Virtual Water as a Policy for Ensuring Food Security in the MENA Region

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INTRODUCTION

The goal of the paper is to analyze the interaction between water, food and trade or what is now called the water-food-trade nexus, at a theoretical, as well as a practical level. This will be done through examining the level of reliance on virtual water imports and the effect on food security in MENA countries with the aim of identifying the risks and challenges. The underlying assumption of virtual water is to diversify production based on the comparative advantage of a country or a region and to earn foreign exchange to buy food imports instead of growing low-value, high water consuming crops. In other words, Trade in virtual water allows water scarce countries to import high water consuming products while exporting low water consuming products and in this way making water available for other purposes. The conditions for relying on virtual water to ensure food security still remain to be clarified and agreed upon.

Including virtual water as a policy option requires thorough under-standing of the impacts and interaction of virtual water trade on the local social, economic, environmental and cultural situation in a country context. A lot of work is still to be done to make the "virtual water trade" concept more explicit in policymaking. Countries might be better off using their scarce water resources for economic activities that bring higher economic returns and buy food instead of growing it themselves. However, countries would be wary of becoming too dependent on external sources for such a basic commodity as food. Under these circumstances, the question is what can be done to enhance food production under water constraint and whether virtual water is a policy option for countries facing budgetary and marketing constraints and expected rise in world costs of grains? (FAO 2003a)

The key question for the MENA countries is whether the current policy frameworks for water and land use will lead to the achievement of the region's food security objectives. As food security is a priority issue, the main issues facing water sector that affect agriculture and food security pertain to its growing scarcity, its deteriorating quality, the rising cost of irrigation development, and the low efficiency of irrigation (both productive and allocative). Within the food security context, there is an urgent need to assess how the growing food deficit can be met under water constraints and what role virtual water can play in narrowing the gap? (Idem). There is no easy way out of the problem and business as usual is not an option. And indeed one of the tasks of this paper is to show the limitations as well as the potentials of the proposed solutions and to examine the challenges facing the decision makers to achieve acceptable compromise solutions.

The paper addresses questions such as: The water-food challenge: How complex? How urgent? What is the status of food production and food security in MENA? What is the connection between food security and virtual water? What are the merits and demerits of virtual water? And what are the key issues that the decision makers have to confront when considering the virtual water as a national policy. It is divided as follows. In the next section (section 2), we present a brief review of the definition of food security. Section 3 examines the concept of virtual water; its definition and origin, practical value and quantification of the concept. Section 4 analyzes the issue of virtual water in the MENA region. This part of the paper includes the background of the study region, the water and food gap, the virtual water trade in the region and the virtual water as a policy for ensuring food security; its potentials and risks. Finally, in section 5, some conclusions are drawn.

DEFINING FOOD SECURITY[1]

Since the World Food Conference of 1974, the concept of "food security" has evolved, developed, multiplied and diversified. The history of thinking about food security can be conceptualized as consisting of three important and overlapping paradigm shifts, which have brought theory and policy progressively closer to "real" food insecurity. The three shifts are (a) from the global and the national to the household and the individual, (b) from a food first perspective to a livelihood perspective, and (c) from objective indicators to subjective perception (Maxwell 1996).

Over the years, various authors and international agencies have offered many definitions that reflect those shifts in food security. Each definition is sensible in some context. But most of these definitions focus on the availability of food and the ability of people to gain access to it. For example, the World Bank 1986 defines food security as "access by all people at all times to enough food for an active, healthy life". The World Food Summit 1996 states that food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary need and food preferences for an active and healthy life (Earle 2001). In a recent report, the FAO (2003b) draws the attention to the following dimensions in describing food security: availability, access, utilization, stability and sustainability. Availability refers to the physical presence of food for consumption. Access refers to the financial ability to acquire food. Utilization refers to the adequate dietary composition of the available and acquired food Stability refers to the year-round ability of households to meet their dietary needs Sustainability refers to the capacity of households to ensure the long-term stability of the household food supply. It concludes that most of the country reports dealing with food security concentrate on the availability and access dimensions and ignores the other dimensions. The widely accepted definition of food security notes that all people should have access, at all times, to enough food for an active, healthy lifestyle. This definition imply that food security entails more than simple availability of food (Scanlan 2004), but involves both a supply component and an effective demand component that describes the ability of people to obtain food, either directly in the market or with the support of a subsidy program. In addition, it allows for inclusion of food imports in a food security strategy, rather than requiring a nation to be self-sufficient in food production (Wichelns 2001).

