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Trade Liberalization and the Olive Oil Sector: The Case of Virtual Water

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Abstract

This working paper examines the Tunisian agrarian domain with a focus on the intensive irrigation entailed by the production of olives and olive oil to analyze the challenges of a potential liberalization of agriculture under the Tunisia-EU Deep and Comprehensive Free Trade Agreement (DCFTA). It intends to fill a gap in a so far under-researched area concerning the impact of liberalization on olives and olive oil production, not only from the classic economic perspective, but also extending analysis through a political-ecological perspective to include consideration of questions of water resources and water sovereignty. The latter is of particular importance considering that the production of olives and olive oil can be a water intensive process. With further liberalization on the horizon, the government's strategy and policies include increasing irrigation in the olive and olive oil sector. The intensity of water usage depends on the type of olive plantation and particular irrigation method employed, the three most prevalent methods include: hyper-intensive, intensive and dry. Two of the irrigation methods – intensive and hyper-intensive – require at least two thousand liters of virtual water per one kilogram of olive oil- and are not sustainable for an arid country like Tunisia. Since its independence, Tunisian agrarian policy has been an agri-export model that does not take into account water resources. This model has reached its limits since Tunisia is at the threshold of hydraulic stress.

Tunisian water is both subsidized and scarce, allowing it to be under-valued as a vital input in terms of pricing for Tunisian olives and olive oil. This research paper discusses the likely impact of further liberalization on the Tunisian olive industry, assessing whether or not the economic benefits derived from the trade of Tunisian olive oil in the European market override the water resource-losses associated with irrigated intensive olives and olive oil production. We discovered that the huge amount of water required for Tunisia's olive industry hinders the country's scarce hydraulic resources and drains its budget since it subsidizes its water and obliges it to bear an export opportunity cost of more than 45 Million TND. This same export opportunity cost is shared by other water intensive exported agrarian products including tomatoes, melon, etc. A potential liberalization of the Tunisian agriculture sector would further limit the government's authority and ability to accurately assess and govern its virtual water patterns and footprints in the shadow of intra-sector competition over an already scarce volume of water. We therefore conclude that such liberalization would be a threat to Tunisia's local water sovereignty.

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Key words:
Agriculture liberalization, virtual water, water sovereignty, free trade, DCFTA
water footprint

Abreviations :

DCFTA: Deep and Comprehensive Free Trade Agreement
EU: European Union
CRDA: Regional Commissariat of Agrarian development.
ONH: National Office of Olive Oili
COI: International Council of Olive

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Introduction

Leonardo Da Vinci once said "water is the driving force of all nature." Indeed, water is the one natural resource guaranteeing the continuum of life. Water is everywhere around us, in our taps, oceans, lakes, food and even our smart gadgets. Water represents 71 percent of the Earth's surface, divided into the 97 percent salty water of oceans and 3 percent fresh water that is either frozen in ice caps and glaciers or running in rivers and lakes. Only the water running in fresh water rivers and lakes is useable but unfortunately available in much smaller supply than that found in frozen waters. Fresh water has been there for billions of years and it has been regenerating through the cycle of water, which is aligned with the cycle of life, as no water means no life and more water will mean more prosperity. Contrary to popular opinion, the water on Earth is finite and its volume has remained constant throughout time. However, the hydraulic reserves on Earth are constantly renewed through the water cycle. According to the Virtual Water project, we have consumed or are at the verge of using around 50 to 60 percent of our fresh water with 70 percent going to agriculture, 22 percent to industry and around 8 percent to private consumption. As with other of Earth's natural resources, there is an asymmetric repartition of water across the globe, as some countries are rich in water while others are water poor.

Though it is increasingly privatized and traded in many parts of the world, water should not be considered a commodity as it is a cornerstone of life and cannot (as of yet) be directly traded in big quantities from one territory to another. In the example of Tunisia, a North African country possessing scarce reserves of hydraulic resources, its water needs cannot be fulfilled by importing water from areas such as the great lakes of North America. Yet, water does have the ability to cross borders indirectly in the form of virtual water exchanges through the trade of goods and services. In other words, virtual water is defined as water that has been used and/or polluted somewhere in the production cycle (Allan 1996). For example, it is estimated that 18,900 liters of virtual water are needed to produce one kilogram of coffee, and 1,220 liters are needed to produce one single cotton shirt (National Geography, 2017). Of course the cotton shirt does not contain 1,220 liters of water, but that is the volume consumed in the different production steps of the production cycle of that shirt. Each day, the average person consumes around 3,496 liters of water, 92 percent of which is hidden in the food they eat.

The virtual water notion is relatively new and not very well elaborated in the academic literature due to its complexity. The expression "virtual water" first emerged in the water assets writings in the mid-1990s by Professor Tony Allan of the University of London (Allan, 1996). Allan picked the term to depict the water used in the production of crops exchanged on international markets. This metaphor was introduced in order to bring to the attention of policy makers the importance of taking into consideration hydraulic resources when assessing trade deals. Later on, in the late 1990s and early 2000s, interest in the virtual water metaphor increased substantially as demonstrated by increased references in the academic literature (Allan, 1996, 1999, 2003, Bouwer 2000) as well as in the topics considered at trade conferences, such as the World Water Forum.

Water-stressed countries virtually import large "volumes" of water in the form of the water required to produce the grains, and other food and non-food related products they import from abroad. Today, it is impossible to talk about a trade deal concerning certain goods or services without also discussing the issue of virtual water.

Agriculture is considered the most water intensive sector (Virtual Water Project, 2017). Thus, engaging in trade agreements or liberalizations in the field of agriculture will inevitably also entail the virtual trade of water whose patterns and quantities will depend on the patterns and quantities of the original trade of agrarian products. This working paper explores the linkage between virtual water and agriculture liberalization in the Tunisian context, taking the case study of intensively irrigated olive farms.

According to the Economic Complexity Index (ECI), Tunisia has the 72nd largest export economy in the world and the 77th most complex economy - in terms of the diversity and complexity of its export basket. In 2015, Tunisia exported $15.7 billion and imported $21.1 billion, resulting in a negative trade balance of $5.35 billion. In 2015, the Gross Domestic Product (GDP) of Tunisia was $43 billion and its GDP per capita was $11.5 thousand. Its top exported agrarian product is pure olive oil with total revenues reaching $942 million in 2015 (The Observatory of Economic Complexity, 2016).

From the early 1970s, government policy enabled increased integration into the global economy through trade. Tunisia's main trading partner is the European Union with which it had signed an Association Agreement in 1995. The agreement aimed to liberalize Tunisia's industrial sector and some agrarian products through the adoption of specific protocols to facilitate agrarian trade via customs exemptions, tariff quotas, export periods and customs reductions.

The Tunisian-European trade bonds were further tightened by the signing of the EU-Tunisia Privileged Partnership on November 9th, 2012, which initiated talks concerning the establishment of a deep and comprehensive free trade agreement between Tunisia and the European Union. The agreement is designed to cover all sectors of the economy, from industry to services and agriculture. The pace of these negotiations was later accelerated, with the October 2015 launch of a new round of talks between Tunisia and the EU, aiming to agree on a framework for further economic integration in the form of a Deep and Comprehensive Free Trade Area (DCFTA) (Eurpean Union, 2016). This agreement was designed to bypass the highly contentious (especially from the perspective of Global North states) World Trade Organization's Doha round of talks, with agriculture now included in the Tunisia-EU DCFTA (Eurpean Union, 2016).

