Larhyss Journal, ISSN 1112-3680, n°43, Sept 2020, pp. 41-55

VIRTUAL CEREAL WATER IN ALGERIA: BLESSING OR CURSE?

L'EAU VIRTUELLE CEREALIERE EN ALGERIE : BENEDICTION OU MALEDICTION ?

ZELLA L.[1], SMADHI D.[2]

[1] Nature and life science Faculty, University of Blida 1, Algeria
[2] National Institute for Agronomic Research, INNRA, Algiers, Algeria.

lakhdarz@yahoo.fr

Research Article – Available at http://larhyss.net/ojs/index.php/larhyss/index
Received May 6, 2020, Received in revised form August 17, 2020, Accepted August 23, 2020

ABSTRACT

This work attempts to understand and analyze the concept of virtual water, a newly introduced device used by developed countries to better refine the evolution of the water situation subject to these inter-country water transfers. However, the transfer of this invisible water hides underlying challenges of supporting and promoting the agricultural economies of exporting countries. The key argument put forward in this new concept of international trade is that of water productivity, particularly in cereal production. However, it is clearly still relatively lower in poor and less developed countries. The very ones that matter a lot and export very little. This is the Algerian case where cereal farming is basically rainfed. In this respect, the application of Ricardo's theory of comparative advantages, from which the concept of virtual water derives, is therefore an instrument of unilateral subjection. Because the virtual quantities of water imported with cereals do not really contribute to Algeria's water balance. This is only possible in the case of irrigated crops. It is therefore more sensible and advantageous to redouble efforts to increase yields and the current cereal area, by absorbing the enormous potential of fallow land and mastering the technical route. On the other hand, it is imperative to provide clear answers to this excessive consumption of cereals. In this way, the country hopes to free itself from massive wheat imports.

Key words: water, virtual, comparative advantage, productivity, wheat.

RESUME

Ce travail tente de comprendre et d'analyser le concept de l'eau virtuelle, un artifice utilisé par les pays riches et développés afin de soutenir et promouvoir leurs économies productives agricoles. L'argument clé mis en avant dans ce nouveau concept du commerce international extérieur est celui de la productivité de l'eau, notamment dans la production céréalière. Or celle-ci est manifestement toujours relativement plus élevée à celle des pays pauvres et moins développés. Dans ce cas, l'application de la théorie des avantages comparatifs de Ricardo dont découle le concept d'eau virtuelle à la céréaliculture algérienne s'avère un instrument d'asservissement unilatéral de son économie à l'instar de celles des pays moins développés aux économies des pays plus développés maitrisant les processus de production. Dans le cas de l'Algérie, il est plus censé et avantageux de doubler la sole céréalière actuelle afin de combler les besoins en céréales, ce qui permettrait de s'affranchir des importations massives de blé et du prétexte illusoire que l'Algérie bénéficie des dizaines de milliards de m^3 d'eau 'virtuelle'. Il est plus logique de redoubler d'efforts afin de garantir l'autosuffisance céréalière et renforcer sa sécurité alimentaire en résorbant l'énorme potentiel de jachère et en maitrisant l'itinéraire technique.

Mots clés : eau, virtuelle, avantage comparatif, productivité, blé.

INTRODUCTION

The Algerian population's diet is essentially based on cereals and has been for centuries. Historically, it is mainly hard wheat and barley that provide the necessary daily calorific intake. However, this food production has become increasingly limited and insufficient due to the limitation of natural resources (land and water), coupled with very high population growth. When it increases by more than 2%, cereal production increases by only 0.3% (Bouazouni, 2008). For decades, it has been cereal imports, dominated by soft wheat, which has become a preference, that have been filling the nutritional gap. National production varies between 3 and 5 million tonnes, mainly durum wheat (FAO, 2013), covering on average only 1/3 of requirements.

