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## Substitutes for Water are Being Found in the Middle East and North Africa

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**ABSTRACT:** Evident mismatches exist between the demand and supply of water in many countries particularly in the semi-arid and arid worlds. The resulting food gaps which concern both the national governments of these countries as well as the international agencies which extend assistance to them, appear at first sight to pose challenges beyond the economic and political capacity of peoples and institutions to make the necessary adjustments. The institutions with responsibility for the allocation and planning of water use at international, national and local levels do not seem to be robust enough, or informed enough, to provide the necessary leadership to ensure that scarce water is used sustainably.

It will be argued that despite the great difficulties which governments and users face in coping with the need to manage water so that it brings a sound return, as well as according to principles of equity, safety, and ecological sustainability, everywhere there are examples of conflict over water being avoided. And while the avoidance of conflict can in many cases be calculated to have been at a cost to the environment, nevertheless, to date conflict of a hot nature has been avoided. Case studies from a region seen to have the worst water resource future outside the industrialised world, the Middle East and North Africa, will be discussed which exemplify the numerous strategies adopted by countries in their various ecological, economic and political circumstances. A fortunate few governments have substituted oil capital for water while others have filled the food gap, which is generally an expression of the water gap, by ceding economic and political autonomy.

### Introduction

It is becoming increasingly clear that some regions of the world have entered a phase of severe water shortages where food imports are rising rapidly and indigenous agricultural sectors will never be able to produce sufficient food to fill the burgeoning food gaps. The most serious food shortages preoccupying national governments and those which have gained the attention of the international community are the shortages in the semi-arid countries of the Middle East and Africa where food imports have been rising at rates of over 10% per year in some countries. The reason that the shortages have gained the attention of the international community is that some of the largest of them have occurred in poor African countries without the capacity to purchase food on the world market and in some cases to distribute it once obtained. Food deficiencies are regarded as uncomfortable yet most of the major civilisations of the past 3000 years have prospered on the basis of 'international' food markets, although it should be noted that regional food trade certainly preceded the

establishment of the 'nation state' by at least two and a half millennia, as well as of the international agencies, the NGOs and of overseas development assistance. The pre-eminence of the temperate world in the food trade is also a recent phenomenon. In the ancient world dominated during one of its phases by Rome it was the semi-arid regions of northern Africa and especially the Nile delta which provided the grain for the metropolitan and other urban populations further north. Such was the agricultural productive capacity of these regions in relation to contemporary populations that they were able, for many centuries, to export surplus grain and olive oil.

Trade has been the normal remedy for economic entities facing food shortages. In the past, and especially in the 19th century, the terms of trade were often strongly affected by colonial relationships and therefore exposure to the strategic food insecurity was underwritten by military and naval dominance. It should be noted, however, that this military dominance was not deployed significantly to ensure the availability of food staples for the European colonial powers although it undoubtedly led to other resource transfers. It could be argued that the food deficits

of the developing countries of the late 20th century are of a different type in that these countries have no military strength, and only the oil-rich have the economic strength, with which to ameliorate the discomfort of food deficits. But there are at the same time numerous examples of substantial industrial economies being dependent on food imports via unfettered trading relationships. Britain's later years of empire and industrial leadership were based on flows of food via normal trade with the United States, with southern South America and fairly straightforward trade with Australasia. The industrial giant of the late 20th century, Japan, has a large food deficit. Nor are food shortages a problem for the oil economies of the late 20th century which are in all other ways significantly deficit economies. These economies can gain access to food on the world market. The existence of a food deficit is clearly only a problem for a poor country. Any problems which Japan has in the area of food are to do with the economic leverage it exerts to protect its own producers which in turn anger the potential importers of food and are nothing to do with its actual capacity to purchase imports of food. Nor for the foreseeable future will food shortages be a problem for an economy with either the capacity to generate foreign exchange, or the ability to earn the political patronage of a power with the will to make foreign exchange available to the poor food deficit economy for the purchase of food. Egypt is such a case.

#### Food Gaps and Water Gaps: Water and the Agricultural Sector

Why is the issue of food such an important one? It is because the production of food requires between 0.5 m metre depth and 1.5 m depth of water to produce a crop in one season, and in those regions where two or more crops can be produced then between 2 and 3 m depth of water are needed annually. No other activity which extends over large areas uses, or disposes of, as much depth of water per unit area as agriculture with the possible exception of the storage of water in massive structures on the river systems of arid and semi-arid regions such as those in the SW of the United States, the Middle East and Africa and in South Asia. But even they are small in area compared with the areas actually irrigated - compare for example the c300,000 ha surface area of Lake Nasser/Nubia with the c2,900,000

irrigated hectares in Egypt. The losses by evaporation at the Lake actually exceed 20% of the water allocated by Egypt to the production of crops and amount to almost twice the volume of water used by non-agricultural sectors - industrial and municipal use - in Egypt but they are still modest in comparison with the volume used annually in agriculture.