The analysis concerning the DCFTA has been divided. Some researchers have perceived the agreement as providing a potential opportunity for economic prosperity and development, guaranteeing new markets and customers for Tunisian producers and farmers. Others have argued that it is only a new form of colonialism masked by promises of economic development that are likely to produce greater dependency and inequality. (Akesbi, et al., 2015). Both perspectives are based on the assumption that the liberalization of especially big agrarian domains such as olive oil, representing a sizable chunk of the Tunisian balance of trade, will have an important impact on the Tunisian economy. This impact can either be positive, through improving the development and access of Tunisian olive growers to European markets, or negative, through depleting Tunisian natural resources, thereby undermining the country's socio-economic stability and sovereignty.

In studying the topic of the Tunisia-EU DCFTA, this paper explores the meaning and reverberations of the liberalization of olives and olive oil domain between Tunisia and the European Union with a focus on irrigated farms from a virtual water perspective. It focuses specifically on the impact of liberalization on the Tunisian economy and, most importantly, on its hydraulic resources as Tunisia is known to be an arid country possessing limited hydraulic resources that are estimated to be around 4,840 million m3 divided between 2,700 million m3 in surface water and 2,140 million m3 in ground water (Fethi, 2012). The scarcity of water at the national level also has ramifications at the individual level, with the available water per habitant computed to be only 450 m3 in 2011, whereas the minimum threshold delineated by the United Nations is 1,000 m3 per habitant per year according to the National Water Distribution Utility (Fethi, 2012).

Moreover, this working paper intends to bring another dimension to the discussions of virtual water. Indeed, the virtual water metaphor has helped highlight the important role of international trade in national efforts to maintain food security, particularly in water-short countries. In studying this topic, most researchers aim to link to it to either trade policy making or food security (Cornich & Fernandez, 2005). This working paper intends to bring another political-economy dimension to the discussions of virtual water by introducing the term water sovereignty (Eljuri, 2008) that we define as the ability of the state to quantify its virtual water exchanges and to have sole control over the flow of its water resources. The main focus of this working paper is to study virtual water and water sovereignty within the framework of the Tunisian irrigated olive oil industry. The choice of olive oil industry came from the fact that, according to the Tunisian Ministry of Agriculture, Fisheries and Hydraulic Resources, olive oil is the main agrarian product exported by Tunisia. This means that, if liberalized, the olive oil industry would have the biggest impact in terms of economic revenues and hydraulic resources usage. Moreover, the choice to focus on intensively irrigated olive farms is linked to the industry's high use of water and the encouragement of Tunisian official authorities of this kind of irrigation method as it guarantees higher yields. Following the talks around the establishement of the DCFTA between Tunisia and EU, this paper addresses the following research question: what are the key political-economic and ecological challenges that would arise from deepening the liberalization of the olive oil industry under the Tunisia –EU DCFTA?

I. Methods and Methodology:

1. Subject

Olive oil was chosen as the subject of the study due to the importance placed on the industry in the government's strategic planning. The olive production is allocated some of the most fertile land. Olive trees extend over the entire agricultural land and currently occupy 1.8 million hectares, representing nearly 79 percent of the total tree area and 34 percent of the arable land. Tunisia is in fact ranked first in the world in terms of the share of arable land devoted to olive trees, with a 1/3 tree to arable land ratio . The olive sector is also very important in the Tunisian socio-economic landscape as it provides between 30 to 40 million working days a year (National Office of Oil, 2016) and plays a leading role in regional development and social equilibrium. The sector is a main source of income and therefore of social stability in rural areas.

Tunisia follows different irrigation methods to maintain its olive farms depending on their varieties, geographic locations and tree density. These farming methods can either be:

- **Irrigated:** the method that requires water and can be broken down into two types of irrigation systems:
- **Intensive:** in this system of irrigation, 1,000 to 1,200 olive trees per hectare are planted and are intensively irrigated in the order of 2,000 to 3,500 m3 per hectare.
- **Hyper-intensive:** in this method of irrigation, 1,200 to 1,600 olive trees per hectare are planted and are intensively irrigated in the order of 4,000 to 6,000 m3 per hectare.
- **Dry:** the method that does not necessarily require irrigation as it relies directly on rainwater but it can be supplemented by additional 1,000 m3 for reasons related to limited rainfall.

The choice to focus on intensively irrigated olives and olive oil was made on the basis that this farming method makes an important contribution to the general olive production and export quantity. Despite representing only 4 per cent of the total olive farms, it contributes to more than 20 percent of the total production on average. The focus on irrigated olives and olive oil as a whole without a concrete precision of either irrigation methods (e.g. intensive or hyper-intensive) was also made for reasons related to data availability at a Ministerial level. The current information about the production and size are only available for the irrigated production as a whole and are not detailed enough to precise each method's yields The Tunisian government follows a strategy of increasing olive oil production by incentivizing intensively irrigated olive production through intensive and hyper-intensive farming methods as they provide higher yields and therefore increase production and exports. This case study analyzes the implications of this strategy from the under-researched perspective of water resources and its centrality to understanding the question of virtual water.

2. Case study : Zitouna I Agriculture Development Corporation:

The Zitouna I Agriculture Development Corporation located in the area of Sminja, delegation of Bir Mcherga, Zaghouan was chosen as the case study by virtue of it being a totally exporting firm. This Bir Mcherga delegation encompasses 7,090 hectares of olive trees and represents 13 percent of the surface of the governorate covering 2,053,814 olive trees and representing 30 percent of the total olive trees area of the governorate of Zaghouan. The company Zitouna I covers 765 hectares, of which 520 hectares are planted with olive trees with a density of 800,000 tree. There are two types of planting density:

- 1,250 tree per hectares for the Koroneiki variety, covering 84 hectares.
- 1,666 tree per hectares for the Arbakina and Arbosana varieties, covering an area of 436 hectares.

Zitouna I Agriculture Development Corporation:

Figure: Agricultural Development Corporation Zitouna I

The company uses a continuous extraction system with two-phase centrifugation (oils and pomace). This technological process works with a decanter of the "Leopard" type, which does not require an additional use of water for the separation of the oily and solid portions containing the pomace and the waste?.

Thus the qualitative and organoleptic characteristics of the oil produced with this decanter are of good quality.

Almost all the quantities of oil produced are exported either directly to America or sold to fully exporting companies with a sale price of € 4.2 per kg. In the 2016/2017 season, the the corporation's production was estimated at 3,560 tons of olive and 560 tons of olive oil.

3. Data Collection Method:

To answer our question, qualitative and quantitative methods were used. The qualitative method was conducted in order to assess the Tunisian olive oil sector in terms of local production and international market share. Qualitative methods, including structured and semi-structured interviews with relevant parties and stakeholders and document analysis, were employed to study the Tunisian government's production and export policies in this sector. They were also used to investigate the process of the DCFTA negotiations so far.

Most of the interviews were conducted with officials from the Ministry of Agriculture working under the Tunisia DCFTA Agriculture negotiations committee, General Direction of Agricultural Production, National Observatory of Agriculture (ONAgri), Tunisian Office of Oil (ONH), Export Facilitation Office for Agricultural Products and Regional Commissariat of Agrarian Development in Zaghouan (CRDA Zaghouan). Interviews were also conducted with a number of Tunisian olive and olive oil producers engaged in trade with the EU along with officials from Zitouna I Agricultural Development Corporation in Zaghouan.

In addition to the qualitative methods, a quantitative method was conducted in order to quantify the Tunisia olive and olive oil sector in terms of production and trade. It was also useful to quantify and track the quantities of water needed to produce intensively irrigated olive oil through the case study of Zitouna I Agricultural Development Corporation. For the purpose of this method, secondary data quantifying olive and olive oil production, trade and world market share were collected directly from the Ministry of Agriculture, Fisheries and Hydraulic Resources and the National Office of Trade along with information related to the state of olives

and olive oil domain in the governorate of Zaghouan from the Regional Commissariat of Agrarian Development in Zaghouan (CRDA Zaghouan). Primary data were also collected directly from Zitouna I Agricultural Development Corporation quantifying the water usage and prices related to the production cycle of olive oil.

