan	Jordan
1955	Unified (Johnston) Plan	USA
1956	Israel Ten-Year Plan	Israel
1956	Israel National Water Plan	Israel
1957	Greater Yarmuk (East Ghor) Project	Jordan
1964	Jordan Headwaters Diversion	Arab League

Table 2: Water Supply and Demand in Jordan Basin (in Mcm/yr)

	1987-1991 Average Supply Non-Drought Conditions	Average Supply Current Drought Conditions	1987-1991 Average Total Demand	1987-1991 Average Deficits Non-Drought Conditions	Average Deficits Current Drought Conditions	Projected Demand 2015-2020
Israel	1950	1600	2100*	150-200	200	2500-2800
Jordan	900	700-750	800	100-125	100	1600-1800
Occupied Territories	650	450-550	600-650	75-100	100	**

*Includes settlements in Occupied Territories and Golan Heights
** Future status indeterminate

The Litani River in the Context of Middle Eastern Water Resources

*John Kolars**

Introduction

Anyone presuming to write on a subject as complex and as crucial as the water supply of Lebanon and attempting to do so in a broad regional context, must approach the subject with caution. It is necessary to suspend one's knowledge of the political chaos that has gripped the country in recent years and which is ending only now, and to treat the subject initially as though the more stable period of the 1950s and 1960s still held true. It is also important to recognise that prior to the disruption brought about by the civil war and the Israeli invasion, Lebanon's hydrologic resources were being planned and managed (for power generation, agriculture, and domestic and industrial use) by a sophisticated and highly trained group of professionals. Thus, a study such as the one presented here is like a weed that flourishes in the disrupted earth of a once fertile garden. And yet, Lebanon is returning to stability, albeit a stability modified by pressures brought about by ever increasing domestic and foreign needs for water. In view of this, new efforts will be made to manage Lebanon's precious water supply, and a study even as modest as this one – hampered as it is by lack of data, conflicting and old data, and a less than perfect knowledge of the

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political tides that are sweeping across the area – may be of use to those attempting to understand the situation and to return it to functional equilibrium.

Prior to the civil war, an intense effort was made to work out a comprehensive management scheme not only for the Litani but for the other rivers of Lebanon vis-à-vis the several demands increasingly placed upon them. The result of this was the beginnings of a unified system of resource management in South Lebanon.

This effort was formalised by the government of Lebanon through its Decree Number 14.552 of 16th May 1970 which defined the disposable water resources, fixed priorities regarding them, and determined the rules for their being shared in an area essentially south of the Beirut - Damascus road.[1] In 1972 a co-operative effort was made by the Food and Agriculture Organisation of the United Nations and the National Office of the Litani (ONL/FAO) to investigate and analyse thoroughly the many aspects that such development entailed.

These reports, which will be referred to in the pages that follow, establish a base line from which further events concerning the river can be evaluated. Once such a line has been drawn, it becomes possible to consider the Litani in 1991 and what may become of it in the years ahead. Because of the very poor information currently available, such a strategy is not easy to follow. Therefore, unlike many studies, speculation and uncertainty must of necessity increase as one approaches the present. Nevertheless, it is believed that the description, analysis and comments which follow will provide a useful and essentially accurate picture of the Litani in the context of its regional setting.

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[1] Food and Agriculture Organisation of the UN 'La Planification du Sud du Liban'. Beirut: 1972.

Lebanon's Water Supply

It is estimated that the total annual volume of surface and underground water consumed in Lebanon just before the civil war (1975) was approximately 854 Mcm, that is 23 per cent of the available reserves in the country.[2] This indicated unused available reserves in the neighbourhood of 2,859 Mcm (Table 1, see appendices). The sources of this water were 62.8 per cent surface water and 37.2 per cent underground water. Other estimates place precipitation for all of Lebanon at 9,200 Mcm with about 4,324 Mcm (47 per cent) lost to evapotranspiration and 4,876 Mcm existing as runoff and infiltrated water.[3]

Although the subject of this discussion is the Litani River, the flow of which is estimated at 920.153 Mcm/yr (18.9 per cent of total estimated runoff and infiltration) it is necessary to consider the other riverine sources of water in Lebanon including the 'Asi (Orontes) River (flow to Syria 370 Mcm), the Kebir (flow to Syria 95 Mcm), and the Hasbani (flow to Israel 140 Mcm).[4] The flow of these four rivers accounts for between 32 to 36 per cent of estimated runoff and infiltrated water in the country. Numerous small streams serving local areas are also important. By the same token, in examining Lebanon's water supply all the uses to which it is put must be

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[2] Associates for Middle East Research, *Hydrology of Lebanon – Preliminary Technical Report* also referred to as the *Engineers' Report*. September 1986.

[3] Fawwaz and Sharafuddine as quoted in Muin Baasiri and John Ryan, *Irrigation in Lebanon – Research, Practices and Potential*. Published jointly by the National Council for Scientific Research, Beirut and The American University of Beirut. Beirut: 1986.

[4] United Nations, Department of Technical Co-operation for Development, Natural Resources/Water Series no.9, *Ground Water in the Eastern Mediterranean and Western Asia*. New York: 1982, p. 103.

considered: agriculture, hydro-electric energy, domestic use and that used for industry.

Domestic Uses of Water

Size and distribution of population along with per capita consumption determine domestic water needs. Beirut in 1977 contained 50.5 per cent of Lebanon's population[5], about 1.5 million people. Held reports that in 1987-88 the estimated population of Lebanon was 2.7 million (a decline from approximately 3 million in 1975) of which about 20 per cent live in Beirut.[6] If we assume that the country will respond quickly to peace and prosperity we may anticipate that Beirut's population will reach 1.8 million after the year 2000.[7] Per capita water use at that time should reach 245 l/d. With assumed wastage of about 18 per cent the city will need at least 190 million cubic metres per year to satisfy its needs. Of this amount, 5 Mcm are scheduled to come from the Litani-Awali system.

In 1970 the three southern regions centred around Sidon, Sur, and Marjayoun included 558 villages with 731,000 inhabitants.[8] Water use at that time amounted to 26.5 million cubic metres or about 100 l/d/person. Losses in the system, however, amounted to at least 35 per cent. This left about 65 l/d per capita on average. Rural areas suffered considerable

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[5] Peter Beaumont, Gerald H. Blake, J. Malcolm Wagstaff, *The Middle East – A Geographical Study*, second edition. Halsted Press, New York: 1988, pp. 215 and 400.

[6] Colbert C. Held, *Middle East Patterns – Places, Peoples, and Politics*. Westview Press, Boulder: 1989, p. 206.

[7] FAO, *op.cit.*, p. 41.

[8] This figure increased to 851,000 (+16 per cent) during the summer months.

shortages, particularly in the summertime. South of the Litani per capita shares of 25 to 40 l/d were common with less in the summer.

In the Barouk mountain zone to the north of the Litani this figure was about 60 l/d per capita. If population growth is taken into account, and net average per capita consumption were to equal 120 l/d (average of winter and summer after water losses) 93 million cubic metres per year will be required. The population of the Bekaa (not available for this study) was and is considerably less and can easily find locally available water supplies. All in all the remainder of the country accounts for perhaps another 25 per cent of the total population.

Table 2 (see appendices) shows the estimated water needs for the three sectors of Lebanon. (It should be noted that the present paper uses estimated demands for southern Lebanon somewhat higher than those proposed by the ONL/FAO – 80.7 Mcm). Table 3 (see appendices) 'Estimated Water use Circa 2000 in the Litani Basin', presents data derived from similar sources.

Industrial Use of Water

Only one reference to industrial water use was available for this analysis[9] and it is cursory. However, considering the nature of the Lebanese economy both before its disruption and at present, industrial water use was and is of little consequence. One might predict, as well, that future industrial water use in Lebanon will remain slight because of the emphasis placed upon the service industries (banking, retailing), the lack of raw materials and the lack of low cost labour.