No other economic activity uses as much water per unit of area as agricultural applications. No other activity, economic or social, generates as little per cubic metre of water as does agriculture with the obvious exception of water allocated to enhance social and environmental amenity where there are problems of determining the economic value of such amenity returns. In other words economic returns to agriculture are relatively poor compared with those from industrial activity or from municipal uses even if the achievement of amenity is assigned even a modest value. It is interesting to compare the use of water on a hectare of irrigated land with that by domestic water users in different economic circumstances throughout the world, (Tab 1, Fig 1).

In all countries or parts of countries where irrigated agriculture has been embarked upon, whether 5000 years ago or just in the past half century, then the proportion of water which has to be allocated to irrigated agriculture exceeds 70% of the total water use and in many cases it exceeds 90% of the national water use budget. With such high proportions of water allocated to a sector which brings relatively poor economic returns, although it must be emphasised that the social returns are significant if difficult to quantify, the impact of such allocations on national economies are major. Unfortunately decisions to irrigate and produce food are made on the basis of addressing a perceived national security imperative - food security, and not as just one more adjustment that has to be made to optimise the management of a national economy where there are unavoidable associated constraints such as scarcity of water. The statistical background to the food security problem is a stark and worrying one in most semi-arid countries and regions especially as governments tend to assume that closing the food gap should be achieved through the development of indigenous natural resources. The food imports of a group of countries which have encountered serious water resource problems, those of the Middle East and North Africa (Khaldi 1984), are rising

Tab 1

The use of water in different countries by individual domestic users compared with that on one hectare of irrigated land in a semi-arid country and comparing earning capacity - 1991 estimates

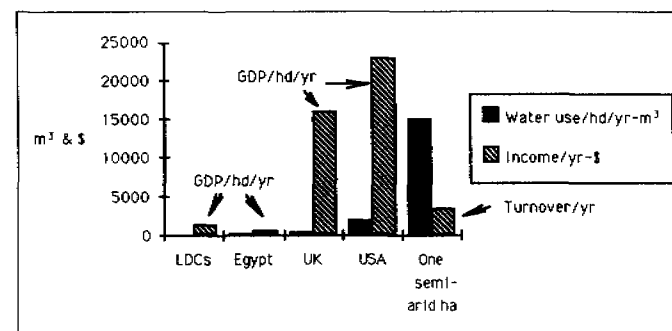
	Developing countries	Egypt	UK	USA	One semi-arid arid hectare in irrigated agriculture
	(per head)	(per head)	(per head)	(per head)	(per hectare)
Water use/ year - m <sup>3</sup>	100	100	500	2000	15000
GNP per year - US \$	1500	700	16000	23000	1500-5000

Source: World Bank and author's estimates

Fig 1  
Water use and returns to water in various countries to illustrate the heavy water use in agriculture

Notes on Figure 1: \* it is assumed that the semi-arid hectare is irrigated in two seasons. \* the numbers supported by an irrigated semi-arid hectare will vary with the economic environment: in an LDC an irrigated hectare can support one or more families; in the industrialised world it can require between five and ten irrigated hectares to support a family.

Sources: as Tab 1



rapidly and are a powerful illustration of the increasing scale and prevalence of water resource problems. The economies of the countries of the Middle East are not uniform, however, in terms of natural endowment; some are oil rich while others are not; some have large populations with a propensity to consume large volumes of food and generate large food import demands while others do not; and some have the renewable natural resource base to develop their agricultural sectors significantly while most do not. Tab 2 suggests a typology of national economies for the region characterised by the underlying strength of the economy, the propensity to import food, the capacity to export food and the status of their water resource gaps.

Tab 2 demonstrates that only Turkey and the Sudan have futures which include, for a period at least, self-sufficiency in food. The others all endure significant food deficits and these deficits are rising. The measures taken by the government of Saudi Arabia to develop groundwater to produce food including food staples such as wheat have been remarkable, in that it is estimated that the agricultural sector contributed 8% of the Saudi GDP in 1990, an extraordinarily high level in an oil enriched economy. But these policies are neither economically nor ecologically sustainable. Water withdrawals are far beyond natural recharge and the capacity to subsidise the use of irrigation water even for an economy such as that of oil-rich Saudi Arabia has to be questioned in the light of the military events in the Gulf in 1990 and 1991 when it was revealed that not only was Saudi Arabia's economic stability dependent on the will of the Western industrialised community, but territorial security was also dependent on the whim of the military will of the same industrialised countries. Chasing the fantasy of food self-sufficiency (Allan 1983) by Saudi Arabia is as irrelevant as pretending that it can be militarily secure. Misallocating funds to the achievement of either the agricultural or the military fantasy actually weakens the economic position of Saudi Arabia while strengthening the economies of the industrialised countries which supply agricultural

equipment and infrastructures on the one hand and military equipment and defence infrastructures on the other.

