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FACTSHEET

Virtual water trade in the WANA region

Prepared by Heather Elaydi, Research Fellow

The West Asia – North Africa (WANA) region is notable for its dry climate and scarce water resources. How to preserve these scarce resources has long been a topic of debate. Given the large amounts of water required to grow food, countries in the region are increasingly opting to rely on food imports rather than on domestic agriculture to feed their populations. The concept of virtual water provides us with a tool to help explore this phenomenon.

What is virtual water?

Virtual water is a conceptual tool that describes the amount of water used in the production of traded agricultural goods and industrial products. It is a way of explaining the amount of water indirectly traded between countries.

This amount of water is referred to as 'virtual' because the final product does not actually contain the real water used to produce it. For example, on average, it takes 2,500 litres of water to produce one kilogram of milled rice, and 15,400 litres of water to produce one kilogram of boneless beef. Each of these amounts is referred to as the virtual water content of the product.

The virtual water content of an agricultural good includes not only the water that the crop requires to grow, but also the water used in the manufacturing of the fertilizers and pesticides used, and the water associated with the operation of farm machinery, over the entire growing process. It also includes the water that those pesticides and machines pollute along the way. Animal products have some of the highest virtual water content of any food, because the grains and roughages the animal consumes over its lifetime are included in the calculation.

A related concept is the water footprint, which is a more detailed, multi-dimensional way to measure virtual water content. It includes the types of freshwater used, where and when that water is used, and the amount of water that is polluted in the production process. Alternative forms of water, such as desalinated or treated waste-water, are not included in the calculation of water footprints.

There are three colours of virtual water which are measured in water footprint calculation:

- **Blue** water is fresh surface and groundwater, such as rivers, lakes, and underground aquifers;
- **Green** water is fresh water in the form of precipitation that is stored in and on plants and soil;
- **Grey** water is waste-water, and in the calculation of a water footprint it's the amount of water polluted in the production process.

A product may also have a different water footprint depending on when, where and how it's grown. Crop water requirement measures the total water needed for evapotranspiration (the amount of water which passes through a plant, plus the water evaporated by the sun) from planting to harvest for any given crop. This measure changes depending on the environmental conditions of the place where the crop is grown and the season it's grown in. Different methods and levels of efficiency in farming practice also contribute to differing water footprints.

Applications of the virtual water concept

There are two main applications for the concept of virtual water. First, it can be used as an import policy tool that water-scarce regions use to achieve food security. The virtual water balance refers to the net import of virtual water through traded goods within a given country or region. A positive water balance means the majority of virtual water in the form of food and other goods is flowing out of the country as exports, while a negative water balance means that virtual water is flowing into the country as imports, to support domestic demand that the country is unable to meet on its own.

Second, the virtual water concept can help draw a link between consumers and the impacts of their consumption choices on water resources. Given the high virtual water content of meat and cereals, water-stressed regions are often advised to steer their populations away from consuming large amounts of these foods. It can also help inform consumers in water-rich countries who consume significant amounts of imported products about the environmental impact of their consumption habits.

WANA origins of virtual water

The term 'virtual water' was first coined in a study[1] looking at trends of wheat and cereal imports to the Middle East. It was observed that some water-scarce countries imported significant amounts of water-intensive agricultural products. The author advised other countries in the region to follow this strategy, and argued that doing so would not only ease pressure on domestic water resources, but would also serve to maintain political stability and avoid conflict over water resources.

Agriculture in the WANA region

Agriculture is the main user of freshwater globally — including in the water-scarce countries of the WANA region. There are several factors that lead a country to use the bulk of its water in the agricultural sector. In some countries, such as Yemen, Morocco, and Egypt, a large portion of the population relies directly on farming for their livelihoods; agriculture also contributes significantly to the GDPs of these countries. Some other countries may choose to use most of their water for agriculture to boost domestic food production in order to decrease dependence on food imports.

	Water Used in Agriculture, as % of Total Use	Labour Force Employed in Agriculture (%)	Agricultural Sector as % of GDP
EGYPT	86	29	15
JORDAN	65	3	3
MOROCCO	88	45	15
SAUDI	88	7	2
YEMEN	91	37	10

Figures for water used in agriculture as % of total use and agricultural sector as % of GDP from FAO-AQUASTAT. Figures for labour force employed in agriculture (%) for Egypt, Jordan, Morocco and Saudi Arabia from CIA World Factbook; figures for Yemen from FAOSTAT.

[1] Allan, T. 1997. 'Virtual water: a long term solution for water short Middle Eastern economies', paper presented at the 1997 British Association Festival of Science, University of Leeds, 9 September 1997.