The reference cited above indicates that water used for industrial purposes amounted to about 35 Mcm. It also states that 20 to 30 per cent of the

9 AMER, *op.cit.*

plants have closed because of war, and that there has been very limited development in the remaining industries. Thus, little else will be said of this subject.

Hydro-electric Production

A complete record of electric power production in Lebanon is not available for this analysis. Some idea of the role of hydropower and in particular of the waters of the Litani within the overall system can be gained from the data in Tables 4 and 5. There are apparently 17 hydro-electric stations established on eight rivers in Lebanon. Their total power in 1985 was estimated to be 278.4 MW (Table 4, see appendices). More than two-thirds of all the hydropower produced in Lebanon came from the Litani-Awali system described below.

The ONL/FAO summary report (1972) states that hydroelectric power constituted 50 per cent of Lebanon's total electrical production that year. Thermal production, however, has continued to increase, while water power, having taken advantage of most of the available sites in the country, has remained unchanged in an absolute sense. In 1985 water power accounted for 17.2 per cent of the electric energy produced. Table 5 (see appendices).

Special mention must be made of the Litani-Awali generating system. A major goal of development planning for the Litani Basin was the construction of a complex hydro-electric generating system (using both the Litani and the Awali Rivers. This begins with the Qirawn Dam and Reservoir). Water from the reservoir is diverted through a tunnel to the Abd el-Al Power Station (the Markabeh plant). Having passed through these turbines, water then continues through a tunnel under the Barouk-Nina crest to the headwaters of the Awali River. On the way, it is supplemented by the flow of the Ain Zarqa (spring) and additional water of

the Litani. Having also received some inflow from the Jezzine area the water is led to a holding basin before being directed by pressurised pipe to a second generating station – the Awali (also known as the Paul Arcache plant). The water is again passed onto a second holding basin farther down the Awali where it is supplemented by some flow from the Bizri River before entering the third power station (the Charles Helou or Joun plant). Thereafter, the water is released into the Mediterranean. There is also the strong possibility that these waters can and will be used to irrigate farms along the coast north of the Litani delta.

During the period 1965-1971 an average of 401 Mcm/yr were diverted through these three plants generating an average of 412.5 million kWh[10] (This figure differs from that given in Table 3 which anticipated additional power generation from the Litani-Awali system).

No attempt will be made herein to estimate the damage caused to this system during the civil war and the Israeli invasion. Destruction appears to have been significant. However, there are indications that repairs have taken place and that the system at least in part has been brought back on line.

Irrigated Agriculture

The importance of the Litani River to the total irrigated agriculture of Lebanon becomes apparent with reference to Table 6. The Bekaa Valley – which in this instance refers to the area essentially south of the Beirut-Damascus Road – accounted for 43 per cent of the total irrigated cropland in Lebanon in 1985. To this can be added another 24 per cent in southern Lebanon which is closely tied to water availability in the Bekaa. The pre-

[10] J.P. Nader, 'Note de synthèse sur l'aménagement du Karaoun', Office National du Litani. Beirut: May 1972, p. 6.

eminence of the Litani within the overall developmental scheme anticipated for Lebanon is abundantly clear from these data and the following statement:

> During the ten years of civil war irrigation using surface water has increased on the average at the rate of 1.2 per cent per year, and irrigation using underground water has increased at an annual rate of 1.7 per cent per year. In this period 930 ha per year were newly irrigated. The areas irrigated represent 7.6 per cent of the total land in the country and almost 25 per cent of the agricultural areas. The most important expansion of the irrigation system was in the Bekaa and along the coastal area of southern Lebanon. The expansion of irrigation took place without any government assistance.[11]

Irrigation in the Bekaa and Southern Lebanon

It is necessary to examine the role of irrigation in the Bekaa Valley and southern Lebanon more closely in order to understand both the water budget of the area and of the river and also to attempt some forecast of future water needs. The ONL/FAO report of 1972 cited above establishes a pre-civil war base line for irrigation. Irrigated lands upstream from the Qirawn Reservoir totalled 15,800 ha in 1972[12] using 122 Mcm annually.

The same summary cites water use downstream from the Qirawn for 3,270 ha on the lower Qasmieh (59 Mcm) and 1,140 ha between Qirawn

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11 AMER, 'Engineer's Report', *op.cit.*

12 FAO, *op.cit.*, pp. 37-38.

and the Qasmieh Canal intake (112 Mcm) making a total for the Litani basin of 20,210 ha using 293 Mcm water annually.

Lands of the South Lebanon Project include 4,020 ha irrigated in the Qasmieh/Ras el-Ain area, 3,270 ha of which are discussed above and an additional 750 ha supplied by the Ras el-Ain Canal. Scattered areas using surface water along the coast to the north accounted for 5,250 ha (75 Mcm). Underground waters from sea-level to 200 metres provided an additional 6,700 ha with 70 Mcm from approximately 800 wells. Thus, an additional 12,700 ha are cultivated in this area using non-Litani water sources.

Some prediction of the use of Litani waters based on the above figures can be attempted for the year 2000+ assuming peace and stability have returned to the area. The southern Bekaa – ie. that area between the Beirut-Damascus Road and the Qirawn Dam – will continue to pump 122 Mcm from both the river and aquifers. Pumping from the latter will have the effect of pumping from the river because of the rapid flow-through time resulting from the karstic nature of the strata. (It should be mentioned here that the estimate given in Table 6 of 32,960 ha for 1985 irrigated from all sources in the Bekaa is suspect, although included in this paper, since little else could be found regarding current conditions). The 122 Mcm cited here is considered realistic for both the present and the year 2000+ because the careful projections made by the ONL/FAO limit themselves to about 23,000 ha and 122 Mcm water and since inspection of maps and reports indicates no other possible land to irrigate.

One concession might be made to this estimate. That is, 30 to 35 Mcm may be taken to the '900 metre canal' as a separate withdrawal to the south. Also the Qasmieh Project may be downgraded. Several early reports mention the profligate use of water within the latter area.

New projects in southern Lebanon will extend along the coast from the mouth of the Awali in the north, southward past the mouth of the Zahrani and the Litani Rivers to the frontier with Israel. Between the Awali and the Zahrani at an elevation between 300 and 600 metres 2,300 ha of land will use 16.1 Mcm water. From the Zahrani to the Litani at the same elevation another 3,300 ha will consume 23.1 Mcm, and along the coast south of the Litani and in the interior and additional 9,400 ha will need at least 38.5 Mcm for irrigation. A total of 15,000 ha will utilise 78 Mcm of water, almost all of which would be led from the Qirwan Reservoir. Additional flow from upstream would also be used with considerable amounts *en passant* to the south (since the capacity of the reservoir is only 220 Mcm) through a series of canals and pipes on both sides of the stream.

A Summary of Projected Litani Water Use

Given the above discussion it may be anticipated that something in the total of 723 Mcm of water will be removed from the Litani River: for domestic use (27 Mcm), hydro-electric power diversions to the Awali River (461 Mcm), and irrigation uses (235 Mcm). (Industrial use – 35 Mcm – drawn elsewhere). No guarantee can be made that these figures are exact, but they provide an idea of the importance of the river and also help to define the parameters and magnitude of problems which may arise concerning these waters in the future. Before discussing possible sources of contention regarding the Litani, a brief review of the actual amount of water to be found in the river is necessary.

The Flow of the Litani River

Five parameters must be examined in considering the physical characteristics of the Litani River: its average annual natural flow, the regime of that flow, the extreme seasonality of such flow, variation in

flow from year to year, and the amount of water found in various segments of the stream. This discussion will spare the reader much of the detailed research underlying the answers to these questions. Such an account will be found in the author's forthcoming book, *The Litani* (University of Southern Illinois Press).