Today, considering only bread, the Algerian population consumes, according to Fedala et al. (2015) daily about 49 million chopsticks. The very low prices of this product, because it is supported by the State, are undeniably at the root of this excessive consumption, making the country the world's leading bread consumer. Knowing that the 250 g of bread can contain and satisfy up to 35% of the daily calories (Fedala et al., 2015). Massive hydrocarbon exports have made it possible to finance ever more imports of this cheap carbohydrate since the 2000s, to the point that Algeria has become one of the largest importers of wheat in the world (more than 5 million tonnes/year). During 2015, according to an FAO study cited by Fedala et al. (2015), the country allocated a per capita food currency allocation of USD308, exceeding that of Morocco (USD189), Tunisia (USD270) or Egypt (USD190). The food bill, which had reached a record high of USD 11 billion in 2014, reached USD 9.3 billion in 2015.

This situation weighs very heavily on the country's financial manna by limiting its development prospects. Cereal imports have become a habit and indirectly restrict the productive sector to some extent, by promoting a certain economy of effort. Several isolated experiments have shown that yields can be increased to more than 50 q/ha (Bessaoud, 2016). Import addiction is underhandedly recommended and encouraged by international institutions of a capitalist nature.

It is on the basis of this introductory analysis that this article attempts to reveal the nuances of the policies of cereal exporting countries. The latter promote the concept of virtual water as a means offered to oil-producing countries with arid climates to really gain large volumes of water.

It is therefore an atypical subject in which several disciplines such as international trade, economics, hydraulics and agriculture are involved. It is only with an analytical approach that we will be able to reveal whether or not cereal imports are more beneficial than local production, as allegedly pointed out by some authors who support this theory. The article attempts to remove the nuance of this notion of virtual water, which only has a real impact on a country's water balance when cereals are irrigated (blue water). In the other case, that of Algeria, where cereal production is subject to the rainfall regime (green water), virtual water linked to cereal imports does not affect internal water stocks in any way. It is therefore a curse to resign yourself to importing.

MATERIALS AND METHODS

The method adopted in this work is simplistic, consisting in analyzing the main scientific approaches published recently. The objective is to disentangle the multiple nuances implied by this newly introduced concept of virtual water in the analysis and quantification of a country's water resources.

To this end, CNIS data on Algerian cereal imports over the last five years (2012 to 2017) have been used. These data were compared with MADR data on national cereal production and their respective balances for the same period. Other sources such as ONFAA (2015), Actualitix (2018), FAO (2013, 2013b), BM (2012) were requested to confirm the figures.

The choice was made for cereals given their strategic nature in our country. The volumes of virtual water imported are deducted from the import tonnages of cereals each year. The cereal-to-virtual water conversion is based on the FAO productivity standard of $1kg/m^3$, or 1000 m3 of virtual water per tonne of cereal (FAO, 2014). This choice certainly minimizes the corresponding water volumes but allows comparisons to be made with studies adopting the same standard. In Algeria, the climate is generally arid, the virtual water or evapotranspiration water is much higher than this FAO standard, resulting in lower productivity and therefore the necessary water can be multiplied by 3. Since the share of irrigated cereals is insignificant compared to rainfed cereals, cereal production is considered totally rainfed and inevitably becomes vulnerable to the vagaries of rainfall.

LITERATURE REVIEW

The need to import grain products

The use of imported products or services generally occurs when the product or service cannot be found locally, is insufficient or of poor quality. Imports have always existed in human history; they have replaced the barter of yesteryear. The silk, salt or gold roads were once the trade routes between different communities and countries. In the recent past, oasisians in southern Algeria traded their dates for northern cereals. Palms are irrigated by groundwater (blue water) while wheat and barley benefit from autumn and spring rains (green water). Thus, the needs of the people were more or less satisfied and as much as the cereal producers, the date producers certainly each benefited from exchanging a quantity of their product. The exchange is based on traded values, probably with reference to a standard value.