VIRTUAL WATER: THE CONCEPT

Definition and origin

Producing goods and services requires water; the water used to produce agricultural or industrial products is called the' virtual water' of the product. For producing 1 kg of grain we need for instance 1000-2000 kg of water, equivalent to 1-2 m3. Producing livestock products generally requires even more water per kilogram of product (Chapagain and Hoekstra 2003). Virtual water therefore, is the amount of water that is embedded in food or other products needed for its production.

The concept of virtual water emerged in the early 1990s and was first defined by Tony Allen. It took nearly a decade to get global recognition of the importance of the concept for achieving regional and global water security (Hoekstra 2003). Growing interest in the Virtual Water has increased substantially since then, as noted in the literature and in topics considered at professional meetings (Allan, 1997, 1999; Turton, 1999; Earle, 2001; Yang and Zehnder, 2001,2002; Hakimian, 2002; Bouwer, 2002; Hoekstra and Hung, 2002; Chapagain and Hoekstra, 2003; Zimmer and Renault, 2003;Wichelns, 2001,2004; Van Hofwegen, 2005).The Institute for Water Education at UNECO-IHE in the Netherlands hosted a meeting of international experts on virtual water in December 2002 (Hoekstra, 2003). A special session on virtual water trade as a strategic instrument in water policy was included at the 3rd World Water Forum in Japan in March 2003. The World Water Council committed itself to organize an e-conference, which was held from September to November 2003, to continue the unfinished discussions started during the Japan's Forum (WWC, 2004).The Stockholm International Water Institute (SIWI) organized an international conference in

[1] Defining food security is an exercise in itself especially when both micro and macro dimensions are included in the definition (Timmer 2000).

February 2005 about water for food and ecosystem during which the virtual water issue was discussed and had much attention.

The virtual water perspective is consistent with the concept of integrated water management, in which many aspects of water supply and demand are considered when determining the optimal use of limited water resources (Bouwer 2000). As Wichelns 2001, pointed out, virtual water combines agronomic and economic concepts, with emphasis on water as the key factor of production. The agronomic component involves the amount of water used to produce crops, while the economic component involves the opportunity cost of water, which is its value in other uses that may include production of alternative crops or use in municipal, industrial, or recreational activities. The concept of virtual water brings focus to the opportunity cost of water when evaluating crop production, international trade alternatives, and in particular when seeking an efficient allocation of scarce water resources. Indeed, the economic aspect of the virtual water concept is closely related to the comparative advantage concept from international trade theory. This concept suggests that nations should export products in which they possess a relative or comparative advantage in production, while they should import products in which they possess a comparative disadvantage (Qadir et al. 2003; Wichelns 2001).

The practical value of the virtual water concept

The virtual water concept has three major types of practical use. First, virtual water can be seen as an alternative source of water. Water-short areas can minimize their use of water by importing commodities that take a lot of water to produce like food and electric power, from other areas or countries that have abundant water. The receiving areas then are not only getting the commodities, but also the water that was necessary to produce them (Bouwer 2000).Using this additional source can be an instrument to achieve regional water security. More firmly stated and this is the political argument that has been put forward by Tony Allen from the beginning of the virtual water debate, virtual water trade can be an instrument in solving geopolitical problems and even prevents wars over water, especially in the MENA region (Allen 1999). Trade in virtual water has steadily increased over the last forty years: about 15% of the water used in the world is for export, in virtual form. Since, at the global level, agriculture is the largest economic sector in terms of water use, trade in agricultural products is the main component of trade in virtual water. According to Hoekstra (2003), 67% of the global virtual water trade is related to international trade of crops; 23% is related to trade of livestock and livestock products; and 10% is related to trade of industrial products. Wheat represented 30% of the total volume of crop-related virtual water trade between nations in the period 1995-1999, followed by soybean (17%) and rice (15%). The trade of beef is also important to global virtual trade.

Second, virtual water can be an instrument to increase 'global water use efficiency'. Hoekstra 2003 argue that virtual water trade from a nation where water productivity is relatively high to a nation where productivity is relatively low implies that globally real water savings are made.

Third, virtual water can be an indicator of water use. Virtual water is an essential tool in calculating the real water use of a country, or its water footprint, which is equal to the total domestic use, plus the virtual water import, minus the virtual water export of a country. A nation's water footprint is a useful indicator of the demand it places on global water resources. Knowing the virtual water content of products creates awareness of the water volumes needed to produce the various goods, thus providing an idea of which goods impact most on the water system and where water savings could be achieved (Hoekstra and Hung 2002).

Quantifying the virtual water concept

According to Hoekstra (2003) assessing the virtual water content of a product is not an easy task. He states two different approaches that have been proposed and applied so far for quantifying the virtual water concept. In one approach, the virtual water content is defined as the volume of water that was in reality used to produce the product. This will depend on the production conditions, including place and time of production and water use efficiency. Producing one kilogram of grain in arid country for instance can require two or three times more water than producing the same amount in a humid country.