The most interesting feature of Tab 2 is the extent of the estimated water deficits in the national economies of the Middle East and North Africa. All of these deficits are rising with the increased demand for water both from agriculture and the other sectors of the respective economies. Yet no country has renounced food self-sufficiency as a major feature of national policy except very briefly, Israel, in the first half of 1991. But this glimpse of the direction which all governments of the region will ultimately have to embrace was very brief indeed as the posture was uncomfortable for Israel internationally and policy making in all areas was overtaken by the unexpected acceleration of the Peace Talks at which it was not possible for Israel to indicate that it could cut water consumption. The heavy rains of the winter of 1991-92 also had their political influence in that they enabled those managing national and local water to relax as they watched water storages, such as Lake Tiberias/Kinneret rise and the coastal aquifers recover. These had been at crisis level during the preceding three years of severe drought.

The historical, psychological and political backgrounds to the development of food policy and related water allocation are very important. Governments of almost all countries find that there is a natural political alliance between apparently responsible leaders and officials on the one hand and the rural community which produces food on the other. The former want to ensure national security including basic food needs. The rural community is the major element in the economy enabling food production and also therefore the major enabling element in the achievement of a country's potential security with respect to food. The natural alliance between those responsible for food security and those capable of providing it dominates policy making in the variously endowed economies of the water scarce Middle East. It also dominates policy making in most economies throughout the world not least in the EC with profound and distorting consequences for world

Country	Balance of trade \$bn	Food trade \$bn	Water deficit* km <sup>3</sup>
<b>GROUP A: Countries with strong trading positions, being major food importers and where the water deficit is not significant. For them the international political economy is not affected by water.</b>			
Middle East			
Bahrain	-0.1	-0.25	-0.15
Iraq	+2.0	-2.00	-0.00
Iraq (pre Aug 1990)	+5.0	-2.00	-0.00
Kuwait	+3.0	-0.30	-0.15
Qatar	+1.0	-0.15	-0.10
Saudi Arabia	+4.0	-3.50	-1.00
UAE	+7.0	-0.90	-0.20
North Africa			
Algeria	+0.2	-2.00	?
Libya	+4.0	-1.10	0.30
<b>GROUP B: Countries with weak trading positions, being major food importers and where the water deficit is significant or very significant (Jordan). For them the international political economy could be seriously affected by water.</b>			
Middle East			
Israel	-1.4	-0.30	-0.20
Jordan	-2.0	-0.30	-0.10
Lebanon	-1.5	-0.20	0.0
Syria	-2.0	-0.50	-0.15
Yemens	-1.0	-0.10	potential deficit
North Africa			
Egypt	-6.0	-5.50	-10.00
Morocco	-1.0	0.00	potential deficit
Tunisia	-1.0	-0.20	-0.20
<b>GROUP C: Countries with weak trading positions, but being food exporters and where the water surplus should ensure future food self-sufficiency (provided Sudan can escape internal political disruption). For them the international political economy is not affected by water.</b>			
Middle East			
Turkey	-5.0	+1.50	+10.00
North Africa			
Sudan	-0.5	+0.10	+ 4.00

(Sudan's position is so affected by the current internal problems that the renewable resource potential of the country cannot be realised. It is therefore difficult to categorise.)

Sources: UN and World Bank data and author's estimates

Tab 2 A classification of the countries of the Middle East and North Africa with respect to water availability and pattern of trade (cf. Fig 2)

\* The notion of deficit is difficult to define, in that it depends on current national policy with respect to water allocation. In Egypt where increased food output is a stated policy it is possible to estimate the amount of water needed to meet the national goals. In countries like Jordan and Israel where adjustments are being made to reduce water use in agriculture the concept of a deficit is more difficult to define. Quantifying the deficit is less important than recognising the relevance of the deficits to the agricultural future of the region.

trade in food and for the tormenting discussions in the GATT conferences. But the EC and the Middle East while resembling each other in terms of area and the size of population are very different with respect to water resource endowment and economic competence. In the EC water is rarely a constraint while it is a constraint in all countries except Turkey, the Sudan and the Lebanon in the Middle East. Yet in both the Middle East and the EC countries, despite their differing water resource endowments, water in the agricultural sector is regarded as virtually a free good and in many parts of the Middle East as a real free good. The dangerous fallacy underlying agricultural and especially food production policies of the countries of the Middle East is that water is free. This assumption lethally distorts the expectations of the farming community and also prevents officials at all levels from making rational judgments concerning the allocation and use of water as the real costs of water are not evaluated in the sectors that use water. If the real costs of water were taken into account, preferably in procedures of environmental accounting where the future costs of current policies would also be counted, then water would be allocated to uses more beneficial to the economy as a whole. At present users of water have no incentive to use water efficiently and governments have no incentive to realise efficient returns to water as there are no institutions or mechanisms which effectively enable the its value to be recognised in transactions of distribution and use by either individuals or by the state.

Any discussion of food production should also include reference to the fact that food is just one agricultural commodity. *Agricultural and food production can be examined at the sub-sectoral level and disaggregated and evaluated in terms of returns to investment, to labour, to land, or most relevantly as far as we are concerned here - returns to water.* Major agricultural economies in the Middle East have for the past century or more emphasised non-food crops such as cotton, and in the past four or five decades have progressively turned from the production of staple foods to the production of high value food crops both for the domestic market as well as for export. This last trend is consistent with the principle of maximising returns to water and could be seen as a rational approach to resource management. But it could be argued that such practices have come into effect not so much because of rational national policy but as the result of special international circumstances in at least one of the major agricultural economies of the region, Egypt. Here, the US self-imposed obligation to reduce tension between Israel and Egypt which involved the stabilisation of the economies of both countries with massive annual subsidies and in the case of Egypt the provision of food aid. The shift to high value crops has been stimulated not so much by a wish to gain better returns to water as by the externality of free, or at least very cheap, food staples. The heavily subsidised food staples on the world market exist through the competing down of the world price for such staples by the EC and the USDA.