Nowadays, new means of transport have shortened distances, trade has increased and increased. The poor performance of agriculture, the lack of water resources associated with the population boom and the improvement in living standards have accentuated nutritional deficits in less developed countries, revealing niches of undernourishment here and there. This is estimated by the FAO (2013) from agricultural production and food trade statistics. A food ration reported to the individual below 2200 kcal/day reflects a very low level of food security and a high percentage of the population affected by malnutrition. A value higher than 2700 kcal/day indicates that only a small percentage of the population is undernourished. While a value below 3500 kcal is rather reassuring and the population has a balanced food intake overall (FAO, 2013).

Developed countries with relatively high, but also heavily subsidized, agricultural productivity constitute the bulk of exporting countries. Rich in financial resources, they easily overcome deficits in their agricultural production by using imports to meet their food needs. Not surprisingly, among the main virtual water exporting countries are the food exporting countries of the United States, Brazil, Argentina, Australia and Canada.

These countries export about 100 km^3 of virtual water per year, just over 300 km^3 for the United States (Zimmer, 2013). Knowing that 1 km^3 of water can feed one million people (Zimmer, 2013). Other countries such as China, France and Japan are both major exporters and importers of virtual water.

Their ration is so rich that it doubles the prevalence of obesity according to the FAO (2013b), revealing that more than 600 million people are obese, or 13% of the world population. These countries, which have perfect control over the levers of profitability and efficiency, dominate international trade and enforce their laws. In contrast, importing countries have economies largely dependent on the production surpluses of developed countries. Invoices related to their food imports severely penalize national economies and hinder their growth. In their development drive, their populations have become highly urbanized and their food needs diversified, but are less and less covered by local productions whose yields have remained derisory (FAO, 2013b).

Algeria, like almost all MENA countries, has a cereal production that is clearly insufficient to meet needs. To this end, it is distinguished by these massive imports of cereals. This situation, which has become sustainable, increases its high external dependence and exposes it to the risk of food insecurity. According to Yang and Zehnder (2002), these countries import twice as much as they produce, while others import all their consumption needs, according to BM(2012). Poor countries, even if they are rich in water, suffer from a lack of infrastructure, resources and above all good governance; this is called economic scarcity. Their growth and gross domestic product (GDP) are highly dependent on rain-fed agriculture. Both agriculture and economic development are largely dependent on climatic hazards due to a lack of irrigation in dry periods and a lack of drainage in rainy periods. Thus, a country's growth is then closely linked to weather conditions.

Globally, it is the poor or arid countries that suffer from the syndrome of insufficient agricultural production. They were unable or unable to adapt to their own situations and became permanent importers. As a result, they reward the economies of exporting countries by allowing their agriculture to continue to grow happily. It is a vicious circle that consolidates the unproductivity of importers' agriculture and delays their development.

In 2010, according to BM(2012), Arab countries imported 30% of the wheat traded worldwide. The sustainability of this situation means that this high dependence on imports, combined with the large budget deficit, makes these countries more vulnerable to the volatility of the international market. Based on the 2011 budget balances, wheat import and consumption data for 2010, BM(2012) estimates that Libya, Jordan, Yemen, Djibouti, Lebanon, Iraq, Egypt, Algeria and Tunisia are the most vulnerable countries to a sustainable food price shock. According to BM (2012), most of these countries spend up to 65% of their income on food, which has consequences for their development.

Many countries fear that supply disruptions (during wars, unrest...) could threaten their national security. So they try to desperately strengthen their strategic stocks and desperately cling to the "salvation" of imports.

In Algeria, the colossal efforts made by the public authorities in the water sector, such as the use of seawater desalination, the construction of new dams and major inter-Wilaya and regional water transfers, have certainly reduced tensions due to widespread water stress, but have not been able to meet the challenge of food self-sufficiency by raising the productive level of agricultural land sufficiently. Substantial budgets (nearly USD 3 billion and USD 20 billion), respectively allocated to the agriculture and water sectors through national development plans, have had only a modest impact on food dependence on the outside (MADR, 2010).