In the second approach, one takes a user rather than a producer perspective, and defines the virtual water content of a product as the amount of water that would have been required to produce the product at the place where the product is needed. This definition is particularly relevant if one poses the question: how much water do we save if we import a product instead of producing it ourselves?

Considering the various studies available, little convergence exist with respect to the general approach taken. Some studies take virtual water content of a product at the production site, other studies consider the hypothetical virtual water content if the product would have been produced at the place where the product is actually consumed. Wichelns (2004) notes that several authors describe the embedded water content of crop and livestock products by accounting for water inputs at various stages of production and processing. They multiply the embedded water coefficients by the amount of goods and services traded, to estimate the volumes of virtual water moving between nations. Those estimates are helpful in generating public awareness regarding the volume of water required to support production and consumption activities. However, there is general agreement that in order to make the concept practical, a unified procedure has to be developed.

VIRTUAL WATER IN THE MENA REGION

Background of the Study region

The Middle East and North Africa, an area that includes Morocco, Algeria, Tunisia, Libya, Egypt and the Middle East through Iran is the most water scarce region in the world. It contains 5 percent of the world's people and less than 1 percent of the world's annual renewable fresh water. The population, having more than doubled in the past 30 years to about 280 million, could double again in the next 30 years (Roberts 2002). About 45 million of the region's people (16%) lack safe water and more than 80 million lack safe sanitation (World Bank 1995). Commonly, when referring to water scarcity or stress, an annual per capita availability of less than 1,600 m3 is used. This amount includes all the requirements of an individual plus the water required to grow his/her food. Clearly, this sum will depend on numerous factors, one being the person's diet. At its most extreme, 'absolute water scarcity' is said to exist where availability falls below 1,000 m3. Clearly, however, the impact of this stress or scarcity depends on the nature of the economy in a given area. (Allen et al. 2003). As populations have grown in MENA region against a background of finite freshwater resources, the water available to individuals has fallen dramatically. According to the World Bank (1995) per-capita availability, about 3,000 cubic meters in the 1960, has fallen by 60 percent to about 1,250 cubic meters in the mid 1990's, and it is predicted to fall by another 50 percent to about 650 cubic meters by 2025. This average covers all human activities-domestic, industrial and agricultural - and masks extreme local variability. According to Allen et al. (2003) annual Per capita water availability in the region varies from the extremely low 220 m3 in Jordan and 330 m3 in Palestine to the 2,000 m3 per capita available to inhabitants living in Iran and Turkey. The issue of water scarcity is aggravated by a high dependence on water resources that originate outside of the region (more than 45%, or even 97% in Egypt and 100 % in Kuwait- FAO AQUASTAT), and the dry climate which makes stability of agricultural production and food security dependent on irrigation. The level of exploitation of water resources is generally high in most countries and pressure over water resources is increasing. Exploitation ratios over 50%, or even nearing 100 in many parts of MENA countries (Egypt, Palestinian Authority, Israel, Libya, and Tunisia). Disruptions between water demand and renewable conventional supply are leading to high competition for water and, consequently, to greater risks of food insecurity in the region (GWP 2000). At present, not only almost all renewable resources are already put into use, but also many countries have resorted to their non-renewable resources and to the use of non-conventional resources such as treated waste and low-quality water (FAO 2003a).

Irrigation agriculture is the biggest consumer of water in the region, with yields in Egypt at 5.5 tones/ha compared with non-irrigated yields of 1.5 tones/ha elsewhere in the region (Allen et al.2003). The expansion of irrigated areas is expected to continue in some countries such as Morocco and Tunisia to provide with food both for the internal and export market. There is a strong dependence on agriculture both in terms of contribution to GDP and in terms of employment. Accordingly, most countries are still engaged in supply expansion strategies of water management to increase irrigation (GWP 2000). The share of resources allocated to agriculture is now being close to or even exceeding 90 percent (Sudan, Oman, Yemen, Iraq, and Syria allocate more than 90%, Saudi Arabia (89 %), Morocco (88), Lebanon (67%), Jordan (70%), Turkey (74%)(FAO 2003a).The benefits of irrigation per unit area are fully recognized under arid environments as little would grow without irrigation. Yet the irrigation sector has become increasingly the target of critics who contend that in terms of costs, equity, environmental quality and even total food production, it would be better to invest in improved rain-fed agriculture (Seckler & Amarasinghe 2001)-table 1.