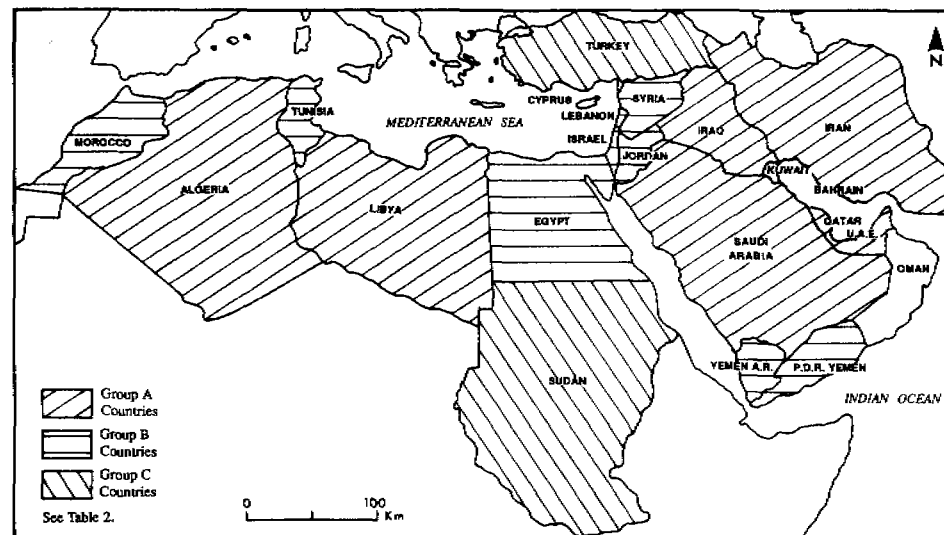


Fig 2 Water availability and patterns of trade in the Middle East (cf. Tab 2)

#### Water Allocation and the Political Economy of Water

All economies are political economies but as there are no concepts of political science which can be readily operationalised into numbers and statistical indicators the political dimension of such matters as water allocation and management are not readily described and still less used in analysing the shape of a international and national economies. Unfortunately it is economic indicators which are used exclusively in monitoring and evaluating the performance of political economies despite the fact that it is political processes which determine their shape and the directions in which they develop. If evidence is needed of the significance of political ideology we need look no further than the UK water industry which has recently been reorganised to accord with a particular view on what is an efficient institutional regime. Meanwhile in the region used mainly to illustrate the arguments in this analysis, the Middle East, political inspiration and pressures, internal and external, determine for example the water allocation policy within the Israeli economy. At the same time the lobbying of the Jewish/Israeli lobby in Washington has ensured a flow of financial resources from the United States which has protected the Israeli economy in general and its agricultural sector in particular from the market forces which would have stifled the extremely imaginative, but non-viable, Israeli agricultural initiatives, especially those in the south of the country. In Libya politically driven policies to utilise remote water on the false economic

assumptions concerning its viable use in agriculture have set the direction of water provision policies in the 1980s and continue dangerously to inspire those of the 1990s. Meanwhile Egypt's water resources are being allocated and developed according to political relationships which lead to unsound economic assumptions which in turn lead to unsound economic outcomes and the misallocation and mismanagement of scarce water.

Water misallocation and mismanagement in an economic sense occurs when the following policy goals are ignored. These goals are relevant at all levels - at the international (river basin), national (sectoral) and local levels:

#### Secure and co-operative use

Water using interests must come together in a political and social context which will facilitate optimum resource use in order to promote co-operation in water use at all levels.

#### Economic and sustainable use

Scarce water must be allocated and managed so that it brings an optimum economic return now and in the future according to sustainable economic principles.

### *Socially beneficial use*

Water should be allocated and managed at all levels so that social benefits from its use are optimised – that is the social benefits of existing water allocation should be recognised and the social costs of reallocating water should also be recognised.

### *Safe use*

Safe water should be provided and waste water safely processed and where possible re-used.

### *Environmentally beneficial use*

Water should be allocated and managed according to ecologically sustainable principles

Note: 'optimum' and 'optimised' are used to indicate optimisation in terms of the overall good of the relevant population or political entity. At the international level this will apply to the river basin or groundwater domain, at the national level it will apply to inter-sectoral allocation and management and at the local level it will apply to intra-sectoral/utility/authority/firm allocation and management of water within the province, municipality etc. The trade-offs are disagreeably numerous.