4. Calculus:

a- Water footprint:

To compute the water footprint of irrigated olive oil production in the case study of Zitouna I Agriculture Development Corporation, the quantities of water used in the different stages of production were tracked as follows:

The production of olive oil was 560 tons in 2016/2017 for an area of 520 hectares: for 1 hectare, 1076 kilograms of olive oil are produced.

Irrigation: The quantity of water deployed in the irrigation process is 2,500 m3 per hectare. The cost of irrigation water is calculated by adding together the pumping cost and the amount paid to the Commissariat of Agrarian Development (CRDA) which It is fixed at TND 0.110 per m3.

1-hectare → 1,076 Kg of olive oil.

So, 1,076 Kg → 2,500 m3 this means that 1 Kg of olive oil will need 2,323 liters of water in the irrigation process.

Cleaning: The extraction of olive oil is made without adding water. Yet, the cleaning process of olives consumes 2,000 liters of water per 4 hours meaning that per hour, 500 liters of water are needed. And each hour, 4 tons of olive oil is obtained, thus 1 ton of olive oil consumes 125 liters of water. On the other hand, 3,560 tons of olive produce 560 tons of olive oil so 1 ton of olive produces 0.157 tons (or 157 Kg) of olive oil. A simple algebra calculation will allow us to conclude that 157 Kg of olive oil consumes 125 liters of water that means that 1 Kg of olive oil consumes around 0.79 liters of water. For simplification reasons, we will consider that 1 Kg of olive oil will need 1 liter of water in the cleaning process.

Foliar treatment: The company uses five basic treatments in different phases of the crop: in winter, before flowering, at the time of setting, insecticide against the potash olive fly to improve the quality of the fruit and three other secondary treatments depending on the conditions.

Each passage consumes 800 liters of water per hectare. So we will have eight passages that each uses 800 liters per hectare, we can conclude that the foliar treatment uses up to 6,400 liters per hectare. That is to say that 6,400 liters of water are deployed per 1,076 Kg of olive oil. Therefore, 1 Kg of olive oil will consume 5.91 liters of water that we will round to 6 liters per kilogram of olive oil.

Chemical weed control: Two passages of 400 liters of water per hectare are used in the chemical weed control process. Therefore, we will have: 800 liters per hectare, thus 800 liters per 1,076 Kg of olive oil, which means 0.91 liter per kilogram. We will around this number to 1 liter of water per 1 Kg of olive oil.

Total amount of water: The total quantity used for 1 kg of olive oil can be summarized as follows:

Stages of Production	Water Usage (Liter/Kg)
Irrigation	2,323
Cleaning	1
Foliar Treatment	6
Chemical Weed Control	1
TOTAL	2,331

b- Export opportunity cost:

The export opportunity cost was calculated to depict the trade-off Tunisia is facing in subsidizing the water that was virtually needed for its irrigated intensive olive oil exports.

Export opportunity cost = Costs of water subsidies * Quantity of virtual water contained in irrigated intensive olive oil exports

With: Costs of water subsidies = real water price - water selling price.

Quantity of virtual water contained in irrigated intensive olive oil exports = quantity of virtual water associated with olive oil production * total quantity of exported olive oil. For the Tunisian case, this number can be estimated following one of the sequent hypotheses:

• Hypothesis 1: the totality of the intensively irrigated olive oil production is exported.

• Hypothesis 2: the proportion of intensively irrigated olive oil exports is equal to their production proportion. This proportion was 40 percent in the 2016-217 season.

It should be noted that both hypotheses give very close results but for reality approximation, hypothesis 2 was chosen.

For the purpose of illustrating the export opportunity cost, we will consider the season of 2016 where the total production was 140,000 tons of which 115,000 tons were exported (Observatoire National de l'Agriculture, 2017). If we take the quantity of irrigated intensive olive oil exported which is estimated by Hypothesis 2 to be around 40 percent of the total 2016's quantity exported, it would come to 46,000 tons. The relative Export Opportunity cost bared by the Tunisian government can be calculated as follows: 0.420 TNDm-3 * 2.331 m3Kg-1 * 46,000,000 Kg, which equals 45,034,920 TND.

II. Results and discussion:

1. virtual water and the question of water sovereignty:

a- Overview:

Water is not only the liquid coming out of a tap and rain or running in oceans and lakes, it is everywhere, in the cereals we eat in the morning, the oil we use to cook and even the computers we use every day to work. Discussed in this research paper as "virtual water," it has been defined as the water used and/or polluted in the production cycle of a good or service. To track the liters of water consumed, we will need to produce what experts call a water footprint, which is defined according to the Water Footprint organization as a measure of humanity's appropriation of fresh water in volumes of water consumed and/or polluted (Water Footprint Network, 2017). In other words, it is the means through which one can calculate the amounts of virtual water of a certain good or a service.

> "A water sovereign state is one which has autonomy over its water resources, meaning that it must be able to broadly quantify the water footprint of all its exchanged goods and services as well as to determine the exact patterns of its virtual water associated with the production and trade of its goods and services."

Depicting all the patterns of virtual water is not as easy as it might seem since it requires measuring the amounts of water needed both directly and indirectly in the production and consumption of a particular good or service, which is both costly and time-consuming. Despite these difficulties, these assessments are vital from the perspective of water sovereignty. A concept that is only starting to make its way into the academic literature, water sovereignty is nevertheless indirectly addressed when tackling policies related to water autonomy and control over hydraulic resources. For the purpose of this study, we have defined water sovereignty as the ability of the state to quantify its virtual water exchanges and to have the sole control over the flow of its water resources.Water sovereignty implies that a water sovereign state is one which has autonomy over its water resources, meaning that it must be able to broadly quantify the water footprint of all its exchanged goods and services as well as to determine the exact patterns of its virtual water associated with the production and trade of its goods and services.

b- Agriculture liberalization and water sovereignty:

Given its water intensive nature, agriculture is consequently considered the main source of virtual water movements. Therefore, if a country A exports olive oil to a country B, country A is said to be an exporter of olive oil and the virtual water associated with its production, while country B is a virtual water importer. The same relationship also characterizes all of the exchanges of goods and services that require water in their production process. To estimate the trade of virtual water from a macro-economic perspective, we need to estimate the water usage of goods and services traded then multiply it by their trade size.

The relationship between trade and virtual water exchange means that when the quantity in trade of water-intensive products increases, the size of virtual water exchange will also increase. Moreover, and since most countries are locked into capitalist models of economic development, they tend to seek to enlarge their trade shares as according to the fifth Mankiw principle of economy: "Trade makes everyone better off" (Mankiw, 1997). With the focus on macroeconomic indicators in calculations, the costs associated with virtual resources deployed in the production cycle of the traded goods or services are often overlooked.

As we have indicated in the first part of this chapter, tracking virtual water patterns can be a nearly impossible mission. It is near impossible for one country to be able to track down all of its water footprints. This is why the notion of water sovereignty is helpful, as it allows us to understand the role of trade and free trade agreements further complicating the water footprint calculations and to countries losing control over water resource flows.Trade deals reduce the state's ability to track patterns of virtual water exchanges, which may eventually threaten the water sovereignty of countries.

"Trade deals reduce the state's ability to track patterns of virtual water exchanges, which may eventually threaten the water sovereignty of countries."