Table 1 Estimated water loss under irrigation in selected Countries of the MENA (2000)

Country	Irrigation withdrawal (bcm)	Irrigation Requirements (bcm)	Irrigation Efficiency (%)	Water lost (bcm)
Algeria	3,94	1.45	37	2.49
Egypt	53,85	28,43	53	15,42
Sudan	36,07	14,43	40	21,64
Iraq	39,38	11,20	28	28,18
Syria	18,93	8,52	45	10,41
Turkey	27,86	11,27	40	16,59
Iran	66,23	21,06	32	45,17
Total	246.26	96.36	40	149.9

Source: FAO 2003a.

One way for such countries to expand their irrigation is by improving water use efficiency. Therefore countries such as Tunisia, Egypt, and Jordan are shifting from supply driven management to demand management policy. Still, the main concept pertaining to integrated water resources development and management remains vague and fragmented between numerous operational and management institutions in most of the countries in MENA region (Arab countries vision 1999).

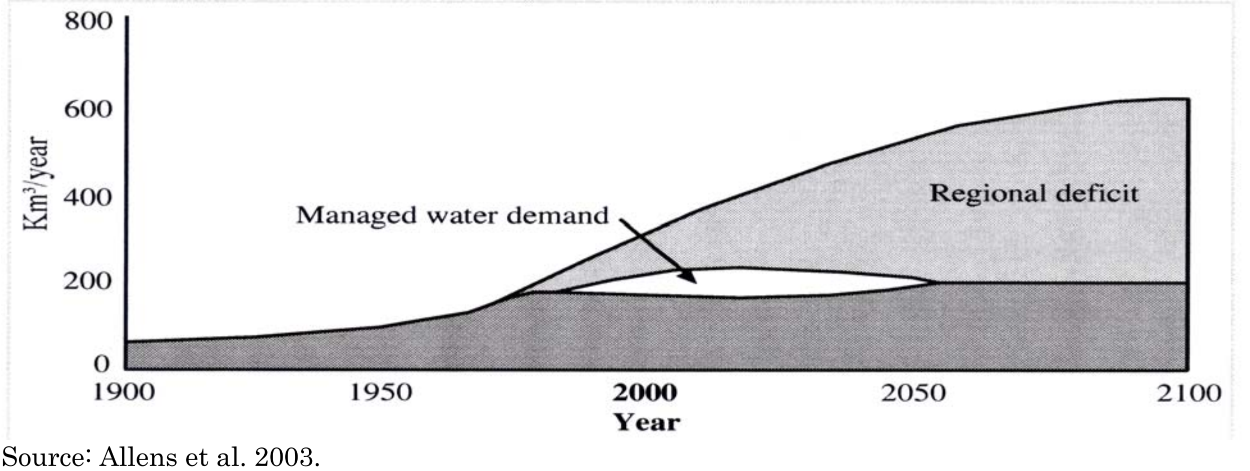
Water and Food Gap

Once a localized phenomenon, water scarcity is now crossing national borders via the international grain trade. The world's fastest growing grain import market is North Africa and the Middle East. The increasing reliance on the world market for food supplies is felt to be a weakness of the region (GWP 2000). Virtually every country in this region is simultaneously experiencing water shortages and rapid population growth. As the demand for water in the region's cities and industries increases, it is typically satisfied by diverting water from irrigation. The loss in food capacity is then offset by importing grain from abroad. Since 1 ton of grain represents 1,000 tons of water, this becomes the most efficient way to import water (Roberts, 2002). As a result, the ability of most countries to maintain national food security depends on import capacity (Lofgren & Richards 2003). Figure 1 shows the history of the MENA region's water use between 1900 and 2000 with projections for 2100.

Fuelled by rising oil income since the 1970s and sustained by rapid population growth ever since, the region has come to rely heavily on the global trading system - principally imports from North America - to feed its population and livestock (Hakimian 2002). Over the three decades to 2000, the nominal food imports bill for the region rose 17-fold (growing on at an average rate of 10% per annum). Much of this growth was concentrated in the oil-boom years of the 1970s: the imports bill rose 9-fold alone in that decade (FAO data). On a per capita basis too the trend has been striking: by 1980, the region's expenditure on food imports shot to about $90 and stabilised at $60 afterwards. By the early 1990s, the region imported as much as one third of its overall cereal consumption making it the largest regional importer on a global scale (Idem).

In terms of embedded water content- or what is called virtual water- food imports totalled 50 million tonnes, over the three decades to 2000. This is equivalent to 50 billion cubic meters of water, which equals the amount of the annual flow of the Nile River freshwater allocated each year to Egypt (Allen 1999). Stated otherwise, the fast-growing water deficit of this region is equal to another Nile flowing into the region in the form of imported grain (Roberts, 2002).

Figure 1 Freshwater demand & supply in the MENA region (1900–2100) & the emerging deficit since 1970



Source: Allens et al. 2003.