It will be noted that first goal is a political one recognising the primacy of the political context for the development and implementation of economically and ecologically sustainable policies. Only through effective political institutions will leaders have the confidence to direct the implementation of measures affecting water resource allocation and management at the sector level at home, or at the international level will they have the confidence to reach acceptable international agreements. The other goals are unexceptionable and are familiar recommendations in the multi-objective programmes of the international agencies. That the principles on which these goals are founded are rarely comprehensively addressed by water managing institutions and could not possibly be the basis of the existing national policies of the leaderships and departments of government of any current Middle Eastern government substantially explain the economic and ecological outcomes of current water management in the region.

### *National Allocation*

The hydro-politics of water at the sectoral level within individual countries in the Middle East are based on the false notion that food self-sufficiency is an achievable objective. The attainment of food self-sufficiency is clearly an attractive and legitimising goal and therefore a dominant one at a national level and also judged to be very appropriate within the agricultural sector. Unfortunately it

is so legitimate that once adopted its attainment appears to sanction all decisions even if they may lead to outcomes that contradict goals other than that of production. Goals such as the attainment of economic productivity and sustainability, as well as the provision of sufficient safe water, the equity of access and the achievement of ecologically sound and sustainable allocation and management are rarely consistent with the simple increase of irrigated area and the increased use of water.

Despite the primacy of the self-sufficiency goal it has not anywhere been achieved, with the exception of Turkey in most years. The economies of the countries with high food needs as a consequence of large populations, such as Egypt, have become major food importers. And these Egyptian food imports represent a water gap of at least 10 km<sup>3</sup> of water per year, approaching 30% of annual agricultural water consumption. Countries with small populations have proportionately difficult food and water gaps, for example Jordan – see Tab 2.

The water deficits do not, however, necessarily lead to international conflict and those scientists and commentators who for the past two decades or so have been advocating the dangers of resource scarcity with respect to the future economic stability of, and international conflict between, the countries of the region (Clarke 1991; Naff and Matson 1984; Starr and Stoll 1987) have to explain why there has been no unresolved international conflict over water in the years since 1967 which was the last occasion when water could have been an underlying element in the war of that year between Israel and its Arab neighbours. Egypt has moved into a hopeless water deficit through its own internal demographically driven demands for food; Jordan has also faced damaging water shortages in both its agricultural and its municipal supply systems during the past two decades and there is no immediate indigenous economic remedy on the supply side. The same is true to a lesser extent of Syria which has, however, the additional complication of uncertainty over the future flow of the Euphrates (Kolars and Mitchell 1991).

Iraq has temporary problems stemming from the consequences of two economically crippling wars which have left it unable to deploy its oil wealth to subordinate its relatively unimportant water constraint. Iraq will be rich again and will not be constrained by intrinsic water scarcities and other natural resource deficiencies and it resume its pattern of importing food to meet its requirements in this area just as it did increasingly throughout the 1970s and the 1980s. The oil rich states of the Arabian peninsula are seriously aggravating their water resource futures by extraordinary investments in agricultural production in for example Saudi Arabia where wheat exports have been possible since the late 1980s and the agricultural sector was calculated to contribute 8% to Saudi GNP by 1990. In the Abu Dhabi the use of water for the enrichment of the visual environment was carried beyond Californian and even Phoenix, Arizona standards. The Saudi experience would appear to mark the extreme of what an economy is prepared to devote to the achievement

of the indigenous production of food staples such as wheat (note soft wheat and not hard wheat) in circumstances of unlimited supplies of capital. The answer seems to be about four to six times the world price of wheat. In Abu Dhabi there seems to be another version of extreme commitment to a single goal, in this case to the attainment of exceptional water resourced visual amenity. Here it would appear that again in circumstances of unlimited supplies of capital it is possible to devote most of the national water budget to this purpose reflecting allocations of over 1% of the national GNP to this single aspect of environmental amenity and annual per capita allocations of financial resources of well over \$1000 per head of the population.

Yemen has very different problems. With a population of 11.6 million in 1990, deficient and difficult to manage water resources, and as yet very little oil, its recent economic past has been dominated by flows of remittances from Saudi Arabia. Its political system is very fragmented with the autonomy of tribal leaders strong. In these circumstances the chances of closing the increasing food gap through the improvement of the allocation and management of water is a remote possibility.

The North African countries also have poorly matched water resource demands and supplies. Morocco has modest renewable water resources; the other countries have serious water deficits to which they are adjusting with varying strategies. Libya is developing its fossil groundwater to replace the overused coastal aquifers by constructing pipelines from the southern fossil water resources, although there is some optimism amongst officials that the southern water will augment rather than merely replace the coastal water.

All the countries of the region have continued to attempt to sustain or expand the allocation of water to agriculture. This strategy is not rational according to any economic or ecological criteria. And the reason it is pursued is because those in leadership positions have no incentive to apply economic principles which would bring publicly demonstrable future political consequences when in due course water resources in some cases actually run out. The officials allocating, and the farmers managing, the water likewise have no pressures on them to use the water economically because they currently receive it as a free resource, and further there is no market related or effective socially driven discipline in water management in the oil rich countries and imperfect disciplines in the rest. The position vis-a-vis water allocation and use arises because neither national leaders and policy makers, nor the agricultural users, have any incentive to defer the immediate political benefits on the one hand and the economic ones on the other which the respective parties are deriving from current practice.