Consider the example of Tunisia, which subsidies its water and charges its farmers from TND 0.005 to TND 0.150 for one single cubic meter of water (Tunisian Ministry of Agriculture, Hydraulic Resources and Fisheries) – which is around $0.002 to $0.062 per cubic meter. From the perspective of a regular farmer, the very low prices of water can seem like a good opportunity. By decreasing production costs associated with agrarian goods, farmers are able to export more of their products and gain more in terms of profits and market share. However, upon closer inspection, and by taking into account the fact that Tunisia is actually an arid country – meaning that it has scarce hydraulic resources – it becomes clear that the use of virtual water entailed by the export of a farmer's agrarian product means that Tunisia will not only loose its scarce hydraulic resources but also its control over the patterns of its virtual water exports. This problem is particularly urgent when considering that the Tunisian government is currently unable to track down the water footprint of its agrarian products, and thus its water sovereignty is currently at risk

2. Tunisian olives and olive oil sector: Production and Trade.

a- Tunisian olive oil production:

Tunisia is a leader in the olive and olive oil market with olive farms spreading across a large part of the territory. Moreover, according to the Tunisian National Office of Olive Oil, Tunisia is the second world producer of olive oil after the European Union in the seasons between 2011/12 to 2015/16 with an average production ranging between 70,000 tons and 340,00 tons (National Office of Oil, 2016).

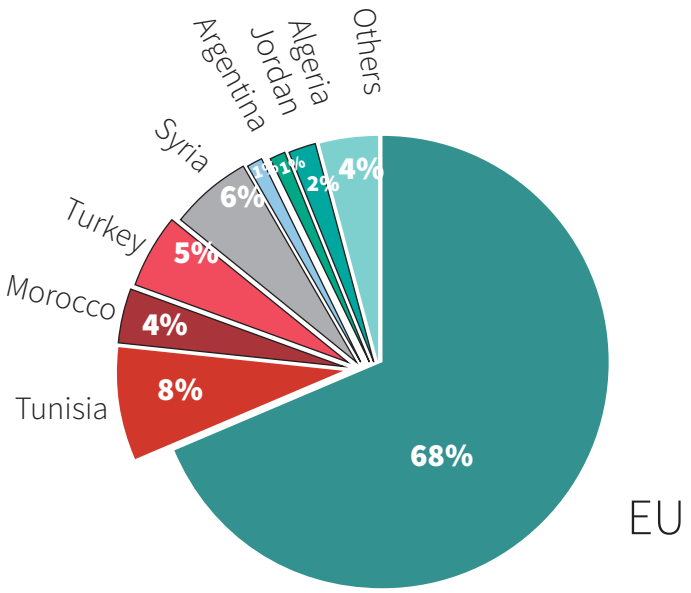


Figure: Breakdown of the world production of olive oil (2011/12-2015/16)

Source: ONH

To obtain olive oil, Tunisia often relies on local oil mills spread in all of its 24 governorates. In addition to the oil mills, the industrial sector also includes:

- 10 units for extracting olive-pomace oil with a capacity greater than the quantities actually processed.
- 15 refining units whose main activity is seed oil due to the low demand of the Tunisian consumer for refined olive oil.
- 40 packing units with a total capacity of more than 165 000 tons / year for any combination of vegetable oil (vegetable oil and olive oil), of which about ten units are specialized only in olive oil.

Because Tunisia is an important producer of olive oil, it has been perpetually working on improving its storage and it currently maintains a storage capacity of 365,000 tons of olive oil, of which 150,000 is held by the National Office of Oil. The rest is held by private oil companies, which have achieved a considerable increase in the storage capacity recorded in recent years through the creation of additional storage units in the existing oil mills and installation of new oil mills with new storage units or the installation of new storage units only.

According to the Ministry of Agriculture, Hydraulic Resources and Fisheries, the intensive irrigation method contributed to 40 per cent of the total production in the 2016-2017 season. These numbers are reflective of the Tunisian governmental strategy of encouraging production through intensive irrigation methods as they drastically provide higher yields despite being high-consumers of water. In interviews with the Ministry of Agriculture, Hydraulic Resources and Fisheries and the Regional Commissariat of Agrarian Development in Zaghouan (CRDA Zaghouan) concerning the relationship between the water deployed in the production process and the sector of olives and olive oil, officials confirmed that production and hydraulic resources are seen as two different and separate divisions, where there is very little synergy. This explains why the unit working on production does not give much attention to the question of virtual water as it mainly focuses on upgrading the harvest and quantities produced. There is blind spot concerning the proven unsustainability of intensive irrigation methods, including their impact on further exacerbating the country's hydraulic stress and on complicating calculations of Tunisia's water footprint.

"There is blind spot concerning the proven unsustainability of intensive irrigation methods, including their impact on further exacerbating the country's hydraulic stress."

b-Tunisian olive oil trade:

-Trade Facts:

Tunisia is now a major player in the world market for olive oil, exporting around 75 per cent of its production and becoming the second largest exporter after the European Union, with an average of 157,000 tons per year during the last five years. Tunisia mainly exports its olive oil in bulk.

Olive oil comprises the highest share of the country's agricultural exports, accounting for up to 40 per cent. Tunisian olive oil also contributes to up to 19 per cent of all international trade in olive oil placing Tunisia second following the European Union. However, a closer look at the 2011-2016 marketing period reveals a more complex picture. Tunisian olive oil exports have actually varied widely, from very low levels (70,000 tons) in 2013/14 to very high levels (312,000 tons) in 2014-2015.

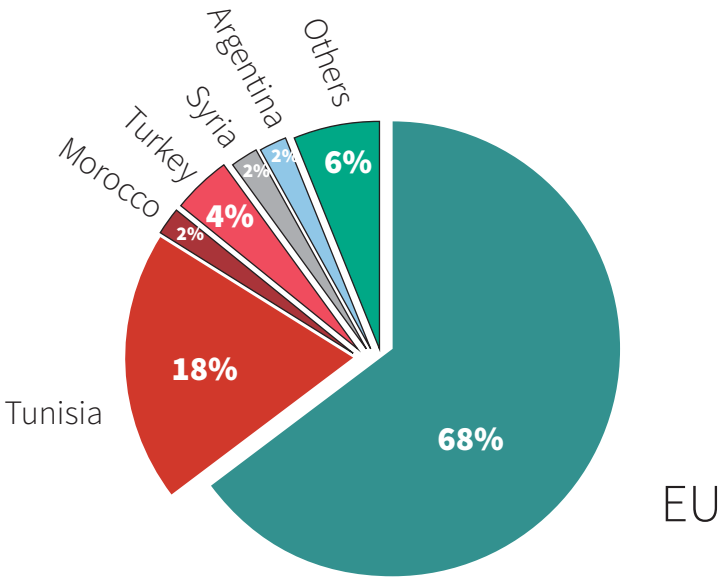


Figure: Breakdown of world exports of olive oil between 2011/12-2015/16

Source: COI

The primary markets for Tunisian olive oil include the European Union, the United States of America, Canada, Australia, China, Japan, and the Gulf countries. In addition, Tunisian olive oil is continually reaching new destinations, thanks to its good quality. It is now sold in 57 new markets in the Middle East, Asia, Africa, Australia and South America.

With the aim of promoting olive oil exports, the Tunisian government has developed several initiatives and measures to support olive growers and olive oil exporters. For example, there are incentive funds available to Tunisian olive oil exporters and several institutions that provide the necessary support for investors in the olive oil sector in terms of production and accessing foreign markets. These include the following institutions: The Ministry of Agriculture, the Ministry of Industry and Technology, the Ministry of Commerce and Handicraft, the Technical Center for Organic Agriculture (CTAB), the Agency for the Promotion of Agricultural Investments, the Center for the Promotion of Exports (CEPEX). It also includes the provision of export support through bodies such as the Export Market Access Fund (FAMEX), which is a project of the Ministry of Commerce, financed by the World Bank, aiming to promote exports of packaged olive oil to promising markets and managed by CEPEX and the Export Promotion Fund (FOPRODEX), which is a financial support mechanism set up by the Tunisian government and managed by CEPEX with the aim of enabling exporters to enter the international market.