At present MENA is the fastest-growing grain import market in the world. Iranian grain imports have recently eclipsed those of Japan, for years the world's leading importer. Currently, Iran and Egypt import more than 40% of the grain consumed by their populations. A significant issue in the region is the growing urban demand for water. Although at present the majority of people live in the countryside, it is expected that by 2025, the urban population will exceed the rural population in all MENA countries. This is likely to have important consequences for the patterns of water and food demand. (Allen et al. 2003). The dependency on grain was 33% in 1995, but it is likely that this dependency may rise to 50% or more for the year 2025 (GWP 2000). Import volumes on such a scale have inevitably caused concern and alarm among policy makers and analysts of the political economy of the region. Considerations of the economic costs of food imports have compounded 'political risks' of food dependency on the rest of the world. For some, this has highlighted the irony of the MENA's 'failure' to feed its own population despite its considerable natural and mineral riches. Unsurprisingly, the Middle East has been characterized as one of the least food self-sufficient regions of the world (Hakimian 2002). Interestingly and in sharp contrast to the above perspective, a different explanation has been offered in Tony Allan's work on virtual water. According to this viewpoint, the rationale for large-scale food imports is ascribed to the natural resource endowments of the region (namely, its well-known water deficit) and the global trading system, far from posing a threat, has provided an *opportunity* for the region's economies to solve their serious and deteriorating water scarcity. It is clear that Allen sees in global trading system in commodities an exceptional opportunity (or a comparative advantage) for water deficit countries of the MENA region to alleviate their pressing food and commodity needs (Idem).

Economic rationale aside, the MENA importing nations have benefited from international trade in food in several ways. The major exporters of grain – the USA and the European Union (EU) – have heavily subsidized food production costs: wheat (the main vehicle of the virtual water trade) is currently shipped only at half its production costs. Moreover, the real price of wheat has declined over the past two centuries resulting in exceptionally 'favorable' supply side conditions for the food deficit countries of the MENA region (Idem). By the year 2010, as indicated in table 2, all MENA sub-regions would have relatively large food deficits, with the exception of Turkey which has large agricultural resources.

Countries may also be grouped according to their projected food self-sufficiency ratios (SSR: food production/total demand) as illustrated in table 3. About one-third of the countries would have SSR of less than 60 percent. They include three oil-rich countries and two low-income countries. The latter would be in a predicament due to their limited food import capacity. Although considered middle-income countries, Iraq and Jordan would face similar problems unless their foreign exchange resources increase commensurately. The second group comprises middle-income countries that would have to generate sufficient foreign exchange to finance the importation of 20 to 30 percent of their domestic needs.

Table 2 Food deficit in the MENA region in 2010

Sub-Regions	Production	Demand	Deficit
Maghreb	49,850	77,654	27,804
N.E. Africa	72,045	88,081	16,027
Arabian Peninsula	17,754	41,811	24,057
West Asia	26,665	56,729	20,064
Middle Asia	157,101	178,935	21,834
Turkey	107, 470	102,515	(Surplus) 4,955

Source: FAO Agriculture Toward 2010

Turkey and Morocco in the third group would be able to meet their food demand from indigenous production. The other two in the group are low-income countries that have sufficient agricultural resources; both their high SSRs are attained at low nutritional levels. Regardless of these inter-country variations, the fact remains that the entire region (with the exception of Turkey) would continue to be a food deficit region (FAO 2003a).

It is now often said that future wars in the region will more likely be fought over water than oil. Perhaps, given the difficulty of winning a water war, the competition for water seems more likely to take place in world grain markets. The countries that will "win" in this competition will be those that are financially strongest, not those that are militarily strongest (Brown, 2000).

Table 3 Projected food self-sufficiency ratios in selected Countries of the MENA (2010)

Less than 60%	60 - 80%	More than 80%
Libya	Tunisia	Morocco
Saudi Arabia	Egypt	Turkey
Algeria	Syria	Somalia
Mauritania	Lebanon	Sudan
Yemen	Iran	
Iraq		
Jordan		

Source: (FAO 2003a).

Virtual water trade in MENA region

It should be pointed out that quantifying the volumes of virtual water is not straightforward because water productivity is variable in space and time. Thus, when assessing the virtual water traded between two countries, one can estimate either the water actually used by the country exporting the food product or the water saved by the country importing it. In many cases these transfers occur from high performing production sites to lower performing sites, which means that globally real water is saved. For example, it has been estimated that not only Egypt saved 5.8 billions m3 of water from national allocation in 2000 through maize imports (about 10% of its annual allocation), but globally a saving of 2.7 billion m3 of real water is generated thanks to the differential of productivity between maize exporting countries and Egypt (Zimmer & Renault 2003).