Towards food security: food self-sufficiency or virtual-water imports?

Water and food security are intimately related, given the vast amounts of water needed to produce food. Thus, for water-scarce countries like those in the WANA region, debates over how best to achieve or maintain food security abound. Some promote a push toward regional food self-sufficiency coupled with improved agricultural and water efficiency, while others advocate reliance on imports.

Many countries in the region have pursued policies of national food self-sufficiency in the past — such as Egypt[2], Syria and Saudi Arabia[3] — but these policies have proved unfeasible in the long run.

From a food security perspective there are two main advantages to choosing reliance on food imports. First, for a water-scarce country that is unable to sustainably achieve food self-sufficiency, imports offer a relatively straightforward alternative solution to feeding its population. Second, a diversion away from using water to produce domestically consumed crops into activities that have higher financial returns can boost a country's economic growth and average wages.

However, there are significant disadvantages to reliance on food imports. Three types of risk associated with import reliant food security have been identified[4]: availability, counterparty performance, and price.

Availability refers to the physical availability of food for export, which fluctuates primarily due to production factors such as extreme weather events and shifts in land use (such as toward biofuel production).

Counterparty performance risk refers to the risk that the exporting party will, for either commercial factors (such as last-minute price hikes) or non-commercial factors (such as export bans, natural disasters, and civil conflict), default on its contract to provide goods. Past cases[5] have shown that in a crisis, a country will prioritize its own population, which is ultimately dangerous for a food-import reliant country.

Price is one of the most common risks associated with food trade. Structural factors, such as rising income which leads to rising food demand, can keep food prices high, while cyclical factors, such as extreme weather events and conflict, can contribute to price shocks; currency fluctuation, commodity speculation, and the price of oil are also contributing factors to these shocks.

Given the high poverty rate in countries such as Yemen and Egypt[6], food price volatility in the global market has the potential to push many people further into poverty. It is therefore a delicate balance to determine how best to assure the food security of these populations – through increased domestic staple crop production, or through increased wages that would allow people to purchase food on the global market.

Exports and the economic value of virtual water

Since the era of food self-sufficiency policies, national strategies have shifted once again away from domestically consumed crops to export-oriented crops. Exporting agricultural products means exporting water — the virtual water that's been used to grow those products. For arid countries in the WANA region, the export of scarce water resources may seem counter-intuitive, but it's often done for social, economic, or political reasons.

While reliance on food imports has the potential to reduce national water consumption, water use is instead often redirected to other "higher-value" production[7]. Growers seek to produce foods that earn more dollars per drop of virtual water used in production.

Egypt, for example, is the world's largest importer of wheat, yet increasingly aims to produce higher value export-oriented vegetables and fruits[8].

Jordan, the second driest country in the world, is also the world's third largest exporter of tomatoes[9] — a commodity that requires 214 litres of water per kilogram to produce.

[2] El-Sadek, A. 2010. "Virtual water trade as a solution for water scarcity in Egypt". Water Resources Management, 24(11), 2437-2448.

[3] Elhadj, E. 2005. Experiments in Achieving Water and Food Self-sufficiency in the Middle East: The Consequences of Contrasting Endowments, Ideologies and Investment Policies in Saudi Arabia and Syria. Doctoral dissertation: School of Oriental and African Studies, University of London.

[4] Sadler, M. and Magnan, N. 2011. "Grain import dependency in the MENA region: risk management options". Food Security, 3(Supplement 1), pp. S77-S89.

[5] In 2008 India and Vietnam banned the export of rice, with other countries increasing export restrictions; in 2010-2011, Russia banned the export of wheat due to a prolonged extreme heatwave that affected production. In both cases, the bans drove up the global price for these commodities.

[6] The national poverty rates of Yemen and Egypt are 54.5% and 25.2% respectively; figures from data.worldbank.org.

[7] Hoekstra, A.Y. 2010. The relation between international trade and freshwater scarcity.WTO Working Paper / January 2010. Twente: University of Twente.

[8] Food Export Council (FEC). 2009. Exports' Objectives from year 2010-2013 [PowerPoint Presentation]

[9] http://www.unctad.info/en/Infocomm/AACP-Products/COMMODITY-PROFILE--Tomato/

Heather Elaydi, Research Fellow

Heather Elaydi holds an Honors BSocSc in International Development from the University of Ottawa, and a Masters degree from the University of East Anglia in Agriculture and Rural Development, with a focus on water security. Her Masters dissertation studied mechanisms of access to land and water for Israeli settler-farmers in the Occupied West Bank. She joins the WANA Institute to assist the Green Economy research team, where her focus will be on the intersection between water and agriculture, food security, and access to natural productive resources in the WANA region.