In order to ascertain the natural flow of the Litani, data from gauging stations along the Litani as well as measurements of side streams and springs were carefully aggregated and a running balance computed along the length of the river (Table 7, see appendices). This balance was matched internally by contrasting additions from the river's many sources against main stream measurements. In some cases it was obvious that upstream removals were through natural causes and eventually re-entered the stream in its lower portions. Another variant was water removed above Qirawn for irrigation. A careful crop by crop analysis of water demand and water use was made utilising aerial photos taken in 1969. This work was conducted by the Société du Canal de Provence for the Office National du Litani.[13] An estimated 118.6 Mcm of water was calculated as removed for irrigation. A second value of 122 Mcm/yr is cited in engineering reports.[14] In computing the average natural flow given here, 120 Mcm was added to the stream data at Qirawn to account for such removals. Continuing this book-keeping to the Qasmieh Delta of the river gives an estimated 920.2 Mcm per year natural flow.

Two additional estimates of the flow were made using two eleven year periods of available data. One data set represents a time when pumping for

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[13] Société du Canal de Provence, 'Irrigation de la Bekaa Sud', Mission GERSAR-SCR, République Libanaise, Office National du Litani, Annexe 111, Document 6, Juillet, 1972, p. 16.

[14] AMER, *op. cit.*

irrigation was taking place but with no removals to the Awali (1955-1946); a second period prior to 1955 was also chosen to represent a time when little or no pumping for irrigation occurred. These data were compared with precipitation figures for Ksara (within the valley). A correlation of r = .82 (r2 = .67) was computed. Based on these and other data the regime of the river was determined to fall into three time periods: that prior to 1955 with no pumping or diversion, that from 1955 to 1965 with pumping but no diversion, and that after 1965 when both pumping and diversion occurred (Graph 1, see appendices).

Given the above information, two other flow figures for the mouth of the river at the Qasmieh Delta were examined. The largest value, 959 Mcm/yr, is found in the Engineering Report given in AMER (1986). This is described as being for 1974, 'an average year', though no rationale for its being average is proposed. Another delta flow datum (795.1 Mcm) for the period 1965-66/1970-71 also appears in the Engineering Report. This was reassigned a higher value proportional to precipitation at Ksara for the same period. This increase took both pumping and removals to the Awali into account and contrasted river flow with a figure found in Vaumas[15] of 610.8 Mcm. Subsequent calculations yielded a value for natural flow at the delta of 937 Mcm. In view of these several attempts, for the purposes of this discussion an average natural flow of 920 Mcm has been used.

Given the location of Lebanon on the eastern littoral of the Mediterranean, the extreme seasonality of the Litani's flow comes as no surprise. Stream flow in a humid year may vary by a factor of eight from winter to late summer (Graph 2, see appendices.) By the same token, water

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[15] Etiènne de Vaumas, Part 1: 'Geological Structure and Relief', and Part 2: 'Climate, Water and Vegetation', *Le Liban: Etude de géographie physique.* Firmin-Didot, Paris: 1954.

removals which occur mainly in the summer leave little surplus in downstream areas (Table 8, see appendices). This is further complicated by the nature of the Litani's valley which, with the exception of the Qirawn Reservoir and a small storage dam proposed for a location near Khardale, has no good sites in which to store winter runoff.

Abd el-Al[16] points out two opposing factors which in unison account for the conditions described above. Rainfall under Mediterranean conditions is concentrated, even torrential. That is, so much occurs in a short time that runoff is almost immediate. On the other hand, the highly karstic and fissured limestones of the mountains on either side of the Bekaa permit rapid and enormous infiltration of water within a brief period of time. The water thus stored within the massifs prolongs stream flow, while surface waters temporarily swell the streams. In the Bekaa itself, where impervious alluvial materials prevent deep percolation, a near-surface water table forms which, in turn, provides additional irrigation water pumped from relatively shallow wells.

The year-to-year annual discharge of the Litani is also highly variable (Graph 3, see appendices). The small size of its watershed combined with an immediate runoff response and the rapid through-flow of water within the karstic aquifers underlying the valley creates dramatic fluctuations in the flow of the river. Given a lead time of perhaps two months between the time of precipitation and the riverine response – whether small or large – plus a certain guaranteed flow from the larger springs and sub-surface additions, short-term predictability of river flow seems feasible. Long-term

16 Ibrahim Abd el-Al, 'Statics and Dynamics of Water in the Syro-Lebanese Limestone Massifs', *Arid Zone Programme II*, Ankara Symposium on Arid Zone Hydrology. N.p., n.d., pp. 60-61.

prediction will depend upon the ability to predict precipitation over the entire watershed.

There remains only the question of the amount of water found in each section of the Litani from its headwaters to its mouth at the Qasmieh Delta. While the explanation given above accounts for the general regime of the river, several anomalous conditions need further exploration. The river and its basin can be topographically divided into four portions: from its headwaters near Baalbek to Mansura, from Mansura to the Qirawn Dam and Reservoir, from the dam to Khardale, and from Khardale along the Qasmieh portion to its delta. The first segment to Mansura encompasses 61 per cent of the total surface area of the basin and receives about 58 per cent of the total precipitation, but only about 37 per cent of the total flow of the river is apparently derived from this area according to stream gauge data. The Mansura to Qirawn area represents 10 per cent additional surface area upon which 12 per cent of the total precipitation falls. However, this same stretch of river accounts for an additional 22 per cent of total stream flow. By the same token, the sub-section from Qirawn to Khardale accounts for 12 per cent of total area, 13.5 per cent of precipitation, but slightly more that 30 per cent of the Litani's total flow. In the final section from Khardale to the Qasmieh Delta, constituting 17 per cent of the total basin area, 16 per cent of total precipitation occurs, but only about 10 per cent of the flow is accounted for. Table 9 (see appendices) indicates that nine per cent of the river's water is somehow missing from this section of the stream. It is this deficit that raises important questions regarding the management of the Litani in the context both of Lebanon's total water supply and the water supply of the extra-national region of which Lebanon is a part.

The Problem of Management

Two problem areas for water management in Lebanon are raised by the above discussion. The first, while challenging, is straightforward. Demands of 723 Mcm water withdrawals are likely to be placed upon the river in the foreseeable future. This, contrasted with an estimated normal flow of 920.1 Mcm per year means that there will be little slack in the system should new needs occur. Nor does the above equation take into account inevitable runs of dry years with flows less than demand, nor the fact that no new, i.e. additional, reservoir capacity seems possible.

One immediate solution to this problem is to shift the burden of energy production to thermal and other sources. However, it has been estimated (1974 prices) that the three main power plants on the Litani-Awali system produced 1.7 kWh for each cubic meter of water passed through the system. This was the equivalent of 475 grams of fuel necessary for thermal generation of the same amount of energy. Thus, a considerable saving in imported fuel oil is tied to hydropower generation. Allocating the waters of the Litani to energy instead of agriculture could be one management choice. But the pay-off between agriculture and energy is more complicated than it at first appears. One might opt for saving oil since water is essentially a renewable resource, but the control of land and the goodwill of those farming the land depends upon the psychological as well as the economic viability of their occupancy.

South Lebanon between the Litani and the Israeli border is of critical importance to both Lebanon and Israel and the fate and mood of its inhabitants will not go unnoticed. Their water needs for both domestic and agricultural purposes will demand high priority in the year ahead.

Another way of approaching this situation might be the careful management of the Litani in order to seek a balance between the two uses given above. The most important aspect of the Litani power plants is their

ability to come on and off line (ie. production) with little or no lag time, unlike thermal generators which need several hours to fire up. Thus, despite the decreasing share of power supplied by hydro-electric sources, their role – and particularly that of the Litani-Awali system – will remain useful if not critical for meeting peak load demands. If such periods were of short duration they might be carefully balanced against irrigation needs with little disruption to either system.