Hoesktra & Hung 2005 have estimated the virtual water flows between and within major world regions as well as the national virtual water balance over the period 1995-1999. The Virtual water flows between nations have been calculated by multiplying the international crop trade flows by their associated virtual water content. The latter depends on the specific water demand of the crop in the exporting country where the crop is produced. Their calculation results show that the global volume of crop-related international virtual water flows was 695Gm3 yr^{-1} in average over the period 1995–1999. For comparison: the total water use by crops in the world has been estimated at 5400Gm3 yr^{-1}. This means that 13% of the water used for crop production in the world is not used for domestic consumption but for export (in virtual form).The total volume of crop-related international virtual water flows can for 30% be explained by trade in wheat, next come soybeans and rice, which account, respectively for 17% and 15% of global crop-related virtual water flows. This is the global percentage; the situation strongly varies between regions and countries.

For the Middle East and North Africa region, Hoesktra & Hung 2005 estimated the total gross import of virtual water to be 92 Gm3/yr over the period 1995-1999, of which 38.45 Gm3/yr is imported from North America, while the total gross export of virtual water from the MENA region to the other regions of the world to be 17 Gm3/yr over the same period. This means that the net virtual water import is 75 Gm3/yr for the MENA region over the period 1995-1999, and it is considered to be one of the significant net virtual water import world regions.

They also calculated the gross virtual water flows between countries within a region by summing up all virtual water imports of the countries of the region that originate from other countries in the same region.). The virtual water flows between countries within the MENA region recorded only 5.68 Gm3/yr over the same period 1995-1999, which means that the countries within the region depend highly on countries outside the region and little on countries within the region, table (4).

Table 4 Average Annual gross water flows between MENA & world regions (1995-1999) (Gm^3/ yr).

Exporter	Importer													
	Central Africa	Central America	C& S Asia	East Euro.	Middle East	North Africa	North America	Oceania	FSU	South Africa	South America	S E Asia	West Euro.	Total gross export
Middle East	0.16	0.03	2.31	0.51	*5.13*	2.64	0.47	0.16	0.24	0.01	0.10	0.54	3.67	10.8
North Africa	0.03	0.03	0.49	0.23	0.75	*0.55*	0.84	0.00	0.04	0.09	0.92	0.03	2.76	6.2
Total gross export	2.9	33.5	196.4	12.0	41.1	50.6	17.5	1.7	9.1	8.0	21.4	40.6	104.7	539.5

Source: (Hoesktra & Hung 2005).

Considering the ranking of gross virtual water import of the Middle East countries over the period 1995-1999, the top-four countries were: North America, Federal Russian, South-East Asia, and Central and South Asia, while their gross virtual water export goes to the following top-four countries: Western Europe, North Africa, Central and South Asia, and South-East Asia. As for the North African countries, the top-four countries for their gross virtual water import were: North America, South-East Asia, Western Europe and South America, while their gross virtual water goes to the following top-four countries: Western Europe, South America, North America and the Middle East.

Virtual water as a policy option

In this section of the paper we review the merits and demerits of virtual water trade concept, as it seems that we have two different opinions about virtual water. One that sees that virtual water can be a panacea for all problems facing water stressed countries. The other opinion sees the virtual water risks that need to be explored.

Merits of virtual water trade

Virtual water is seen by some as a concept with potentially great implications on various issues such as water scarcity, international water systems and other natural resource management, conflict prevention and food security as well as international trade policy. It is also seen as an essential element that provides a viable policy option that stabilizes political economies of water-scarce regions, as it helps to balance the regional water gap and the global water surplus in a politically non- or less- stressful way. And it is also recognized as a novel way of interpreting the impact and strategies of the worldwide trade in agricultural products.

According to the FAO 2003a, the concept of virtual water is well founded, provided countries have more transparent picture of its comparative advantage and accordingly they can translate it into a competitive advantage. However, the concept is still fairly new, and case studies are so far limited in number due to the term's recent entry into the academic and professional language. Still, being intuitively an easily understandable and practical concept, it has been drawing increasing attention widely as an analytical tool to rethink the issue of water scarcity and water conflict. It is expected that research into "virtual water trade" will also provide a significant and innovative perspective over management of trans-boundary water basins. One of the key challenges therefore is to bring the politicians into the decision making process as early as possible. The lessons vary, but the message remains remarkably consistent: planning future water development and options for addressing water stress demands consistently greater breadth in decision making capacity than has often been the case in the past.