### *River Basin Allocation*

Possibly the most important issues of water allocation in terms of regional tension over water is at the

international level. Rising demands for water within an international river basin match neither the volumes available naturally, nor those allocated by international agreements which have been put in place during the 20th century to take into account the national needs of water. The only agreement which has some significance is the 1959 Nile Waters Agreement between Egypt and the Sudan. This allocated 75% of current estimated long term flow to Egypt and 25% to the Sudan with new water being equally shared. And both governments agreed to consult before arranging any future use of water internally or any agreements with other Nile Basin governments upstream. A number of natural and political events have occurred in the past four years which have demonstrated the inadequacy of the Nile to meet the expectations of the signatories of the 1959 Agreement. First the drought in the 1980-1987 period in the upper catchment – Ethiopia and the southern Sudan – reduced the annual flow of the Ethiopian Nile tributaries by approximately 20%; these tributaries provide about 80% of normal Nile flow for the northern Sudan and Egypt. And secondly the relationship between Egypt and the Sudan has deteriorated with the change of government in Khartoum to such an extent that in December 1991 representatives of the Ethiopian and the Sudanese Governments reached an accord indicating that there would be agreements on water between the two countries. Throughout the period since the completion of the High Aswan Dam in the early 1960s the relationships between the Egyptian and the Sudanese Governments were generally very cordial and the inter-government Permanent Joint Technical Commission had few problems to address as there was sufficient water in the system until 1973 and since that date the United States has assisted Egypt to meet its food gap caused by the growing water gap. While Egyptian officials are understandably concerned about plans to use water upstream any problems deriving from adjustments to Nile flow and water quality through increased use are for the foreseeable future minor compared with the current water deficit caused by the increased water demands generated by population increase and the Egypt's propensity to reclaim new land for irrigated farming. To argue that Egypt will not continue to make the political adjustments which have been witnessed since the mid-1970s seems as perverse as suggesting that Egypt would embark on the hopeless course of securing its long term Nile water militarily. In the short term Egypt will adjust to the political economy of water by accepting the economic assistance, and particularly the food assistance, of the United States. In due course it will generate the capacity in its non-agricultural sectors to enable it to expand its purchases of food on the world market.

The tension over the international allocation of water in the Tigris-Euphrates catchment is also less immediate, and at the same time less long term, than suggested by a number of commentators (Naff and Matson 1984; Stoll and Starr 1987; Kolars and Mitchell 1991). Shortages of water are predicated on the assumption that Iraq will need to utilise water in its agricultural sector. The current

Country	Population '000	% of total regional population	%
<b>Countries self-sufficient in water or able to purchase food</b>			
<b>GROUP A: Water surplus countries</b>			
Turkey	56277	17.1	
Sudan	25191	7.7	
Lebanon	3000	0.9	
<b>Total</b>	<b>84468</b>	<b>25.7</b>	
<b>GROUP B: Major food importers competent to purchase food</b>			
Iraq	18914	5.8	
S. Arabia	14902	4.5	
Libya	4546	1.4	
Kuwait	2141	0.7	
UAE	1592	0.5	
Oman	1554	0.5	
Bahrain	504	0.2	
Qatar	439	0.1	
<b>Total</b>	<b>44592</b>	<b>13.6</b>	
<b>GROUP C: Oil economies which are major food importers, with serious water constraints and limited purchasing power</b>			
Iran	56925	17.3	
Algeria	25056	7.6	
<b>Total</b>	<b>81981</b>	<b>25.0</b>	
<b>Total of water or economic surplus countries</b>			<b>64.3</b>
<b>GROUP D: Countries with food &amp; water deficits and food purchasing problems</b>			
<b>Major economy with water constraints and purchasing constraints</b>			
Egypt	52061	15.9	
<b>Total</b>	<b>52061</b>	<b>15.9</b>	
<b>GROUP E: Other economies with food deficits and water and purchasing constraints</b>			
Morocco	25091	7.6	
Syria	12533	3.8	
Yemen	11612	3.5	
Tunisia	8175	2.5	
Israel	4656	1.4	
Jordan	3154	1.0	
<b>Total</b>	<b>65221</b>	<b>19.9</b>	
<b>Total of water or economic deficit countries</b>			<b>35.7</b>
<b>Overall Total</b>	<b>328323</b>	<b>100.0</b>	<b>100.0</b>

Source: World Bank

Tab 3 Classification of Middle Eastern countries by population and resources - water and competence to import food. Population data for 1990 (cf. Fig 3)

economic crisis has political causes and is not related to shortages of water resources. When Iraq re-establishes a stable economy based on oil generated income it will also resume its import of food staples and other food types and it will not have the urgent or destabilising need to produce food from its difficult to manage land and water endowment. There is sufficient water in the Euphrates system to provide sufficient water for Syria's agricultural development plans even if Turkey reduces the flow of water by the proportions realistically estimated. Meanwhile Syria will in due course re-examine its water allocation policy and its management of water and may conclude that allocating water to agriculture is neither economically nor ecologically sustainable. It will certainly not take military action against Turkey to secure its water.