-Olive oil trade with the European Union:

As the purpose of this working paper is to focus on the trade relations between Tunisia and the European Union, this section focuses on the Tunisian exports of olive oil to European Union markets.

Trade relations between Tunisia and the European Union date back to 1976 and were made official on July 1995 by the establishment of the Association Agreement. This Agreement established a free trade area under which all two-way trade in industrial products is exempt of any trade tariffs. In regards to agricultural, agro-food and fisheries products, the EU and Tunisia agreed to a progressive opening of their respective markets for selected products (European Commission, 2016).

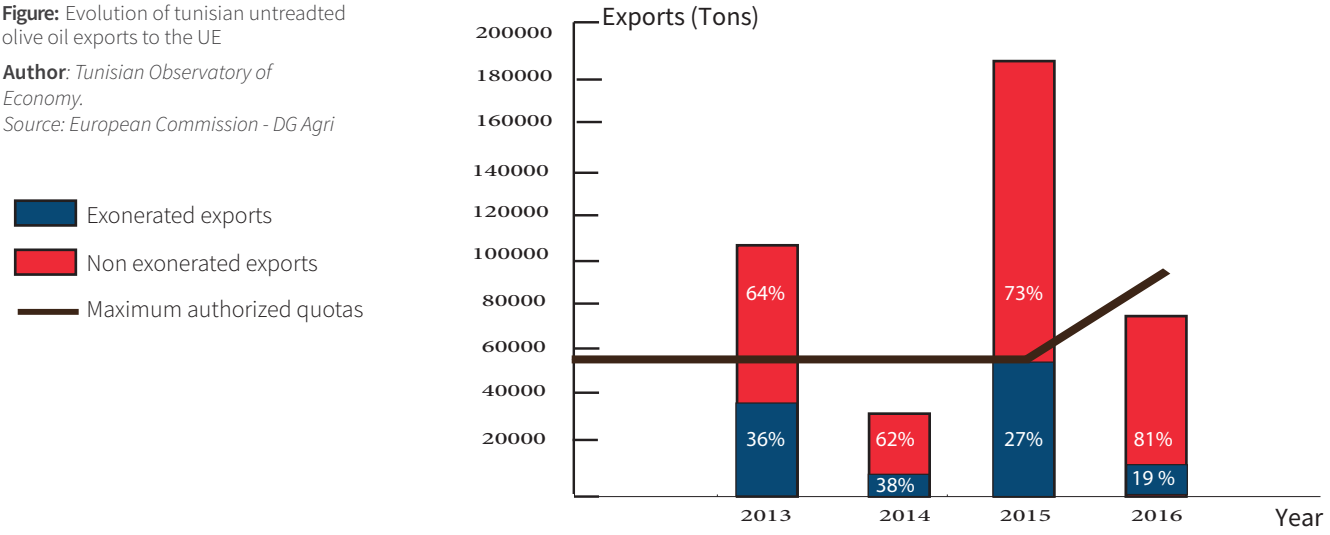
In the aftermath of the 2011 Tunisian uprising, the European Union focused on closer economic relations with Tunisia through enhanced economic and trade integration and a Mobility Partnership. This EU political response to 2011 uprising was a strategy to maintain its status quo as first Tunisia's trading partners, a result of colonial legacies and post-colonial development strategies. The Tunisian authorities made the political choice to strengthen the country's relations and integration with the European Union in counterpart of financial aid, resulting in the 2012 'Privileged Partnership' and an expansive EU Neighborhood Policy Action Plan.

As indicated above, the European Union market is the first destination for Tunisian olive oil exports, mainly olive oil exports in bulk to Italy and Spain. These exports are governed by the regulation number 1918/2006 of December 20, 2006 under the order number 09.4032. This regulation follows the tariff contingents system that provides trade tariff relief on an agreed upon quantity of certain exported products. The regulation limited the maximum annual tariff-free contingents to 1,000 tons for each January and February, 4,000 tons for March, 8,000 tons for April and 10,000 tons for each month between May and October – as long as the sum of the exonerated olive oil exports does not exceed 57,600 tons per year. In addition, and following the 2015 terrorist attacks, the EU continued its support to its privileged partner by offering it additional olive oil trade quotas under the regulation 2016/605 allowing Tunisia to have access to an additional tariff-free quota of 35,000 tons in case of depletion of the annual 56,700 tons quota. Following this regulation, the original exonerated quota of 56,700 tons was calculated on annual rather than monthly-quota basis. The additional quota was not welcomed by the Italian olive growers as it has been perceived as a direct threat to them especially as Tunisian olive oil prices are way below those of Italy.

If we take a closer look at the whole contingents system offered by the European Union and following the numbers published on the official website of the European Commission (European Commission, 2017) we see that it was more political posturing than economic policy. According to the Tunisian Observatory of Economy (TOE), the European Union's claimed support for Tunisian olive oil exports was not actually materialized on the ground (Ben Rouine, 2017). Take the example of 2013 olive exports. During this year only 36 percent of Tunisian olive oil exports to the EU were actually exempted from customs duties even though these exports met the contingents quotas. Similarly, in 2014, 2015 and 2016, only 38 percent, 27 percent and 19 percent of the exports respectively were in reality tax-free.

Figure: Evolution of tunisian untreadted olive oil exports to the UE

Author: *Tunisian Observatory of Economy.*
Source: European Commission - DG Agri



3.Case study: Olive and olive oil liberalization from a water sovereignty perspective:

In this section we discuss the case study that was conducted based on Zitouna I Agricultural Development Corporation, a totally exporting corporation in Zaghouan. In particular, we assess the quantity of virtual water deployed in the production of intensively irrigated olive oil.

a. Initiation: Importance of the olive oil sector in the governorate of Zaghouan

The olive sector is considered one of the most important productive sectors in the region. Olive groves in the governorate of Zaghouan represent the main pillar (about 90 %) of the fruit tree sector. Olive trees cover an area of about 54,607 hectares, equivalent to 29 percent of the total arable land in the governorate, a heavy concentration when compared to the 1.7 million hectares, or 3.1 percent of the country as a whole that is covered with olive trees . There are 33 mills in Zaghouan with a total conversion capacity of 2,060 tons per day, as well as 40 canning units. The total production rate of olive oil during the last ten years reached about 40 thousand tons annually and the value of this production was about 35 million dinars. This sector contributes to up to 14 percent of the total value of agricultural production in the region.

The 2016/2017 season's harvest estimated total was 21,800 tons of olive oil (4,360 tons of oil) compared to 45,400 tons during the last season (Ministry of Agricultures, Fisheries and Hydraulic Resources, 2017).

b- Virtual Water Share in the Olive Oil Production:

As revealed by our case study, the quantity of water used in the different stages of the production process of olive oil comes from different sources, including: 2,323 L/Kg from irrigation, 1L from cleaning, 6L/Kg fromKg from foliar treatment and 1 L/Kg from chemical weed control.

According to the case study conducted using data collected from Zitouna I Agrarian Development Corporation, we calculated that an export of 1 Kg of olive oil will lead to a virtual export of around 2,331 liters of water, exacerbating the country's water-stress. Following on from this calculation, we can conclude that signing the DCFTA with the EU will result in the export of greater units of olive oil and thus more units of virtual water.