Careful investigation should also be made of the payoff between sending water directly down the Litani to be pumped to South Lebanon – (and also diverted into the Qasmieh Canal) as opposed to generating power with it and thereafter using the same water along the coast at Sidon and to its south. The confessional homogeneity (Shi'i Muslims) in both areas – south of Sidon on the coast and south of the Qasmieh Litani – should ease such an arrangement.

Domestic use will remain a small proportion of overall use. Here, as in other countries, the choice becomes one of deciding between agriculture and urban-industrial demands. If Lebanon is able to restore its pre-eminent role in the service and quaternary activities, the above choice should be manageable.

It is at this point that Lebanon's role in its region at large becomes critical. While the Litani is found entirely within the borders of the country, the waters of the Kebir River are shared with Syria, and those of the 'Asi (Orontes) with Syria and Turkey.

In the latter case, a natural flow of 420 Mcm from the headwaters in the northern Bekaa is reduced by agriculture to about 370 Mcm before entering Syria. An additional 430 Mcm enters the river from Syrian tributaries, but 630 Mcm are removed for irrigation in the Ghab Valley and further upstream. Transboundary flow into Turkey is in the neighbourhood of 170 Mcm. This is then augmented by waters of the Afrine River which rising

in Turkey flows through a corner of Syria on its way to the sea (230 Mcm) in Turkish Hatay. This situation is exacerbated by Syria's proposal to build a dam on the Afrine as well as another dam at Kremish farther south on the 'Asi. Removals of as much as 130 Mcm from the Afrine in Syria for irrigation are foreseen. The remaining 270 Mcm reaching Turkey may not be sufficient for the burgeoning population in and around Iskenderun.[17]

Nor is this situation complete in itself. Turkey has launched a major river development scheme on the Euphrates and Tigris Rivers (The GAP), the headwaters of which it controls. As uppermost riparian on those streams it controls 98 per cent of the flow of the Euphrates and 50 per cent of the Tigris. More than one million ha of Turkish land may be irrigated with waters from the Euphrates. This could result in a possible 50 per cent reduction in river flow to Syria and Iraq by the year 2020. Syria and Iraq have felt the pinch already as Turkey has filled the Keban, Karakaya and Ataturk Reservoirs on the Euphrates. In fact, the former two countries in 1990 entered into an uneasy alliance in order to protest Turkey's actions. Little came of that first partnership which was cut short by the invasion of Kuwait. Nevertheless the situation on the Euphrates remains to be resolved and Syria's dam on the Afrine could become a factor in the diplomacy between Syria and Turkey. Nor is the role of Iraq to be discounted in this struggle for the river.

As of this writing little is known of the Kebir or of any potential competition for its waters. Nevertheless, a close watch should be kept on this potential trouble spot.

This brings the discussion to its most controversial part.

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[17] United States Government, US Army Corps of Engineers, *Water in the Sand – A survey of Middle East Water Issues.* Washington, DC: June 1991.

The Litani and the River Jordan

The competition for scarce water resources between Israel, Jordan, and the Palestinians of the West Bank and Gaza has been amply documented.[18] Israel receives approximately one-third of its water from inside its own borders, one-third from the West Bank, and one-third from Lake Kinneret (Lake Tiberias) which in turn is served directly by the waters of three rivers which flow into it from the north: the Dan, the Hasbani, and the Banias (Table 10 and Table 11, see appendices). The waters of the Yarmouk are also used in part by Israel although technically this stream enters the Jordan below its exit from the lake.

All in all, Israel uses anywhere from 90 per cent to 110 per cent of the renewable waters available to it depending on the method of book-keeping employed to compute this amount. In this desperate situation the West Bank is particularly at issue.

The Israelis contend that their use of 83 per cent of the water originating there either for local Jewish settlers numbering between 100,000 and 200,000 or through its transfer by artificial pumping and natural aquifers to Israel proper is legal and based on the right of prior usage. The remaining portion serves the indigenous Arab population of more than one million. Mention must also be made of the impact on water supplies of an additional million plus Soviet Jewish immigrants scheduled to arrive in Israel.

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[18] Thomas Naff, 'The Jordan Basin: Political, Economic, and Institutional Issues', revised version of a paper presented at the World Bank, Water Resources Management Workshop, Washington, DC: June 24-28, 1991; Thomas Naff and Ruth C. Matson, *Water in the Middle East – Conflict or Co-operation?* Middle East Research Institute, University of Pennsylvania. Westview Press, Boulder: 1984.

Jordan also feels the pressure of a steadily increasing water shortage. Rationing of this precious commodity is in effect: aquifers such as that which fed the al-Azraq oasis have already begun to fail; and the waters of the Yarmouk which are brought south by the East Ghor Canal are insufficient.

Thus, water from any source becomes of critical importance in the search for peace in the Middle East. This is particularly true when Lebanon's waters and the sources of Lake Kinneret are considered. Early plans for the state of Israel drawn up by Lowdermilk[19] included the use of Litani River waters, and during the Israeli invasion of Lebanon it was rumoured that the hidden agenda of this action was to gain control of that river.

There has been much talk of the Israelis digging a tunnel to tap the Litani near Beaufort Castle (where the river makes a sharp westward bend to its Qasmieh portion) in order to bring water to the Hasbani Valley north of Lake Kinneret.[20] Personal interviews with two UN Peace-keepers and also with Professor Arnon Soffer of Haifa University indicate there is no convincing evidence that such a tunnel exists. In the same vein, reports of waters being trucked from the Litani to Israel are denied by Israel and further research indicates that the only water moved by truck has been to posts and settlements in South Lebanon and has not crossed the Green Line into Israel proper. UN Peace-keepers have told this author of a pumping station on the Qasmieh which raises water from the Litani to

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19 Walter Clay Lowdermilk, *Palestine, Land of Promise.* Harper and Row, New York: 1944.

20 Leslie C. Schmida, 'Israel's Drive for Water', *The Link*, Vol. 17, No. 4 (November, 1984), pp. 1-16; Lydia Georgi, 'Litani River Chairman Scores Israeli Intentions', *Monday Morning*, No. 514 (26 April 1982), pp. 26-31.

villages in the South, villages which are in turn connected by pipelines to northern Israel. In the case of either trucks or small pipelines the amount of water transferred is physically insignificant, but the action could, nevertheless, be symbolically sensitive.

The Sources of Lake Kinneret (Lake Tiberias)

On the other hand, the consolidation of the Golan Heights into the State of Israel is as much due to the snow fields on Mount Hermon providing water for Hermon Spring (the source of the Banias River which helps supply Lake Kinneret), as it is to any strategic consideration of 'overlooking Damascus' or 'overlooking Israeli settlements'. Certainly, control of the Hermon basin and watershed ranks high on the list of reasons for annexing the Golan despite the need to pump water from Lake Kinneret to water the cotton fields of its Israeli settlers.[21]

In the context of this discussion other sources of the Jordan, the Hasbani River and the Dan River, both of which join with the Banias to feed Lake Kinneret are of particular interest. The former two streams receive almost all their water from large springs – the Dan Spring – and the Wazani and Hasbaya Springs in the case of the Hasbani. The remarkable thing about these three springs is that their flow is much greater than can be explained by the area of their catchments and the precipitation that falls thereon (Table 12, see appendices). The Dan Spring for all practical purposes receives all its water from outside its own basin, while the springs on the Hasbani receive 88 per cent (122 Mcm) from similar, unspecified sources. References to Table 12 illustrates this phenomenon.

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21 Joe Stork, 'Water and Israel's Occupation Strategy'. *MERIP Reports* (July-August, 1983), p. 23.

