

# Virtual Water Policy: A Case of Saudi Arabia

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## Abstract

Virtual water—an emerging concept in water resource management—refers to water used in and during the process of producing and consuming agricultural commodities. In recent years, the concept has become increasingly popular among countries facing water scarcity, such as the Middle Eastern countries. This case study is about how Saudi Arabia’s government has adopted and implemented the virtual water policy to optimize the country’s existing water resources by assisting the Saudi food manufacturing companies to buy agricultural lands and by promoting the cultivation of less water-intensive crops. With this case, students are expected to understand the water management system and past agricultural policy in Saudi Arabia. Based on this knowledge, students should be able to identify both visible and hidden stakeholders in the national policymaking process. Also, as the virtual water policy involves international trade and geopolitical issues, attention will be placed on the international regulatory aspect of transnational water management (or the lack thereof).

**Keywords:** Virtual Water, Agricultural Policy, Underground Water, International Trade

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## นโยบายน้ำจำลอง: กรณีศึกษาประเทศซาอุดีอาระเบีย

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### บทคัดย่อ

น้ำจำลอง หรือ น้ำเสมือนจริง (Virtual Water) เป็นแนวคิดที่ว่าด้วยการบริหารจัดการทรัพยากรน้ำที่ใช้ในกระบวนการผลิตอาหารและสินค้าทางการเกษตร ในช่วงระยะเวลาหลายปีที่ผ่านมา แนวคิดน้ำจำลองหรือน้ำเสมือนจริงนี้ได้รับความนิยมอย่างแพร่หลายในประเทศที่ขาดแคลนน้ำ เช่น ประเทศในแถบตะวันออกกลาง เป็นต้น กรณีศึกษาเป็นกรณีศึกษาเกี่ยวกับการนำแนวคิดน้ำจำลองไปใช้ในการบริหารจัดการทรัพยากรน้ำโดยรัฐบาลซาอุดีอาระเบีย เช่น การสนับสนุนให้บริษัทอาหารข้ามชาติสัญชาติซาอุดีอาระเบียไปลงทุนซื้อที่ดินเพื่อการเกษตรกรรมในประเทศอื่น และการสนับสนุนการเพาะปลูกพืชที่ใช้ปริมาณน้ำน้อย เป็นต้น กรณีศึกษานี้มีวัตถุประสงค์เพื่อให้ผู้อ่านมีความรู้ความเข้าใจในสถานการณ์การจัดการน้ำและนโยบายด้านการเกษตรในประเทศซาอุดีอาระเบีย จากความรู้ความเข้าใจดังกล่าว ผู้เรียนถูกคาดหวังให้สามารถระบุผู้มีส่วนได้เสียที่ชัดเจนและผู้มีส่วนได้เสียแอบแฝงในกระบวนการกำหนดนโยบายที่เกี่ยวข้องกับการบริหารจัดการน้ำ นอกจากนี้ นโยบายน้ำจำลองยังเกี่ยวข้องกับการค้าระหว่างประเทศและกรณีพิพาทด้านภูมิรัฐศาสตร์ ดังนั้น กรณีศึกษาจึงให้ความสำคัญกับระเบียบกฎหมายและสนธิสัญญาการค้าระหว่างประเทศตลอดจนการบริหารจัดการทรัพยากรน้ำข้ามพรมแดน

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The whole chamber of parliamentarians adjusted their seats as they listened with keenness to the Minister of Water and Agriculture. They had all realized that if they continued with the “business as usual” modus operandi, it would be impossible to secure enough food to cater for the growing Saudi population which at that time was now standing at 30 million and still counting. Some critics from the opposition party eagerly waited for the question and answer segment. There had always been discontentment in the upper house of assembly that the agricultural policy was non-strategic and that the looming catastrophe was self-inflicted and engineered to benefit few elite minorities.

*“Ladies and Gentleman, the combination of agricultural and water resources management policies that we as government have spearheaded over the past decade have proved to be both non-strategic and unsustainable. Now as we face this global climate change threat we should think of a new way of doing business. My Ministry has gathered evidence of the depletion of our underground water aquifers, which has largely been due to extensive overhead irrigation to support wheat and alfalfa production. Can you imagine that, yearly we are drawing nearly five trillion gallons of water from the nonrenewable underground aquifers and at this rate, mathematical modelling has shown that we will run dry in the next 50 years. It is in light of this background, ladies and gentleman that I call upon a reform in policy, We should make a radical move towards virtual water trade...This policy option will help us to optimize water use and protect the little water resources that we have at the same time guard against food insecurity.”*

Soon after the minister gave an end note to his presentation, thunderous applause echoed from the whole august house, some parliamentarians clearing their throat to seek further clarity on the proposed and unfamiliar virtual water concept. This was back in 1999, and it landmarked the turning point in Saudi Arabia water and agriculture policy direction.