“An export of 1 Kg of olive oil will lead to a virtual export of around 2,331 liters of water, exacerbating the country's water-stress. Following on from this calculation, we can conclude that signing the DCFTA with the EU will result in the export of greater units of olive oil and thus more units of virtual water.”

From an economic perspective, the total virtual water costs to produce 1 kg of olive oil are 2.331 m3 * TND 0.110 = TND 0.257; close to TND 0.3. Considering that the export price of 1 kg of olive oil is € 4.2, or TND 11.42, one might argue that the TND 0.3 cost of virtual water is negligible by comparison. However, if we consider the fact that Tunisian water is actually subsidized and devaluated, the numbers turn out to be much larger.

To further explain this, let's take the average price per m3 sold to European Union farmers that is estimated to be € 0.5 per m3. With this price, and despite the fact that European water is partially subsidized, the virtual water deployed in the production of EU olive oil will cost € 1.1655 which is around ¼ of the selling price of 1 Kg of olive oil. If the amount of water subsidized by the government at .420 TND per m3 is taken into consideration, it becomes clear that the production of one kilogram of Tunisian olive oil actually costs more than 1,235 TND, which brings it closer in price to the EU olive oil. The conclusion to be deduced from this analysis is that because water is undervalued, the real benefits of farmers are actually overvalued.

To further illustrate the above point, we can calculate the export opportunity cost of liberalizing irrigated intensive olive oil exports for the Tunisian government with the mathematical equation proposed in the Methods and Methodology section:

Export opportunity cost = Costs of water subsidies * Quantity of virtual water contained in irrigated intensive olive oil exports

Inputting estimated 46 M Kg export of intensively irrigated olive oil and a water subsidies cost of 0.420 TND, results in an opportunity cost of 45,043,920 TND. This important calculation shows the Tunisian government is not only subsidizing local farmers' production, but also, indirectly, foreign olive oil consumption.

Irrigation water prices have long been very low and far from the actual costs. Farmers benefited from explicit and implicit subsidies. The explicit subsidies come as a direct reduction of water prices sold to farmers and the implicit ones include costs of investment in water infrastructure, the costs of reduced resources available for future generations, etc.- costs that are solely borne by the state. According to the World Bank (1995), the water prices paid by farmers in 1994 were 0.04 Tunisian dinars per cubic meter (TND / m3). However, production costs range from 0.15 to 0.52 TND / m3 for irrigation water. Even if they were made for social and economic objectives to support production and farmers, the low costs of irrigation water have prompted agronomists to waste water while it is a scarce commodity. An estimated at TND 17.3 million are spent every year on direct water subsidies, according to the Domestic Support report submitted by Tunisia to the World Trade Organization in 2015.

IV. Tunisia-EU Deep and Comprehensive Free Trade Agreement in the agrarian sector:

According to its official definition, the DCFTA is part of the European Neighborhood Policy, a joint project between the European Union and its neighbors to enlarge and consolidate their economic cooperation. In the Tunisian context, the DCFTA came to concretize a major objective of the Privileged Partnership negotiated by Tunisia and the EU in November 2012, an instrument for integrating the Tunisian economy into the internal market of the European Union. Thus, it is not merely a new trade agreement but rather an attempt to more deeply integrate the Tunisian economy into the Euro-Mediterranean economic space.

> "according to interviews conducted with the negotiation committee in the Tunisian Ministry of Agriculture, Hydraulic Resources and Fisheries, it seems the government has no real intention to address the water resource angle in negotiations"

This agreement has two dimensions: the "comprehensive",encompassing all sectors of the Tunisian economy (e.g. liberalization of services, agriculture and fishery products, competition, investment, public procurement, intellectual property, sustainable development, transparency, customs procedures for facilitating trade) and the "deep", requiring institutional transformation, where Tunisian standards and legislation are adapted to approximate those of the EU (Chandoul, 2017).

According to the DCFTA rationale, the Tunisian economy's more complete integration into the European economic space can only be achieved once:

- the commercial, economic and legal environments are progressively harmonized,
- non-tariff barriers are reduced,
- the customs procedures are simplified and facilitated,
- access conditions for products and services to both markets are improved.

The DCFTA aims to integrate the economies of Tunisia and the EU through liberalizing all of their sectors from industry to services and agriculture. In this working paper, we only consider the liberalization of agriculture - a sector that was first blocked in the 2001 WTO Doha Round of talks by the Global North countries, especially the United States and the EU, who refused to reduce their agriculture subsidies. It is important here to highlight that the shift in forums results in limiting agriculture liberalization negotiations to questions of market access only, with a focus on quotas, tariffs and non-tariff barriers, whereas the subsidies side of the negotiations are now absent.

The last updated version of the EU text was posted on April 2016 and comprises general guidelines for the liberalization of agriculture that were included in the first round of negotiations. The list of products to be liberalized and by what specific means is not yet available since the negotiations have yet to be relaunched. The current text comprises guidelines for the next round of negotiations to be held between Tunisia and the European Union.

These guidelines can be summarized in the following points:

- The adoption of an asymmetrical approach to take into account the differences of development between Tunisian and European agriculture;
- The list of sensitive products through the application of the negative list approach, in order to increase the transparency of the liberalization process. Such a list will cover only sensitive, non-liberalized products that require specific treatment;
-The treatment of sensitive products (e.g. tariff quotas);
-The quantities of tariff quotas for sensitive products;
- Dismantling schedules, transition periods for Tunisia, and rate of increase in tariff quotas;
- Adjustment of the entry price regime.

The Tunisian government has not yet presented a version of its own proposal as the negotiation process is currently put on hold due to reluctance concerning employment and the vulnerability of Tunisian agriculture. However, according to interviews conducted with the negotiation committee in the Tunisian Ministry of Agriculture, Hydraulic Resources and Fisheries, it seems the government has no real intention to address the water resource angle in negotiations. This reluctance is most likely linked to the particular, export-led agrarian policy model adhered to by successive Tunisian governments despite being proven unsuitable for the country as it favors production at the expense of sustainability of resources.

Conclusion

Virtual water is defined to be the water used and/or polluted in the production cycle of a good or a service. Because of its complexity, the question of virtual water is under-studied. This paper examined the link between virtual water and the agriculture liberalization process in the context of the DCFTA currently being negotiated between Tunisia and the European Union. The liberalization of Tunisia's agriculture and important agrarian sectors such as that of olives and olive oil might at first glance appear to be good news for Tunisia since it has a competitive advantage, as highlighted by its ranking second in global production and export of these products. However, if we look at it from the perspective of virtual water, control over hydraulic resources and thus water sovereignty, we can conclude that it is not as good as it seems.

According to this paper's calculations, the production of one single kilogram of irrigated olive oil requires 2,331 liters of water deployed throughout its production cycle. Attempts to further integrate the Tunisian and EU economies under the DCFTA will lead to increasing export incentives for the olive oil industry as Tunisia has a comparative advantage in this field. The greater the level of exports, the greater the amount of virtual water used in the production cycle. As this paper has demonstrated, the Tunisian government already subsidizes the irrigated olive oil sector. Expressed in terms of export opportunity costs, more than 45 Million TND a year is spent subsidizing virtual water exported along with the olive oil exports.

Based on the above analysis, we recommend an urgent revision of the current Tunisian water subsidy system and the development of more suitable policy that balances the socio-economic benefits such as job creation, net profits, etc. with the ecological risks associated with the over-usage of water. Moreover, as we have shown, since irrigated olive oil contains higher quantities of virtual water, it is perhaps not a wise policy to subsidize all olive oil exportations. Instead, a balance should be struck between productivity in terms of water intensity and water supply /water scarcity in developing a policy that subsidizes more or only olive oil coming from dry regions.