The sources of this unaccounted water may possibly be explained geologically. A large syncline underlies the lower valley of the Litani River.[22] This structure extends from the Djebel Abu Rayata west of the Litani to the Valley of the Hasbani with its eastern limb merging into a monocline which forms the summit of Mount Hermon. This formation is composed in part of a highly fissured and karstic Cenomanien-Turonien limestone of Cretaceous age which is capable of holding enormous quantities of water. It is this stratum and an overlying nummelitic formation of Senonian age which may serve as reservoirs for the springs of the Hasbani and the Dan. It should also be noted that the loss of water identified on the Qasmieh section of the Litani nearly matches the unaccounted flow of the Wazani and Hasbaya Springs (Table 9 and Table 12, see appendices).[23] The thickness of this structure and its areal extent reinforce such a speculation.[24] It would seem that the Israelis are aware of this situation for they have apparently fenced off portions of the Hasbani region of southern Lebanon[25] and have placed pumps and pipes along the stream to enhance its flow to Israel.[26]

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[22] Pierre Birot and Jean Dresch, La Mediterranée et le Moyen-orient, Tome Second, *La Mediterranée orientale et le Moyen-orient*. Presses Universitaires de France, Paris: 1956, pp. 214-15.

[23] An alternative explanation of the missing amount may be underground flow along the steam channel of the Litani to the Mediterranean Sea.

[24] I am in receipt of a strong denial of this hypothesis by Fathi Chatila, publisher of *Arab Water World International*, one that emphasises the need for unimpeded investigation of the area by neutral, objective hydrologists.

[25] H.J. Skutel, 'Water in the Arab-Israeli Conflict', *International Perspectives* (July-August, 1986), p. 24.

[26] Stork, *op.cit.*, p. 24.

This discussion has gone a long way to present what may seem a small point. A possible flow of perhaps 100 Mcm per year hardly seems worth the effort. But it is precisely the potential for this flow which should alert both diplomats and planners alike, Lebanese and Jordanians, and Israelis, to the importance of this area and what it implies: the hydrologic unity of the region. If Israel insists upon maintaining the integrity of its water supplies and perhaps considers extending its control of their sources, and if Lebanon is to accomplish its rebirth and reconstruction which includes the full use of the Litani River, and if Jordan is to survive its growing water crisis, then comprehensive regional planning must settle the question of the relationship between the flow of the Litani and the sources of the Hasbani. The removal of more than 700 Mcm from the watershed of the Litani (which will be possible only in good years) might diminish the fund of water that feeds the northern sources of the Jordan. If in dry years the flow of the Litani is significantly reduced without compensating reductions in demand, mining of the aquifers might irreversibly reduce the flow of those same springs.

The law of underground waters is insufficient and untried in cases such as this. Israel may demand control over, or at least a veto of, projects in Lebanon that might affect the springs in question. Certainly, the small valley of the Hasbani in south eastern Lebanon – which at present falls de facto under the hegemony of Israel – does not alone hold the key to the situation. In a very real sense, the management and legitimate control of the Litani river by the Lebanese will become an important key to the peace process.

Bibliography

Abd el-Al, Ibrahim, 'Statics and Dynamics of Water in the Syro-Lebanese Limestone Massifs', *Arid Zone Programme II*, Ankara Symposium on Arid Zone Hydrology. N.p., n.d., pp. 60-76.

Associates for Middle East Research, 'Hydrology of Lebanon – Preliminary technical Report', also referred as the 'Engineer's Report', September 1986, pp. 120.

Bassiri, Muin and Ryan, John, *Irrigation in Lebanon – Research Practices and Potential,* Published jointly by the National Council for Scientific Research, Beirut and the American University of Beirut. Beirut: 1986, pp. x and 165.

Beaumont, Peter; Blake, Gerald H.; Wagstaff, J. Malcolm, *The Middle East – A Geographical Study*, second edition. Halsted Press, New York: 1988, pp. viii and 623.

Birot, Pierre and Dresch, Jean, La Mediterranée et le Moyen-orient, Tome Second, *La Mediterranée Orientale et le Moyen-orient.* Presses Universitaires de France, Paris: 1956, p. 520.

Davis, Uri; Maks, Antonia E.L.; Richardson, John, 'Israel's Water Policies', *Journal of Palestine Studies*, Vol.IX, No.2 (Winter, 1980), pp. 3-31.

El-Hindi, Jamal, 'The West Bank Aquifer and Conventions Regarding Laws of Belligerent Occupation', Master's Thesis, The Law School, University of Michigan, first draft (June 1991).

Food and Agriculture Organisation of the UN, 'La Planification du Sud du Liban'. Beirut: 1972, pp. 91.

Faour, Ali, 'Population Movements and Prospects for Development in South Lebanon', *Population Bulletin of ECWA*, No. 25 (December, 1984), pp. 49-88.

Georgi, Lydia, 'Litani River Chairman Scores Israeli Intentions', *Monday Morning*, No. 514 (26 April 1982), pp. 26-31.

Guerre, A. 'Etude hydrologique préliminaire des karsts libanaise', *Hannon – Revue Libanaise de Geographie*, Vol. IV, 1969.

Held, Colbert C. *Middle East Patterns – Places, Peoples, and Politics.* Westview Press, Boulder: 1989, Chaps. 3, 12, 13, 14, 15.

Kolars, John, *The Litani*, AMER, The University of Southern Illinois Press (forthcoming, 1992).

Lowdermilk, Walter Clay, *Palestine, Land of Promise.* Harper and Row, New York, 1944.

Nader, J.P. *'Note de Synthèse sur L'Aménagement de Karaoun'*, Office National du Litani. Beirut: May 1972, pp. 5 & 7.

Naff, Thomas, 'Data and Analysis of the Jordan River System', Associates for Middle East Research. Philadelphia: May 1987, pp. v, 125, 15.

Naff, Thomas, 'The Jordan Basin: Political, Economic and Institutional Issues', revised version of a paper presented at the World Bank, Water Resources Management Workshop. Washington, DC: June 24-28, 1991 pp. 34.

Naff, Thomas and Matson, Ruth C. *Water in the Middle East – Conflict or Co-operation?* Middle East Research Institute, University of Pennsylvania. Westview Press, Boulder: 1984, pp. 236.

Schmida, Leslie C. 'Israel's Drive for Water', *The Link*, Vol. 17, No. 4 (November 1984), pp.1-16.

Simpson, Barbara and Carmi, I. 'Hydrology of the Jordan Tributaries (Israel) – Hydrographic and Isotopic Investigation', *Journal of*

Hydrology. Elsevier Scientific Publishing Co., Amsterdam: 1983, Vol. 62, pp. 225-42.

Skutel, H.J. 'Water in the Arab-Israel Conflict', *International Perspectives* (July-August, 1986) pp. 22-24.

Société du Can de Provence, 'Irrigation de la Bekaa Sud', Mission GERSAR-SCR, République Libanaise, Office National du Litani, Annexe III, Document 6 (Juillet 1972), p. 16.

Stork, Joe. 'Water and Israel's Occupation Strategy'. *MERIP Reports* (July-August, 1983), pp. 19-24.

Syrie et Monde Arab, 'L'importance du Litani dans l'économie Libanaise', No. 180, 1969, pp. 34-39.

United Nations, Department of Technical Co-operation for Development, Natural Resources/Water Series No. 9, *Ground Water in the Eastern Mediterranean and Western Asia.* New York: 1982, pp. 73-80 and 98-105.

United States Government, US Army Corps of Engineers, *'Water in the Sand – A Survey of Middle East Water Issues'*. Washington, DC: June 1991.

..... Department of the Interior, Bureau of Reclamation, *'Litani River Project – Reconnaissance Report'*. Beirut: June 1951, pp. 156 and maps.