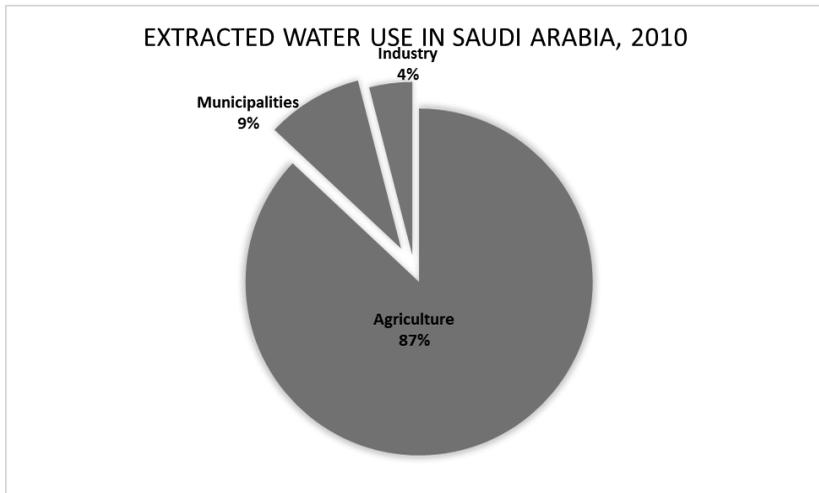
## **About Saudi Arabia – Beyond the Edge of Water Shortage**

The Kingdom of Saudi Arabia is largest country in the Arabian Peninsula. The total population of Saudi Arabia is 24.6 million and the GDP per capita stands at US\$ 20,813. The Saudi Kingdom is the world's largest oil exporter and dominates the Organization of Petroleum Exporting Countries (OPEC). Oil revenues account for about 90 percent of export earnings and about 80 percent of government revenues. Saudi Arabia's economy has been on the rise owing to the global economic recovery in oil prices, and enlarged fiscal spending by the government in oil exports (Ibrahim, 2013). While the country is making giant economic strides, the water scarcity remains a threat to its socio-economic development.

This arid state covers an area of 2.15 million km<sup>2</sup>, and of this area, 1.01 million km<sup>2</sup> is used for agricultural purposes (Franken, 2009). Temperatures are high in the summer and low in the winter characterizing its desert-related weather conditions. Saudi Arabia receives very low annual rainfalls with an estimate of 2,045 million cubic meters per year and has very limited fresh water supplies (DeNicola et al., 2010). The water resources in the country are divided in two—surface and underground deposits. Surface water comes from rainfalls which are found predominantly in the west and south-western regions of the country. Ground water is found in the basement rocks, and the thickness of these rocks is about 500 m. Ground water is held in aquifers, some of which are naturally replenished, while others are non-renewable (Zaharani, 2011).

According to the United Nations, Saudi Arabia is classified under the water scarce nations (Rijsberman, 2006). The country does not have permanent rivers or lakes. Being a desert country, rainfall, surface, and underground water are extremely limited. This situation has worsened by decades of extensive agricultural production, which has left the country's aquifers almost depleted. Furthermore, climate change and exponential population growth have detrimental impact on water resources, thereby exacerbating the water scarcity situation in Saudi Arabia. It is estimated that at the current underground withdrawal rate, Saudi Arabia will run waterless in the next 50 years (Drewes et al., 2012). Water scarcity aggravates existing social problems,