Taking the above analysis seriously would require a new government strategy to better manage and coordinate the demand for water by the different users and according to different needs (drinking water, irrigation water, etc.). This is especially the case considering that Tunisia is classified as a water scarce country, where there is a strong pressure on water resources and where the scarcity of water resources may pose a serious constraint to economic development. It is therefore clear that sustainable management of this resource should be based on an integrated approach while taking into account the costs of the resource by demand. Finally, policy makers must seriously consider the tradeoffs related to scarce water resources in further negotiations of the Tunisia-EU DCFTA. One possible solution is to consider upgrading the methods of olive oil trade and shifting from unprocessed, bulk exports to a new method that invests in value-added processes before engaging in free trade with the EU.

It is to be noted that this study could be further improved if the water footprint calculations of all types of olive farms and other agrarian fields were available.

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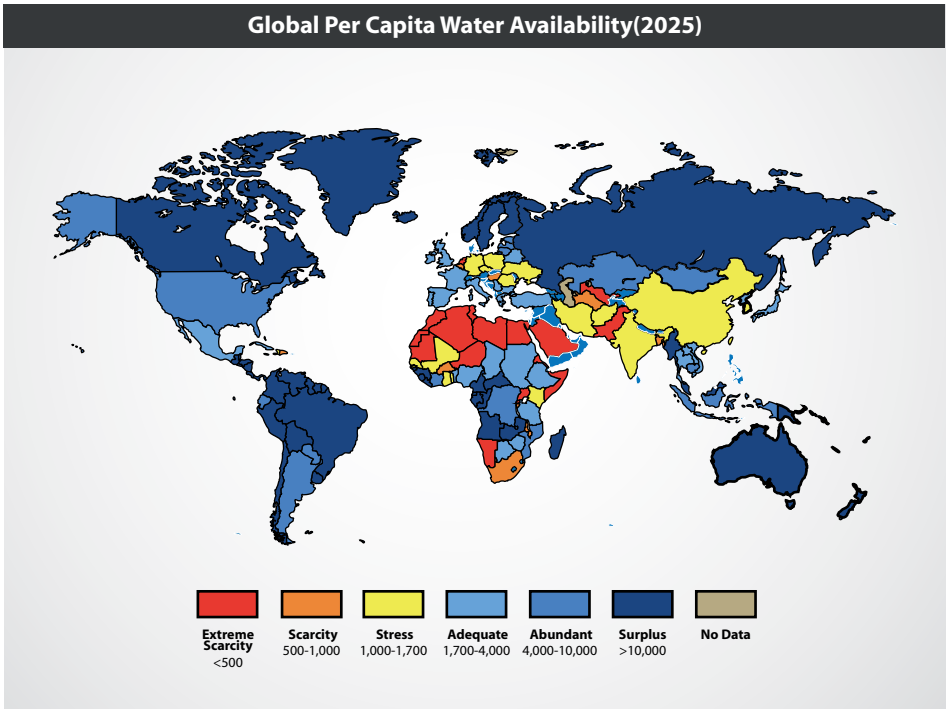
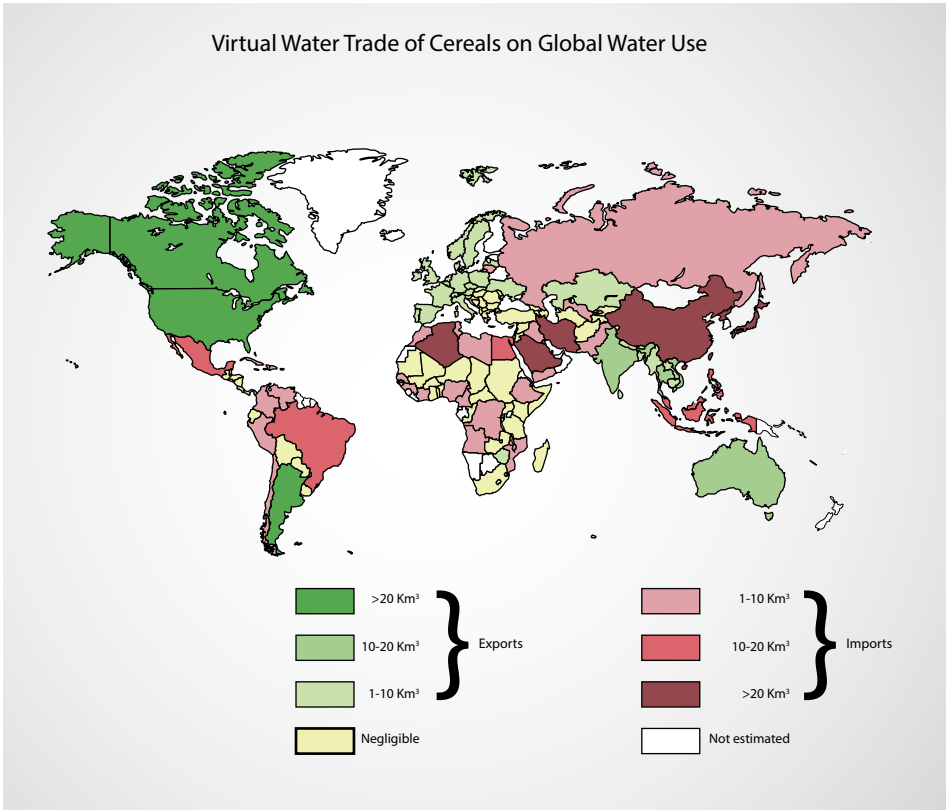
Appendices

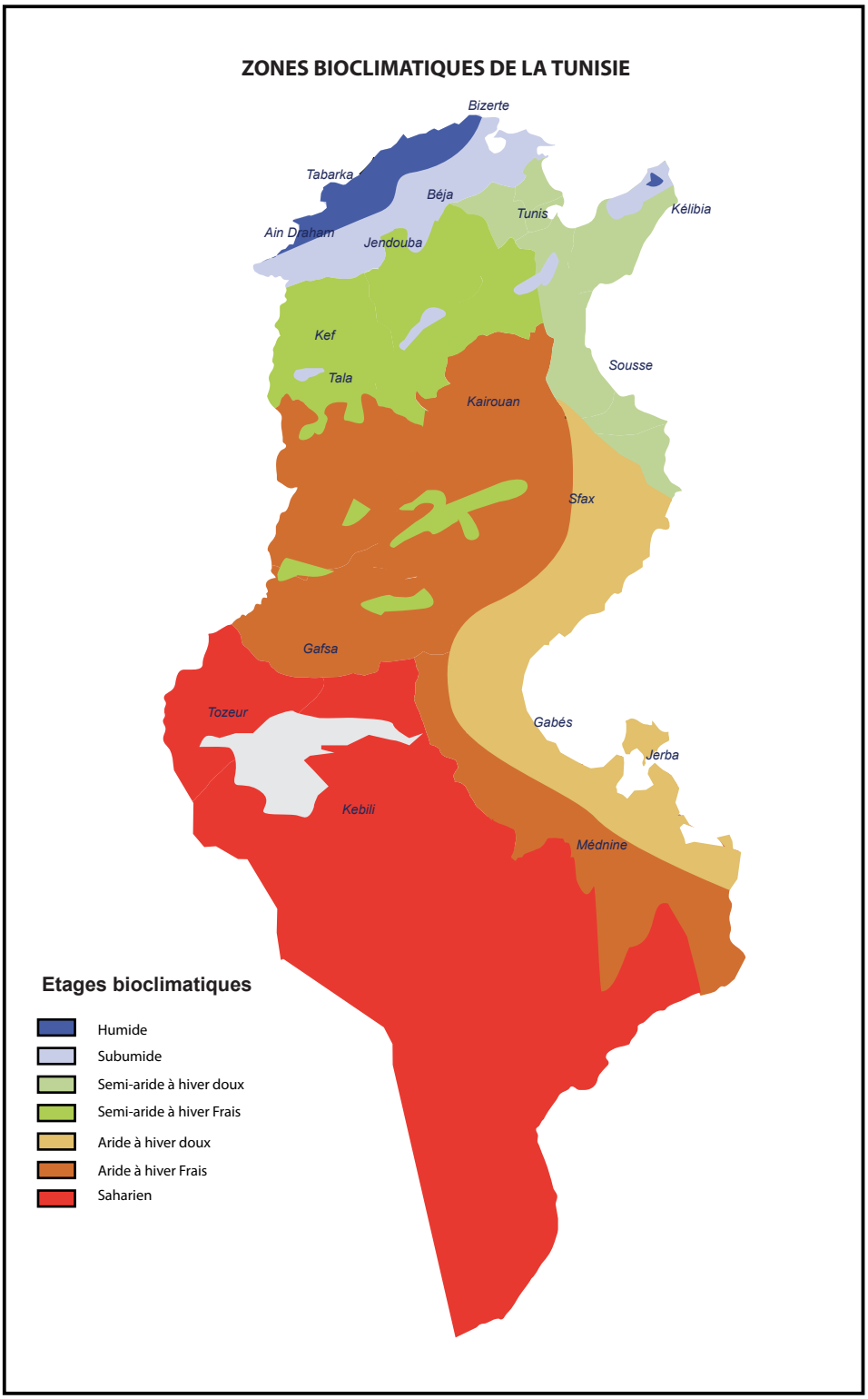
Appendix A: Water Proportion in the World