.....'Development Plan for the Litani River Basin, Republic of Lebanon'. Beirut: June 1954, Vols. I-XI.

De Vaumas, Etiènne, Part 1: 'Geological Structure and Relief', and Part 2: 'Climate, Water and Vegetation', *Le Liban: Etude de géographie physique*. Firmin-Didot, Paris: 1954, pp. 1-216 and 217-367.

Table 1: Distribution of Water in Lebanon
(all figures in millions of cubic metres)

Precipitation*	9,200	9,700**
Lost to evapotranspiration	4,324	
Runoff and infiltration	4, 876	4,300
Consumed	854	
Available reserve	2,859	
Total Available Reserve	3,713	

	Surface Water		Groundwater		Total Consumed	
	volume	%	volume	%	volume	%
Utilisation						
Irrigation water ***	422	79	247	78.3	669	78.4
Domestic water	105	20	40	12.3	145****	16.9
Industrial water	10	1	30	9.4	40	4.7
TOTAL	537	100	317	100.0	854	100.0

Source: AMER, Preliminary Technical Report (Philadelphia, Sept. 1986), p.6, unless otherwise noted.
*Fawwaz (1969) and Sharafuddine (1971) as quoted in Baasiri and Ryan, p. 30.
**United Nations, Natural Resources and Water Series, No. 9, *Ground Water in the Eastern Mediterranean and Western Asia.* New York: 1982, p. 103.
***Guerre, *et al* (1981), as quoted in Baasiri and Ryan (p. 45) are in close agreement with these figures.
****Pathan, as quoted in Baasiri and Ryan (p. 41), cites 123.3 Mcm/yr but this is for treated water only. Many small towns and villages perforce use untreated water. Total water treatment capacity in Lebanon in 1975 was 338,700 cubic metres per day (124 Mcm/yr) (Baasiri and Ryan, p. 41).

Table 2: Estimated Domestic Water Needs CA 2000+

Region	Estimated Population	P/C Needs (l/d)	Amount (million cm/y)
Beirut	1,800,000	245**	195
South Lebanon	1,700,000	120***	93
Remainder	1,160,000	120***	64
TOTAL	4,660,000		352

* Population estimates are admittedly highly speculative. Beirut is expected to grow more rapidly than the rest of the country (i.e. 2.57 times its 1970 population of 700,000). South Lebanon which holds the second largest concentration of people is assumed to increase nearly as much. The remainder of the country has been assigned an additional 25 per cent of the population.
** Assumed system loss 18 per cent.
*** Assumed system loss 20 per cent.

Table 3: Estimated Future Water Use (CA 2000+) in the Litani Basin and the Southern Coast and Interior
(all values in Mcm)

Type and Location	Normal Year	Source	Comments and Reference
Domestic			
Beirut	5*	Awali-Litani	FAO 1972 unless otherwise noted
	55	Jezzine-Bizri	
Villages – north coast	24	Damour-Barouk	
Villages – south coast	15*	Qirawn Res.	
	7*	Khardale Res. (proposed)	
	24*	Beit ed-Dine (proposed)	
	35	local	
Irrigation			
South Bekaa	122*	local pumped and surface	SOC.C. de Provence and FAO 1972
Sidon Project	(31)*	Qirawn Res. (incl. in the Litani diversion: 6 Mcm were diverted for this in 1972)	
Qasmieh/Ras el-Ain	78		
	47*		
New Southern Projects	39.2		
	65.8*		
Litani-Awali Diversion			
	115*	Ain Zarqa and below Qirawn Reservoir	Nader, 1936
	346*	Qirawn Res. and upstream	Nader, 1936
	102	Awali Basin	Nader, 1936

(Table 3 contd....)

Type and Location	Normal Year	Source	Comments and Reference
Litani-Awali Diversion			
	115*	Ain Zarqa and below Qirawn Reservoir	Nader, 1936
	346*	Qirawn Res. and upstream	Nader, 1936
	102	Awali Basin	Nader, 1936

* Removal from Litani; total for Litani waters = 723 Mcm.
A complete discussion of this table and its contents is found in : Kolars, *The Litani*, AMER Associates (forthcoming).

Table 4: Hyrdo-Electric Power Plants in Lebanon, 1985

Region/River	Power Plant	Startup date	Power MW	%Total	Turbine Water-Mcm
North Lebanon					
– Jaouz	Kaftoun	1954	5.00	1.8	46
– Abu Ali	Blaouza	1961	8.40	3.0	48
	Kousba	1972	7.40	2.6	44
	Mar-Lisha	1958	3.10	1.1	20
– el-Bared	Bared I	1954	13.50	4.7	148
	Bared II	1961	3.70	1.3	52
	Bcharre	1929	1.63	.6	na
	Mar-Licha	1958	3.10	1.1	20
Mount Lebanon					
– el-Kalb	Hrache	na	1.91	.7	na
–Ibrahim	No.1	na	15.00	5.3	na
	No. 2	na	12.50	4.4	na
	No. 3	na	4.98	1.8	na
–Damour	es-Safa	na	13.12	4.7	na
Litani Basin					
–upstream from Qirawn	Bardawni	na	1.12	.4	na
–downstream	Markabeh*	1962	34.00	12.1	317
–Awali	Awali**	1965	105.00	37.3	282
	Joun***	1968	48.00	17.1	377
TOTAL			281.50	100.0	

* Also known as the Abd el-Al Power Station.
** Also known as the Paul Arcache Power Station.
*** Also known as the Charles Helou Power Station.

Source: The above table consists of the combination of two sources: Baasiri and Ryan, p. 119 and the Journal *en-Nahar*, p. 7 as cited in AMER, 1986, p. 9. Inconsistencies exist between the two sources and the above table must be viewed with reservation.

Table 5: Power Production in Lebanon

Year	Thermal kWh	Thermal %	Hydroelectric kWh	Hydroelectric %	Bought by Syria (source unspecified) kWh	Bought by Syria (source unspecified) %	Total kWh
1982	1792	71.9	576	23.1	125	5.0	2493
1983	1812	64.1	919	32.5	94	3.4	2815
1984	1686	62.1	984	36.2	46	1.7	2716
1985	2599	81.6	547	17.2	39	1.2	3185

Source: *Journal en-Nahar*, p. 7 (cited in AMER, 1986, p. 9).

Table 6: Distribution of Irrigated Land in Lebanon – 1975 & 1985

Region	Year	Total Irrigated Area ha	%
North Lebanon	1985	16,700	21.9
	1975	14,900	22.3
Mount Lebanon	1985	8,340	10.9
	1975	7,600	11.4
Southern Lebanon	1985	18,200	23.9
	1975	15,900	23.8
Bekaa Total	1985	32,960	43.3
Total	1975	28,500	42.6
Central	1975	18,100	27.1
Southern	1975	10,400	15.5
Total Lebanon	1985	76,200	100.0
	1975	66,900	100.0

Source: AMER, 1986, all 1975 data agree with those given in Baasiri and Ryan, p. 45.

Table 7: Sources of Litani flow: 1964-65 / 1972-73

Station No.*	Flow at Non-Litani Stations (Mcm/yr)	Subtotals + (subsurface additions)	Flow at Litani Stations Mcm/yr)	
1	6.741			
2	3.147			
3	9.284			
4	8.733			
5	11.357			
6	62.213	(no. 7 Anjar canal excluded)		
		101.475		
		(23.696)		
8			125.171	
9	63.576			
10	43.175			
11	6.945	(nos. 12 & 13 subsumed under no. 11)		
14	23.046			
15	20.647			
		157.389		
		(36.120)		
16			318.680	
17	9.394			
		9.394		
		(87.347)		
19			415.421	
18	11.452			
20	83.643			
21	25.816			
		120.911		Estimated Natural Flow
AT AWALI DIVERSION			536.332	536.332
(Diverted to Awali)			235.906	+120.000 (irrigation replacement)
22			300.426	*(Contd.....)*

(Table 7 contd....)