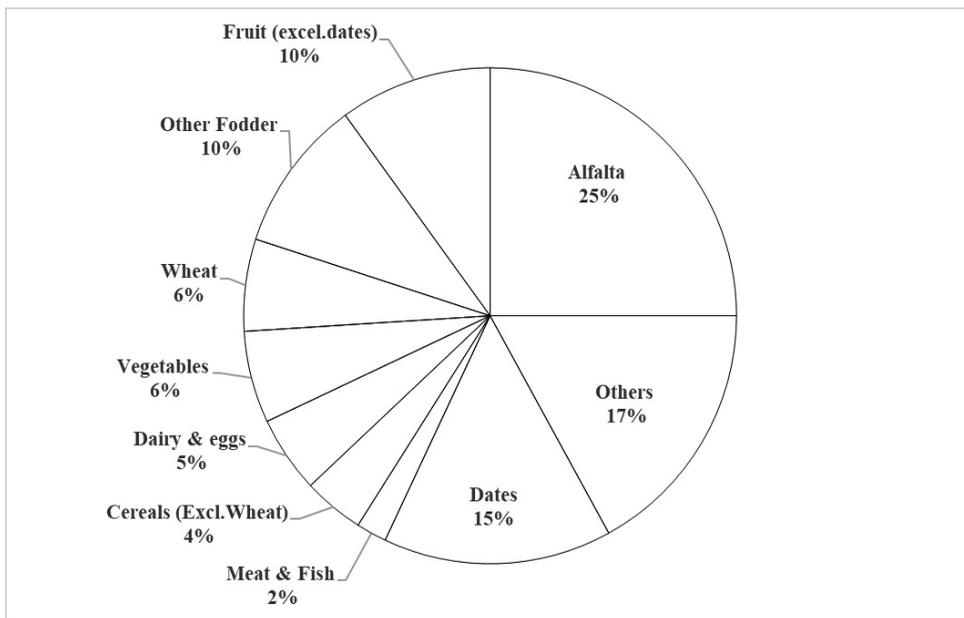
most notably poverty (Namara et al., 2010). The current water consumption scenario puts the future of this oil-rich county at stake. Almost 90 percent of the water resource is used for agriculture whereas only nine and four percent are used by municipalities and industries, respectively (Napoli, 2016) (Figure 1).



**Figure 1:** Extracted Water Uses Distribution (Allan, 1997)

Source: Allan (1997)

Further, as shown in Figure 2, 31 percent of the water extracted is used to produce alfalfa and other fodder, which provide feed for the meat and dairy industries. Fruits (including dates), vegetables and cereals (including wheat) consume 41 percent of all water for agriculture (Woertz and Keulertz, 2015). This water use pattern and the water scarcity situation call for immediate actions with regards to sustainable water use. These actions might include Saudi Arabia's reduction in agricultural production and water management policy framework.



**Figure 2: Water Uses Distribution**

Source: Woertz and Keulertz (2015)

## What is the Virtual Water?

The concept of virtual water is an emerging ideology in water resource management. It was first introduced by Tony Allan in the early 1990s. He defined it as the water which is used in and during the agricultural production process (Allan, 1997). Due to an exacerbated impact of climate change on water resources, virtual water has in the past decade begun to attract interests in many countries. The first international conference on virtual water was held in December 2002 in Delft, the Netherlands to discuss its applicability in fostering regional and global water security. This was followed by a special session at the Third World Water Forum in Japan, March 2003.

Looking at it closely, virtual water refers to the hidden flow of water consumed during the production and processing of food items, such as meat, vegetables, and dairy products (i.e., agricultural produce) (Renault, 2003). For instance, we need 1,000 liters of water to produce one kilogram of wheat and 15,400 liters to produce one kilogram of prime beef (Allan, 1997). The virtual aspect arises from the fact that the real water used to produce the food is no longer contained in the food or a country in which the food is produced. This helps to understand the volume of water required to produce different goods and services.

In discussing about virtual water in this globalizing world, another important concept is virtual water trade. This refers to the process of importing and exporting of goods and services, which require water for their production, as well as processing, such as fruits, vegetables, and livestock (Hoekstra, 2010). Virtual water trade is beneficial to arid countries like Saudi Arabia, Jordan, and Egypt (Allan, 1997). Notably, because in these arid countries there is a serious need to optimize the utilization of existing water resources and to promote cultivation of food, which requires less amount of water. Yet, supporters of the virtual water trade is said to be economically invisible and politically silent. However, these supporters struggle to find solutions for the water-scarce regions to avoid finding water within their territories to produce tons of water-intensive and politically sensitive commodities (Allan, 2001).

Virtual water can be measured in water footprint calculations, where the water footprint refers to the amount of water used in and around our home, school, and throughout the day (Hanlon et al., 2013). Theoretically speaking, water footprint is the total use of household water the resources, minus the virtual water export flows, plus the virtual water import flows (Chapagain & Hoekstra, 2004). The footprint calculation is based on three different categories:

- Blue water, such as fresh surface water from lakes, rivers, and undergrounds,
- Green water stored in the form of precipitation in plants and soil, and
- Grey water, which is the amount of water polluted during the production process of goods.