Demerits of virtual water trade

Food imports are essential where countries cannot grow enough food but a major problem with trade, of course, is that food imports must be paid in foreign exchange, earned from exports or by grants and loans. This fact was somewhat hidden by large amounts of donor assistance in hard currency and historically heavily subsidized exports from the USA and Europe (Seckler & Amarsinghe 2001). Beside the direct financial cost, other costs to be considered related to imports by water deficit countries to solve food deficiency are: (i) increased dependency on main exporting countries; (ii) if not able to compete or adapt, local agriculture may be damaged, because of importing food; (iii) the exporting country may start interfering in internal affairs of importing country; and (iv) imports may result in foreign reserve depletion if there is no export compensation of less water intensive or higher value commodities.

Virtual water trade as a component of water policies is contingent to the rules of the international market that the WTO today is trying to establish. Current trade climates and conditions are not very supportive for enhancing virtual water trade as option in Countries may also be grouped according to their projected food self-sufficiency ratios (SSR: food production/total demand) as illustrated in table 3. About one-third of the countries would have SSR of less than 60 percent. They include three oil-rich countries and two low-income countries. The latter would be in a predicament due to their limited food import capacity. Although considered middle-income countries, Iraq and Jordan would face similar problems unless their foreign exchange resources increase commensurately. The second group comprises middle-income countries that would have to generate sufficient foreign exchange to finance the importation of 20 to 30 percent of their domestic needs. Turkey and Morocco in the third group would be able to meet their food demand from indigenous production. The other two in the group are low-income countries that have sufficient agricultural resources; both their high SSRs are attained at low nutritional levels. Regardless of these inter-country variations, the fact remains that the entire region (with the exception of Turkey) would continue to be a food deficit region (FAO 2003a). Water policies for especially the poorest countries. Countries facing food insecurity and water stress need to be assured that they can have fair and secure trade with water-abundant nations. Secure basic food trade conditions for water-poor countries should become a priority for the World Trade Organization. Trade arrangements, access to markets, finance and foreign exchange must all be taken into account (e-conference 2004).

The tension in the food trade debate relates to the fact that the game of global competition is played with rules that many see as unfair. Countries with large virtual water exports, which contribute to the water budgets of other countries, are unfortunately also the countries that are accused of nefarious food trade practices for other reasons. Centralized imports of cereals may create a food 'reservoir' giving the state a monopoly on the food market, allowing it to create a client base in the major cities, distributing food in exchange for political allegiance. Such allegiance brings a degree of political dependency. Unless a set of norms, principles, rules, and decision making systems are carefully designed and successfully converged upon, it would lead to even more conflicting situations in the rapidly changing global trading systems. These implications are politically sensitive especially since the current low food prices of the global market are closely related to the high level of subsidies in many exporting countries and since they have a detrimental effect on the agriculture development of the countries importing food products (Idem).

The agricultural subsidy systems and import quota and tariffs of especially USA, Japan and the European Union, are the biggest obstacles to free trade and constrain the development of the virtual water market considerably. The magnitude of the agricultural subsidies from OECD countries is huge (about 1 billion US$ per day), has a major impact on the prices of agricultural products in developing countries and on the economic returns from farming to the detriment of producers in developing countries (Idem). In addition, economic consultants have the revelation that water-scarce countries should devote their irrigation water only to high-valued crops, like flowers, fruits and vegetables, export them and then buy the cereals they need on international markets. The problem, of course, is that high-valued crops constitute very narrow and highly competitive markets, where only a modest increase in supply drives prices virtually to zero. Every country, developing and developed, is already trying its best to produce high-valued crops. Another advantage of international trade is that imports help to build local markets, tastes ad skills that can result in new domestic industries through import substitution. On the export side of the developed countries, it seems evident that there will be significant environmental and financial constraints on EU exports. Environmental pressures against irrigation and restoring water quality are also building in the USA and Canada (Seckler & Amarsinghe 2001).

Hakimian 2002 notes a more general qualification that applies to the political economy of trade policy, which is the question of to what extent trade policy should be based on *static* comparative advantage considerations. This is a vexed issue over which there is equally a long tradition of debate and controversy. The free trade tradition of thought in economics is viewed by some suspicion partly because in the words of Joan Robinson (1964) 'free trade is the ideology of strong nations'. Finally, at the global level, virtual water trade has geopolitical implications: it induces dependencies between countries; it is influenced by and has implications on the world food prices as well as on the global trade negotiations and agreements on tariffs and trade.

The case of the MENA region

Past food security policies in the MEN Region was based on area expansion to support the objectives of self-sufficiency and to enhance exports. That era seems to have peaked out. The question now, is whether the region should produce food grain domestically or is it cheaper to import it (virtual water trade)? The analysis for a number of MENA countries shows that it depends on how water is valued. The issue of virtual water is still very complex and cannot be fully analyzed at present to decide on what crops should be produced locally or imported. The prevailing incentive framework for agriculture in general has a strong anti-export bias. Any reform in water policy area, such as increasing the cost of water has to be evaluated in the context of economy wide and sectoral policies.