Hydropolitics are believed to play the biggest role of all in the Jordan catchment. Water resources are correctly judged to have been one of the factors contributing to the military events of the 1947-1967 period and to the continued military presence of Israeli forces in the West Bank and southern Lebanon. The reason that there are severe shortages of water for the populations of the Jordan catchment is that the water allocations to agriculture take over 70% of the national water budgets of Israel and Jordan. The allocation of water according to principles of returns to water would shift water from non-viable economic activities such as agriculture to uses more economical of water. The brief adoption of this policy during the summer of 1991 by Israel will be re-installed by Israel and adopted by Jordan once the diverting imperatives of the Peace Talks have been negotiated. In the Jordan catchment as well as in the other much bigger catchments the non-military adjustments to water shortages have been significant and they will play an increasing role in the future. In the case of the Jordan the willingness of the United States to sustain its support of the crucial economy has been and will remain a major factor in maintaining economic stability by making possible the substitution for the evident water shortages.

#### Actual Adjustments

The water resource allocation and management options appear to be very bleak. How then is it possible to argue that there are substitutes for water? The answer is partly that they have already been found for the country with the major water problem in the region, Egypt, and many of the other countries either have no real problem even if they are seriously misusing their water resources. The position can be summarised as follows for the approximately 330 million people of the Middle East and North Africa and for the 20 countries of the region (Tab 3).

Countries self-sufficient in water or able to substitute for it by purchasing food on the international market:

1) Turkey, the Sudan may have economic problems but they cannot be attributed to their water resource endowment. The Lebanon does not have serious water problems but does of course have serious political problems which make investment and institutional development difficult.

c 85 million people, c 26% of the region

2) The relatively low population oil rich countries - Iraq, Saudi Arabia, Libya, Kuwait, UAE, Oman, Bahrain and Qatar have no real water resource problems; they only arise if they decide to allocate water to agriculture. They will for the foreseeable future be able to acquire food from the world market. They should certainly not be using scarce water to raise food at a period in economic history when food is being traded cheaply. Iraq has temporary problems.

c 45 million people, c 14% of the region

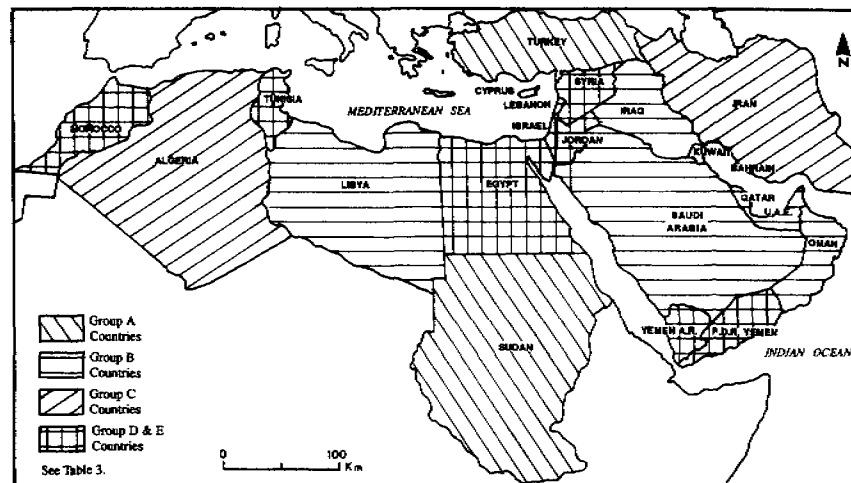


Fig 3 Water and food self-sufficiency in the Middle East (cf. Tab 3)

3) The relatively large population countries with oil, Iran and Algeria, have serious agricultural problems and Iran has political and international relations circumstances which means that it does not fall into the same categories as the other oil rich countries or into the protected category of Egypt. Iran will need to address both its traditional sector farming and its modern sector pursuing policies and practice based on the five guiding principles and goals listed above.

Algeria has similar agricultural choices to those of Iran although it does not have a well watered province such as Iran enjoys on the southern shores of the Caspian. Oil revenues have not enabled Algeria to mobilise successfully its scarce agricultural resources and it will require particularly effective policy formulation and implementation if it is to create a viable rural economy on the basis of its scarce water.

c 82 million people, c 25% of the region

The above countries comprise 64% of the total population of the Middle eastern and North African region.

Countries with food and water deficits and economic problems which make food purchases difficult:

4) The large population country with only modest oil resources Egypt is such a special case that its problems have for the moment been solved by politically motivated external funding. The US Government has apparently assumed responsibility for the serious and deteriorating

water gap of Egypt by providing grants and loans which almost exactly match the food/water deficit reflected in the progressively increasing food import bill of Egypt.

c 52 million people, c 16% of the region.