Deductively, the virtual water concept can be constructed into two practical uses: (1) an instrument to achieve water security and efficient water use and (2) a linkage between consumption patterns and the impacts on water. In the first usage, virtual water can be an alternative source of water, which means it can relieve the pressure on the nation's water resources where water is scarce. It can also help solve geopolitical problems between Saudi Arabia and neighboring countries (Wichelns, 2004). Based on the international trade theory, nations should export products, which possess relative or comparative benefits in production, while importing products with comparative disadvantage (Wichelns, 2004).

For the second usage, which is basically the water footprint function, virtual water policy can help predict the environmental impact of water consumption. This is because knowing the water content of products offers information about which products have greater impacts on the water system and where water savings could be achieved.

## **Optimal Water Use**

Saudi Arabia—which has neither rivers nor lakes—experiences low precipitations, and most of its aquifers are almost depleted. Against this background, optimal utilization of water resources becomes imperative. Optimal water use is one of the guiding principles of virtual water trade, called “the Best Alternative Use” Principle. In this principle, the virtual water trade is a sustainable strategy of water resource management with multiple steps to ensure that water is indeed used in the most appropriate way in the public interest. It is also consistent with the principle of integrated water resource management since water resource protection affects decisions related to water usage. For example, in a certain area, water has the best alternative use in an aquatic ecosystem. In other areas, this may not be the case. Thus, the use of water resources varies across different community contexts (Li et al., 2014).

## Virtual Water and Food Security

Food security can be defined as “access by all people at all times to enough food for an active, healthy life” (Gang & Epstein, 2010: p. 35). It is concerned with five components food availability, food accessibility, food sufficiency, individual, household and national food stability and food quality reliability. The concept of food security is a critical component at the center of all governments, especially in Saudi Arabia due to rapid population growth and economic performance in the 1980s (Roudi-Fahimi et al., 2002). Saudi Arabia’s current population is 3,251,469, and the government needs to create innovative food security initiatives to meet the growing demand in the face of water scarcity. Food security exists when all people have physical, social, and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (Grindle et al., 2015). Food security, environmental health, and social equity are the rationales for adopting the virtual water trade as a water policy instrument. Countries might be better off by using their scarce water resources for economic activities that bring higher economic returns. These countries may opt to buy food instead of growing and producing on their own. In this vein, Saudi Arabia moves from being the world’s sixth largest wheat exporter in the 1990s to virtually a net wheat importer. The social adaptive capacity of a country is vital to alleviate water scarcity and provide food security through virtual water trading.

### Saudi Arabia Situation Today- Toward the National Virtual Water Policy

The virtual water policy first gained the public attention in Saudi Arabia in the late 1990s in response to a growing threat of the depletion of nonrenewable aquifers in the face of massive population growth. In order to address vital aspects of food security and sustainable development, the Saudi government adopted the virtual water policy option. However, there is no explicit policy document entitled virtual water in Saudi Arabia. Yet, the virtual water concepts and strategies are embedded within fragmented water and natural resource policies under the Ministry of Water and Agriculture.

In Saudi Arabia, water distribution and water use are regulated by the government under the ministry of agriculture and water resources. Beginning in the 1970s, the government adopted a massive wheat and barley production in which private farmers were given subsidies to extract water from the aquifers, so that they could transform the desert into irrigated fields. An arid Saudi Arabia was turned into the world's sixth largest wheat exporting country (Elhadj, 2005). This government policy option was mainly driven by the need for self-dependency and food security. Saudi Arabia's strong economic base from oil reserves caused them to adopt liberal water management and unsustainable agricultural policies that led to the depletion of aquifers for this arid Arab state. Currently, the country faces critical water shortage with depleted aquifers and extinct renewable groundwater due to limited precipitation. It has been estimated that at the current rate of withdrawal, these water supplies will be gone in less than 50 years (DeNicola et al., 2015).