Station No.*	Flow at Non-Litani Stations (Mcm/yr)	Subtotals + (subsurface additions)	Flow at Litani Stations Mcm/yr)	
23	6.000			
24	5.091			
29(n=6)	31.596			
25	1.488			
26	1.091			
27	4.228	(no.28 subsumed under no. 27)		
		49.494		+49.494
		(104.791)		+(104.791)
30			454.711	810.617
32(n=7)	7.348			
		7.348		+7.348
		(37.142)		+(37.142)
31			499.201	855.107
33(=8)	-77.433			
		-77.433		
			421.768	
		(65.046)		+(65.046)
34(n=8)			486.814	920.153

Source: Rapport Téchnique sur l'Hydrologie du Litani – étude détaillée, Consultation and Research Institute (S.A.R.L.). Beirut: Août, 1986.
*Station numbers in order of entry into Litani.

Table 8: Water Balance of the Litani – Mcm/yr

River Portion	Natural Flow	Amount Withdrawn	Amount Remaining
	For an 'average year – 1974'		
Upstream of Qirawn	527	122	405
Downstream of Qirawn	432	101	331
TOTAL	959	223	736
	For summer of an 'average' year		
Upstream of Qirawn	159	122	37
Downstream of Qirawn	145	87	58
TOTAL	304	209	95

Source: UNDP/FAO, Table 38, p. 90.

Table 9: Hydrologic Parameters of the Sub-sections of the Litani River

Sub-section	*% of Basin*	*% of Precip.*	*% of Available Surplus*	*% of Streamflow*	*Difference*
To Mansura	60.7	58.4	49.6	36.9	-21.7m
Mansura to Qirawn	10.3	11.9	10.5	22.4	+11.9
Qirawn to Khardale	11.8	13.6	18.9	30.8	+11.9
Khardale to Qasmieh Delta	17.2	16.1	21.0	9.9	-11.1
TOTALS	100.0	100.0	100.0	100.0	-9.0

Source: AMER, Engineering Report. Computations by Kolars.

Table 10: Sources of the Upper Jordan River

Spring	River (Hebrew)	Flow(1000cm/yr) Low	Average	High
Dan	Dan (Nahal Lidani)	173	239 ('recent 20 years')	285
Wazani/Hasbaya	Hasbani (Nahal Snir)	52	138 (1962–1980)	236
Hermon	Banias (Nahal Hermon)	63	117 (1962–1980)	190
	Sub-total	288	494	701
Precipitation	130			
- Run off		39 (est)	55	95 (est)
- Other		8 (est)	11	19 (est)
TOTAL to Lake Tiberias		241 (est)	560	815 (est)

Source: Simpson, Barbara and Carmi, I., 'Hydrology of the Jordan Tributaries (Israel) – Hydrographic and Isotopic Investigation', *Journal of Hydrology*. Elsevier Scientific Publishing Company, Amsterdam: 1983, v. 62, pp. 225-242.

Table 11: Stream Flow to Lake Tiberias – Six Estimates (1000cm/yr)

Author	Total Flow	Used Upstream	Inflow
Kahan	651	110	541
Serruya	668	110	558
Inbar/Maos	631	110	531
Mekorot	–	–	520
Ben Arieh	–	–	536
AV. TOTAL	650	110	535

Sources: As quoted in AMER, *Data and Analysis of the Jordan River System.* Philadelphia: 1987, p. 96.

Table 12: Unaccounted Spring Flow – The Upper Jordan River (1000cm/yr)

River	Flow	Precipitation Recharge over Basin Area	Unaccounted
Dan	239	none*	239
Hasbani	138	16	122
Banias	117	56	61
TOTAL	494	72	422

*'The Dan Spring has a surface catchment area that is effectively zero'. Simpson and Carmi.

Sources: AMER, Data and Analysis of the Jordan River System. Philadelphia: 1987, pp. 96-98.

Beyond Litani – A Commentary

*Khalil M. Malouf**

At the conference on *Peace-Keeping, Water and Security in South Lebanon* organised by the Centre for Lebanese Studies on 4th October 1991, two recognised water experts – Professors Thomas Naff and John Kolars – presented papers on the implications of the waters of southern Lebanon for the region as a whole.

The following comments are presented as a complement to the two papers and should be read in conjunction with them.

Historical

The concern of the Zionist movement with water availability long predates the State of Israel. Very early after the turn of the century attempts were made to have the Litani as the northern border of a 'Jewish homeland'. The initial agreement between England and France in 1916 (Sykes-Picot) left the southern border of Lebanon running from Ras en-Naqura inland in a west-east direction then in a south-east direction west of Safad to hit Lake Tiberias, then along its northern shores and finally northwards.

Over the next few years Zionist lobbying for inclusion of more water-rich areas was kept up which, in addition to the Anglo-French tug-of-war,

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finally resulted in boundaries agreed and implemented in February/March 1923 (See map).

Within the present context we are primarily concerned with the boundaries of Lebanon, Syria, and Palestine, which give rise to the following main, water-related points:

– The Litani was kept completely within Lebanon.

– The southern border of Lebanon (northern border of Palestine) was altered to cut out a north-south finger extending north to Metulla/Baniyas and including the Dan Spring which accounts for about 50 per cent of the water resources of the Upper Jordan.[1]

– Of equal significance was the eastern border between Palestine and Syria. Contrary to accepted international practice, this ran to the east of all water bodies involved right up to the Yarmouk River in the south. Thus all of the upper Jordan with Lake Hula and Lake Tiberias lay in their entirety inside the borders of Palestine.

It is therefore, easy to agree with the conclusion arrived at by Professor Naff (p. 17) that Israel 'will continue to make a determined effort to share or control the waters of southern Lebanon'.

Hydro-geological

Professor Kolars presents a well researched paper which analyses both surface and ground water resources in Lebanon and mentions some of their links to neighbouring countries. Although some numbers may be at variance with other sources, it would be more profitable to proceed to look

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[1] C.G. Smith, 'The Disputed Waters of the Jordan'. Reprinted from *Transactions and Papers*, p.142, Table 1, Publication No.40, 1966. I would like to thank Mr C.G. Smith for his advice and for making this paper available to me.

at the overall picture and accept Kolars' own statement that his paper 'will provide a useful and essentially accurate picture of the Litani' in ... a 'regional setting'.

Kolars (pp. 20-22) discusses at some length the possible existence of a subterranean linkage between the Litani and the northern head-waters of the Jordan River. In his paper presented at the World Bank in 1991 Naff implies the same idea in passing when he writes '...(if one accepts that the Hasbani links the Litani with the Jordan)... some 80 per cent of the basin is situated in Jordan, Israel, and the West Bank ...'

Kolars also presents computed values (See Kolars: Appendices Table 9) which show that 9 per cent of the Litani waters is 'somehow missing' and the reader is left with the impression that this negative water balance is considered (when combined with other evidence, pp. 20-21) to be near-conclusive proof of an underground link with the Hasbani, Dan, and/or Baniyas sources.

This may well be, and the point is certainly worth further field study as Kolars suggests.

Kolars' paper, however, makes no mention of the number of off-shore springs which occur at intervals all along the Lebanese coastline. These have total quantities of flow which amount to several times the deficit in the Litani water balance.