5) Morocco, Syria, Yemen, Tunisia, Israel and Jordan are countries with significant water resource constraints and with the exception of Israel they have limited ability to mobilise investment to improve water management systems. They will in future have to address their food deficit problems by generating foreign exchange in other sectors with which to purchase food and thereby reduce pressure on their scarce water resources. Israel and Jordan are already, if unwillingly, well down this road.

c 65 million people, c 20% of the region

These food deficit countries which have food purchasing difficulties comprise only 36% of the population of Middle Eastern countries.

The above analysis suggests that for the first three categories of countries there is not a serious resource problem if the resources could be effectively allocated and managed. They either have sufficient water or they do not need it since they can substitute oil revenues to purchase food which cannot be produced at home because of water shortages. Two oil economies, Iran and Algeria, currently have balance of payments and political difficulties which are impairing their capacity to develop but will still be able to underwrite their food deficits with their limited oil revenues. The fourth category, Egypt, cannot substitute for

water on an economic basis but it has been very successfully substituting for water through the acceptance of political support from the United States since the mid-1970s. While this is not a satisfactory long term solution, and is even one which the United States probably cannot afford to sustain, it is also very likely that other sources of funding would be available from other OECD countries if the United States signified that it could not continue to fill Egypt's water gap. There is, however, a much clearer message concerning how Egypt itself will substitute for water in future. It will be through the strengthening of its economy in the industrial and service sectors so that they generate the foreign exchange with which to purchase the food needed to feed the country's rising population. This is the normal pattern of economic activity for economies as they develop. OECD investments will be directed to accelerate this process and thereby gradually ensure that Egypt become a self-sufficient economy despite its inability to be food self-sufficient. The demographic position of Egypt will continue to deteriorate but there will be a reduction in the rate of increase in population as the economy improves.

The 36% of population of the Middle East and North Africa in the remaining categories is currently exposed to difficult water resource circumstances and these will endure for the foreseeable future. These countries will face the greatest challenges in substituting for water in the short term at least. Two of the countries, Jordan and Israel, are close to recognising the impossibility of allocating the 70-80% of water of the national water budget to agriculture, although there will be many years of tormented Peace Talks negotiations before the policies are put in place. Since agriculture contributes less than 3% to the Israeli economy and about 7% of the Jordanian economy the real consequences of reallocating water will not be great, although the internal political reactions may be considerable. Syria, Morocco and Tunisia will have in due course to adopt the same reallocative policies through an ability to substitute industrial sector revenues for the deficient water but the move will only come after their existing water resources have been more effectively reorganised. The problems of Yemen are unique in that the water allocation and management institutions require considerable development.

#### The Future: Further Research Issues and Development Challenges

The conclusions reached in the preceding section are based on a number of assumptions which deserve more detailed study than is possible here. The first major assumption is that there will be sufficient surplus food on the world markets in the short and long-term futures to meet the demand of Middle Eastern and North African consumers as well as those which will increase from other regions of the world. The evidence concerning future food availability is by no means clear. Studies by the FAO and

the World Resources Institute indicate that there are worrying constraints, mainly of an institutional nature preventing the productive capacity of the world's environments from being achieved. Meanwhile there are concerns about global warming and its varying regional impacts. But the evidence here is arguable and as yet inconclusive (compare the varying estimates from a single scientist - Parry 1988, 1990 and 1992) and it is assumed here that the impact of climate change on agricultural production and productivity will not be significant.

A second assumption is that world food prices will remain similar to the current ones. Here the position is not clear as the availability of food will be affected by institutional changes such as EC and US recognition of GATT recommendations on economic support of agricultural sectors. It could also be affected by climate change with as yet very imperfectly understood negative and positive consequences.

A third assumption is that the reorganisation of former Soviet agriculture will also have hard to estimate consequences, some of which are likely to be negative initially as agricultural sector institutions adjust, but in due course are likely to be very positive as for example major agricultural economies such as that of the Ukraine achieve levels of productivity of their EC equivalents such as France. It is for example estimated that the Ukraine which was supplying 80% of the food of the former Soviet Union is only 40% as efficient as France in terms of agricultural productivity.

A fourth assumption is that the political posture of international entities outside the region will maintain policies of economic stabilisation in crucial economies with the consequence that the aggravation of food shortages will not affect particularly vulnerable economies such as those of Egypt, Jordan and Israel. It is further assumed that other OECD entities will take up this role if the United States indicates that it is a task better addressed by a number of competent economies.

Since all of these assumptions are untried they all require substantial research in order to make more sound analyses upon which to predict the future of global food security. That such externalities can, however, be identified as crucial for the economic and political stability of Middle Eastern countries suggests that they are the factors which deserve most attention. As it is the economic and political context, including economic and political externalities, which will determine the performance of the water using sectors it is desirable that they are understood by all those involved in policy making for the allocation and management of water at all levels as well as by those operating engineering and institutional systems.

These uncertainties aside there are many other serious difficulties facing the governments and people's of semi-arid and arid countries stemming from their water deficits. There is some comfort, however, that the experience of the past two decades does suggest that the realities of the political economy of water have been recognised by some individual governments and despite the ill-inspired food

self-sufficiency policies which aggravate the position within countries as well as internationally, the tendency is

to make adjustments which are conflict avoiding through economic and political substitutions for water.

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