The massive population growth has created an enormous demand for water. The government has had to revise the 1970s policy to move to the virtual water option amid growing threat of water scarcity. The government has decreased the domestic production of water-intensive crops, such as alfalfa and wheat. In 2009, the Saudi Agricultural and Livestock Investment Co. (SALIC) was established to secure stable food supplies to avoid food shortages the Saudi population (Woertz & Keulertz, 2015). Virtual water trading countries with SALIC include Sudan and Ukraine and others in South America and Asia. This policy option is significantly reducing the demand for water from the agricultural sector. The Saudi government's "Initiative for Saudi Agricultural Investment Abroad" launched in 2008 provides government credit and diplomatic support for the Saudi companies to buy foreign land and water to feed the Saudis. The Saudi investors have generous access to water and the right to export at least 50 percent of the harvest back to Saudi Arabia (Cotula, 2009). This arid Arab state is proud of the strategic move to virtual water policy (Lippman, 2010: p. 90):

*“Our policy is to help countries that have land and water,” said Abdul-Aziz al-Howaish, general director of the agriculture ministry’s international cooperation department. “We have the technology and capital. We will help them to produce, for them and for us.”*

## **Global Policy Environment – What are the Challenges with Virtual Water?**

The lack of a robust international framework for virtual water trade is a hindrance to a full-scale adoption of virtual water policy option both in Saudi and in an around the world. The world in general is facing water resource challenges owing to global warming, poor awareness of how to optimally use and save water, and lack of coordination and planning for the use of conventional water sources, such as ground water or rains (Gutub et al., 2013). The Global debate on plausibility of virtual water calculations, net import and net export benefits landscape, and food sovereignty continue to be sticky points around the virtual water dimension of water resource management. Theoretically, virtual water discourse aims to promote the global water resource governance with a fair resource allocation, mutual trade benefit, and sustainable development.

## **Virtual Water Trade – Gaps**

The concepts of virtual water and virtual water trade have the potential to cushion the arid and semi-arid regions from catastrophic effects of water scarcity, consequently improving regional and global water use efficiencies. However, critics of the model argue that the current framework does not take into consideration international trade regimes and dependencies that shape the local social, economic, and cultural environment (Orlowsky et al., 2014). Moreover, there is limited consensus on the standards of virtual water measurements. Calculations of virtual water are inconsistent or inaccurate (Orlowsky et al., 2014). The proposed volumetric indicators do not take a blind eye on a number of important local socioeconomic factors related to water consumption. Those who do not support virtual water policy option argue that these calculations have the potential to harm vulnerable populations water (Wichelns, 2001).

Application of the virtual water concept poses a threat to national sovereignty and autonomy. Exporting countries, which are in most cases richer countries, develop neo-colonial tendencies and might want to interfere with importing countries' domestic politics. Without a proper international regulatory framework, the virtual water policy can destroy local agriculture and compromise individual families' right in deciding and controlling their diet. The dynamics of food security, food sovereignty, and culture makes it very difficult for policy makers to introduce rules or prices for the use of water (Wichelns, 2001). The question on self-sufficiency and independence from other countries continues to be a sticky point that introduces a political deadlock to the adoption of virtual water ideology.

Virtual water trade has the potential to cause depletion of water resources in the exporting countries especially if it involves water intensive crops. A classic example is the depletion of the Colorado River and Ogallala aquifer in USA due to increased water demand exerted by increased Japanese consumers (Aldaya et al., 2010). The virtual water trade can ideologically be a tool to optimize global water use. However, without appropriate trade agreements and good governance it can end up being a vehicle to transfer water scarcity challenges from the importing to the exporting regions (Aldaya et al., 2010).

Nevertheless, this concept thrives very well in countries that have sizeable foreign reserves and booming economic indicators, such as Saudi Arabia. It is often recommended that the net import of virtual water in a water-scarce nation like Saudi Arabia can relieve the pressure on a nation's own water resources (Gutub et al., 2013). However, the policy in virtual water trade should always consider the water scarcity-induced implications of food imports. Furthermore, the global political will to foster mutual trade benefits and sustainable resource management are prerequisites for successful implementation of the virtual water trade and policy.

## Conclusion

It goes without saying that, Saudi Arabia's past agriculture policies can no longer be accommodated in the current water scarcity crisis that the country is facing along with the rest of the Arab region and the rest of the world. Scaling up virtual water as a hallmark of their water resource management does not only require its economic muscle to buy fields and produce food abroad. It calls for broader world trade regulations and advancement in virtual water scientific research. The climate change dent on both surface and underground water resources is enormous globally and cannot be ignored. The impact keeps growing and poses a huge threat to water as a public good, food security, and the very existence of the human species. Faced with this global water scarcity dilemma, could virtual water be the panacea for all those problems?

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