Appendix B: Exporters and Importers of Virtual Water



Appendix C: Bioclimatic Stages of Tunisia



Appendix E: Interview Questions

Questionnaire: Olives and Olive oil liberalization under DCFTA and the question of virtual water.

Name of interviewer: Sahar Méstour **Starting time:**
Date: **Ending time:**

Interviewer Introduction:

Hello my name is Sahar Méstour an undergraduate student at Tunis Business School, University of Tunis. I am conducting this questionnaire as part of the primary data collection process for my research paper under the theme Olives and Olive oil liberalization under DCFTA and the question of virtual water.
The answers will be appreciated in understanding the topic of agriculture liberalization in the field of olives and olive oil and its impact on Tunisian water sovereignty

Section I: Informative questions about interlocutor and institution:

1. What is your name?
2. What is your position in [institution's name]?
3. What is your institution's contribution to the field of olives and olive oil?

Section II: Tunisian olives and olive oil field:

A. Tunisian olives and olive oil overview:

4. For the past years, Tunisia has been among the top producers of olives and olive oil in the world, what are the main reasons behind this leading position, according to you and your institution?
5. According to numbers provided by the ministry of agriculture, olives and olive oil are among the most produced agrarian products in Tunisia, does this production match the local Tunisian market's demand?
- Yes/No.
6. Does this production match the demand of the Tunisian trading partners and the contingents they offer?
- Yes/No
7. 2016 Tunisian olives harvest was the lowest for the past 5 years, do you think this is due to the seasonality fact of olives or to other reasons?
- Please further explain.
8. What are the reverberations of this low harvest on the prices of olive oil locally and internationally?
9. What is the impact of this low harvest on the job creation associated with the field of olives?
10. Was Tunisia able to meet the contingents proposed by its trading partners this year?

B. Virtual Water:

11. As we know, olives need water in order to grow, this water is best known as virtual water, are you familiar with this term?
- Yes/No

12. (If no: virtual water is defined to be the amount of hydraulic resources needed in order to produce a good or a service).
Should an importance be accorded to the amount of water needed in the production of olives and olive oil?
- (Yes/No) Please further explain.
13. Do you think that the decrease of hydraulic resources in the year 2016 due to the lack of rain can explain the decrease in the 2016 olives harvest?
- (Yes/No) Please explain further.
14. What kind of water is most used in irrigating Tunisian olives? Green (coming from rain) or Blue (coming from ground and surface water)?
15. In places such as the Guadalquivir River Basin in Spain, Tunisia's direct world competitor, olives use up to 25% of the overall Spanish water resources, is this consumption close to that of Tunisia?
- (Yes/No) Please explain further.
16. In 1995 the Tunisian ministry of agriculture attempted to establish an adaptive strategy of water resource management in order to preserve this precious resource.
Are you: Aware of this strategy/Not aware of this strategy/Involved in its establishment/Not aware of its establishment?
17. (If [interviewer] has a previous knowledge of the strategy)
Was this strategy successful in preserving Tunisia's hydraulic resources?
- (Yes/No) Please further explain.
Was this strategy adapted and updated to the current agrarian situation?
- (Yes/No) Please further explain.
(If yes) Were you (and/or institution) consulted in the process of updating the water resource management to the current agrarian landscape?
- (Yes/No) Please further explain.
18. As we know, Tunisian water is subsidized meaning that it is sold for the general public at a price that is lower than the real one. Wouldn't this underprice of water lead to an overuse of the Tunisian scarce hydraulic resources?

C. Free trade and DCFTA:

19. With the world being interconnected, a lot of countries engage in multilateral and bilateral trade agreements in order to commercialize their products abroad. How much do you know about liberalizing agriculture and most importantly olives and olive oil field?
20. In 2012 and following the Tunisian revolution, Tunisia has signed a privileged partnership with the European Union in order to strengthen the Tunisian-European trading bonds. This partnership entitled Tunisia to augment its exports of olive oil to the European market, is this partnership economically beneficial for Tunisia and the Tunisian farmers in terms of international market position and export revenues?
- (Yes/No) Please further explain.
21. Did this privileged partnership lead to the rise of the Tunisian production of olive oil?
- (Yes/No) Please further explain.
22. Did it also lead to the creation of more job opportunities in the field of olives and olive oil?
- (Yes/No) Please further explain.
23. In 2015, talks have raised about the establishment of a deep and comprehensive free trade area (DCFTA) between Tunisia and the EU which aims to liberalize trade patterns of all the economic sectors from industry to services and agriculture. How much do you know about the DCFTA?

24. What are the repercussions of liberalizing Tunisian agriculture, according to you and your organization?
25. Do you see liberalizing the field of olives and olive oil under the DCFTA as a means of economic growth, a means to improve the quality of the Tunisian olives and olive oil, a means to create more job, a threat to local farmers and local hydraulic resources or a masked imperialism?
26. The DCFTA negotiations between Tunisia and the EU started in 2015, are you involved and/or are you a follower of these negotiations?
- Yes/No.
27. Why do you think the negotiations of the DCFTA agreement are on hold?
28. If agreed, a liberalization of agriculture in the field of olives and olive oil will lead to augmenting the Tunisian quantity produced in order to meet the European market needs, wouldn't this increase in production harm the local resources?
29. Tunisia is solely an olive oil exporter, do you agree that accepting to engage in the DCFTA, will lead to creating new European markets for Tunisia which will lead to increasing its exports and thus its virtual water export?
- Please further explain.
30. Do you think that a high export of olives and olive oil will threaten Tunisia's local hydraulic resources and water sovereignty, especially that Tunisia is an arid country?
31. Tunisian olive oil is sold at a price which lower than that of the world price, it is also obtained through the use of water that is subsidized, which means that the Tunisian olive oil is in fact underpriced in terms of world price and resources used. Wouldn't this be considered as a loss for Tunisia – economically speaking?
- (Yes/No) Please further explain.
32. Do you think that by following the same pricing strategy for water resources and olive oil products, Tunisia will be a loser or a winner from the DCFTA?