Starting in the north close to the highway tunnel near Chekka, a sweet water sub-marine spring resurges at about a depth of ten metres a short distance off-shore in the Mediterranean. Gischler[2] refers to it as 'Ain Sheqqa' and lists it among the important karstic springs in the entire area (N.B. The paper suggests isotope studies for our area). Further south, and

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2 Christian E. Gischler, *Water Resources in the Arab Middle East and North Africa*. Menas Press: London, 1979, p.64.

although not off-shore, the karstic spring of Fawar Antelias has created much spelaeological interest since the 1930s. It was not until 1965 that tests demonstrated a practically direct subterranean connection between the Ain Dara sink hole and Fawar Antelias. Yet further south along the Sidon-Tyre coast a number of off-shore sweet water springs can be found. This writer does not have first-hand knowledge of these, but has been given to understand that flows from these springs far exceed that of Ain Chekka.[3]

This all goes to show that in an area such as Lebanon with massive porous limestone rock, it is not easy to determine the precise origin of water emerging from karstic springs. Where such subterranean waters go to, or where they originally come from, are questions which may not have simple answers. Field studies, as Kolars suggests, are therefore necessary.[4]

But even this leaves the overall picture with yet one more question unanswered: Insofar as water is concerned, what lies beyond the Litani?

Israel, Jordan, and the occupied territories have a present water deficit of over 200 MCM/yr, and it is estimated that in twenty years' time the deficit will be about 2500 MCM/yr. Naff (See Naff: Appendices, Table 2) gives figures which result in a present combined deficit of about 300 MCM/yr and a projected deficit for the years 2015-2020 which could rise to over 2500 MCM/yr. When the entire flow of the Litani is estimated to be

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[3] Reference HE Mr Kamal Khoury.

[4] Professor John Kolars has sent the following rejoinder: *I am gratified by the commentary of Dr Malouf regarding the 'missing' waters of the Qasmieh/Litani. I was unaware of the magnitude of the off-shore springs which he mentions and could easily accept that as an explanation of the water in question. If his supposition is correct, the problem of the source of the Dan Spring - whose surface recharge area is too small to adequately account for its discharge - remains a fascinating question. More field work is definitely needed.*

between 700 and 900 MCM/yr, where is the extra water going to come from? Özal suggested a 'peace pipe-line' from Turkey. Naff (p. 13) describes it as 'costly and vulnerable'. Since 1980 this writer has been proposing water from the Nile – naturally a highly controversial proposal. Ben-Shahar[5] also outlines a project based on Nile water.

A debate over this question is obviously beyond the scope of the present discussions. But, if talk about a lasting peace in the region is to be at all serious, it will have to face the problem of equitable water redistribution across many more national boundaries.

Israel and Zionist leaders before it have coveted the waters of south Lebanon for a long time now. In view of the magnitude of the requirements for water in the Jordan Valley in twenty years' time, all parties must realise that only a major source capable of providing several times the flow of the Litani will be viable. Any other source will be able to serve only as a short term stop-gap arrangement and could end up by doing more harm than good in the long run.

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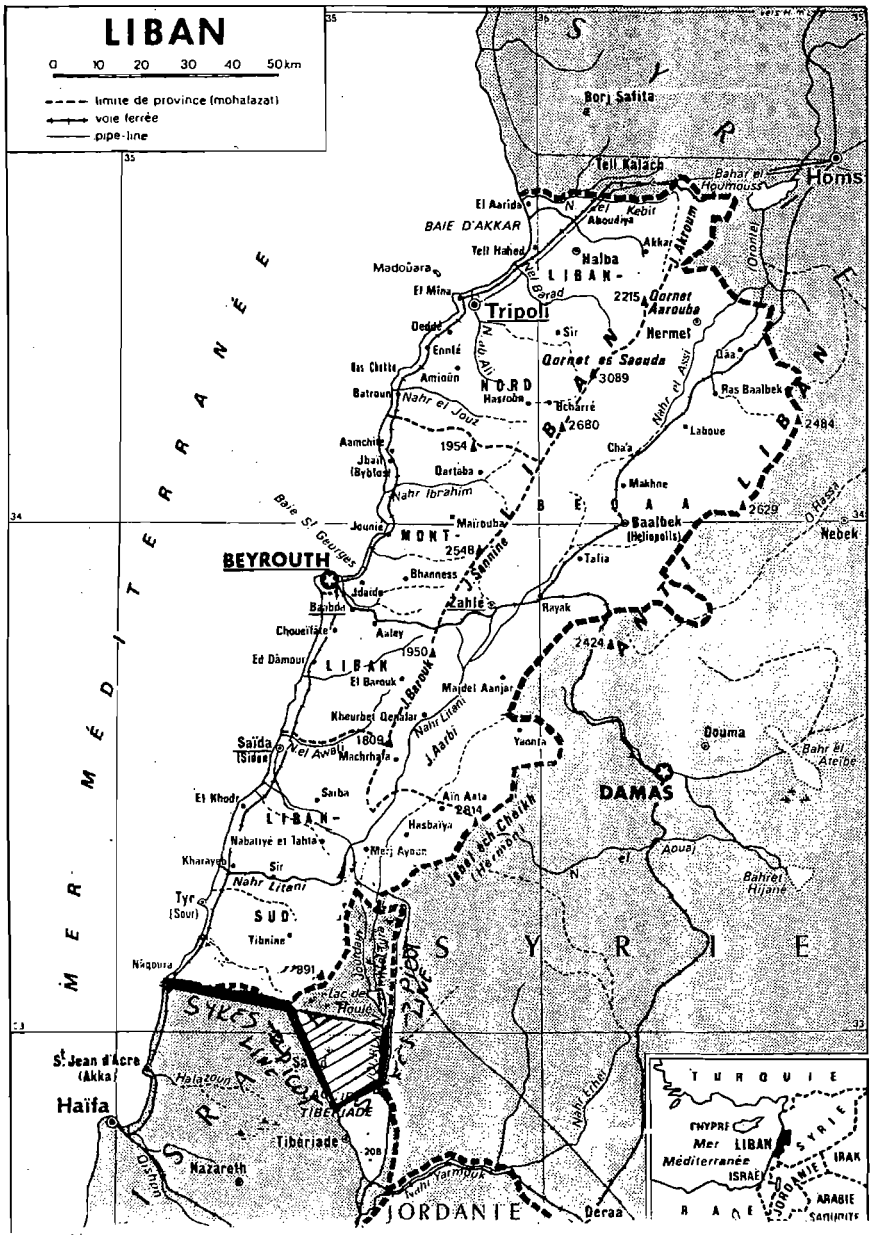
[5] Haim Ben-Shahar, Fishelson and Hirsch, *Economic Co-operation and Middle East Peace*. Weidenfeld and Nicholson, London: 1989.


LIBAN
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limite de province (mohafazat)
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MER MÉDITERRANÉE
SYRIE
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Tell Kalakh
Homs
Bahar el Houlmouss
El Aarida
Ouadi el Kebir
Aboudiya
BAIE D'AKKAR
Tell Hahed
Akkar
Halba
Madoûara
El Mina
Tripoli
Qornet Aarouba
Hermel
Qornet es Saouda
3089
Ras Baalbek
2484
Batroun
Nahr el Joûz
Hasroûn
Bcharré
2680
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Aamchite
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Qartaba
Nahr Ibrahim
Makhne
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Jounie
Mairouba
MONT-LIBAN
2548
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2629
Nebek
BEYROUTH
Bhanness
Talia
Baabdat
Jdaide
Zahle
Rayak
Choueifate
Aaley
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1950
LIBAN
El Barouk
Majdel Aanjar
Kheurbet Qenaïar
Nahr Litani
Saïda (Sidon)
Nel Awali
1809
Machrhafe
Douma
Bahr el Ateibe
Yaanta
DAMAS
Saïba
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2814
Hasbaiya
Nabatiye et Tahta
Merj Ayoun
Aoual
Bahret Hijané
Kharayeb
Sir
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SUD
Tibnine
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Lac de la Houlé
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St Jean d'Acre (Akka)
Haïfa
Halatoun
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208
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ISRAEL
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