The second point is the distortion that exists in international costs. The cost transmitted to farmers is highly distorted with domestic support to the agriculture sector in the developing countries at two levels, the production subsidies and export subsidies; the end result is that the farmers' comparative advantage is distorted and they cannot compete with cheap imports and high transaction cost to export. In such a case, it is simply not possible to know the exact value of the so called "virtual water". It does not let developing countries to establish its natural comparative advantage to base its competitiveness (Idem).

The third issue pertains to the level of the economic base, i.e. whether the economy of the country is well developed and diversified to take the decision of reallocating water from cereals, which provide subsistence living to large sections of rural population. The experience in the region, perhaps globally, is that a number of economic, political and social factors come into play when resource allocation for valuable input like water are made and hence on the issue of virtual water. Finally, one of the aspects of the Virtual Water Concept implies that importing food grains is cheaper than investing in large-scale water transfers or reservoirs. In other words grow food, where water is abundant, and transport food to water scarce regions, where food is required. However, because of long-term food security reasons and prevention of geopolitical dependency, countries even with water scarcity may consider producing basic-crops as priority, if they cannot afford to import products.

CONCLUSION AND RECOMMENDATION

The concept of virtual water import originated from empirical observations that food imports, especially cereal imports, have played a crucial role in compensating for the water deficit in water scarce countries. For these countries, the underlying motivation of importing food (virtual water) is hardly a pursuit of comparative advantage, but to fill the domestic shortfall of food supply and to maintain social stability. It is in these situations that the imperative rather than comparative advantage drives the virtual water trade import in these countries. Until now MENA countries have done this unconsciously. One can only speak of virtual water trade if conscious choices are made in water and environmental management policies, whether or not to make water available or to release pressure on the domestic water resources by importing goods that else would have consumed much of the domestic water resources available. To make conscious choices, the elements of choice and the players involved in virtual water trade have to be made visible. This means a policy for virtual water that takes into consideration the other factors of production land, labor and capital as well as the other elements such as; integrated water resources management, technical efficiency, comparative advantage…etc. The main conclusions include the following:

- The water situation will never be the same again in the MENA region, as it has been in the past. Expected increases in water demand cannot be met in most cases by developing additional water resources since such water is increasingly not available. There is a need to cope and avoid the water crisis that, in some countries is already a reality.
- Agriculture will remain the dominant user of water at the global level and in countries situated in arid and semi-arid region of the world like the MENA region. This dependency can be expected to intensify.
- Future increase in agricultural production must come from the increased land and water productivity, both in terms of higher yields and cropping intensities for which scope still exists. This will lead to greater water savings by reducing water losses and achieving more efficient water use and better agronomic practices.
- Irrigation is crucial for future food production and irrigation water use efficiency increase when the right policy and market incentives are in place.
- The regional gathering has proved, in many regional joint communities in the world, to be the most appropriate socio-economic resort towards mitigating the stress prevailing at the national level in the region, particularly in respect to water and food aspects.
- The policy relevance of the virtual water concept is gained only by including information regarding the scarcity of water (i.e. its opportunity cost) in a given region or country. The policy relevance of the virtual water will be greater where scarcity values (opportunity costs) are substantial.
- Countries might be better off using their scarce water resources for economic activities that bring higher economic returns and buy food instead of growing it themselves. However, countries would be wary of becoming too dependent on external sources for such a basic commodity as food. One factor that might alleviate the fear of dependency might be if there are multiple sources of food from which to import and that the development of quasi-monopolies is prevented.
- The issue of virtual water is related to that of globalization, which raises a concern among politicians and the general public. Alternatives to the current trends and directions of economic globalization must be developed, tested and supported. Regional approaches are worthwhile to stimulate.
- Many obstacles in the virtual water trade could be removed by developing a political willingness that allows special trade agreements among regions, common market countries, and even between countries of different commercial blocks. This requires mutual interest, trust and political stability (e-conference 2004).

- Food security is a priority issue. It will be achieved by enhancing economic growth, sustainability in land and water resources management on which agriculture production depend, and managing population growth to reduce the pressures on limited resources.

The end result of these considerations as Seckler & Amarasinghe 2001 note is that developing countries with a high percentage of their populations in rural areas will attempt to be as self-sufficient in agriculture as they reasonably can in order to conserve foreign exchange and provide rural livelihoods. They will gradually relax this objective over time as exports grow, the growth of the labor force slows and employment opportunities in other sectors improve. Of course, many countries cannot achieve this objective because of water and other constraints and will need to import considerably more food in the future. How much water do we need to feed the growing population, where it comes from, and the environmental consequences depend on choices made in the next few years.

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