Algeria has distinguished itself as one of the leading wheat importing countries in recent decades. Its agriculture, which produced only 43 Mq in 2007, only provided barely 50% of its population's needs, estimated annually at 250 kg/inhabitant, including animal consumption (Smadhi and Zella, 2012), resulting in a daily consumption of 3 baguettes of bread, twice the world average. The agri-food import bill amounted to USD 4.8 billion this year. This, which is closely influenced by population growth (2.15%), rose to 6.5 billion USD in 2017 (CNIS, 2018). About one million more people each year generate additional needs of around 250,000 tonnes of cereal products. In the long term, if significant progress is not made, these needs will essentially be covered by imports.

All national reports corroborate the high level of cereal consumption, explaining this over-consumption by state-supported prices and the resulting waste. The 40 million Algerians need 100 Mq of cereals annually. National production fluctuates year on year from 30 to 50 Mq/year, resulting in an average deficit of 60%. Notwithstanding the share of cereal land equal to 80% of the UAA, i.e. nearly 8 million ha, only less than half is actually exploited, and despite the colossal investment efforts made in recent years, the country is no longer able to free itself from imports. Average yields have remained very low at around 13 q/ha, knowing that one hectare can only cover the needs of 7 people (FAO, 2013). The cereal area (6 Mha) must be doubled to meet demand. As it is possible to simultaneously affect area and yield (Zella et al., 2017), or to reduce over-consumption in one way or another.

The irregularity of Algerian cereal production (9.7 Mq in 1994 and 52.5 Mq in 2009) is often attributed to that of the rainfall regime, it varies in a ratio of 1 to 5 (Smadhi and Zella, 2012). However, the water requirements of wheat are hardly exorbitant, the C3 photosynthetic system plant, adapted to the temperate climate with low lighting, is satisfied with 450 to 550 mm annually. Thus, to assimilate 1 g of CO_2, C3 plants such as wheat sweat more than 600 g of water, twice as much as a C4 like corn (Zimmer, 2013). The reputation of corn as a water-loving corn then becomes erroneous, as for beef, it requires, according to the same author, about 1300 l/kg of meat produced.

Rather, it is the inadequate rainfall distribution or even excess light that could be a stressful constraint. The soils responding to such rainfall offers are very low in Algeria and the irrigation option is problematic because of insufficient water.

Basically, we know that rainfed cereal production (using green water) depends on several factors, starting with the climate and soil, but also on the genetic potential of the seeds and the entire technical itinerary (ploughing, seeding, fertilization, phyto-sanitary treatment, harvesting and transport). Each element is decisive in the productive profitability (q/ha) or even the productivity of water (kg/m^3). Water is certainly a necessary but not sufficient factor to guarantee high yields. The profitability will depend on the dosage of water (rain or irrigation) in relation to the needs throughout the vegetative period and in proportion to the dosage of light. The water factor contains several determinants such as its natural abundance, quality, cost and operation, which are additional inputs. The economic calculation must be very detailed if we want to estimate the real cost of the quintal produced. Matching agricultural production to a necessary volume of water, as recognized in the notion of virtual water, seems to be a great approximation.

The notion of virtual water

Indelicately believing that a country's food imports save it volumes of water that would have been necessary for the production of these same imported agricultural products, the concept of virtual water was born, associated with so-called green water (free) and so-called blue water (with a cost). This concept was introduced by Allan in 1993, (Allan, 2001b) based on Ricardo's famous 1817 theory of comparative advantage, which is an extension of Adam Smith's 1759 theory of absolute advantage over trade and free trade. Ricardo tried to show that international trade makes it possible to increase production (and consumption), as each national economy specializes in exporting goods for which it has one or more comparative advantages.

If the comparative advantage is calculated by integrating all the factors of production, the theory of virtual water trade is based only on the water factor. Its abundance is not necessarily sufficient, according to Blouin (2011), to amount to a comparative advantage in the production of a water-intensive good or service. Although the concept of virtual water theoretically applies to any good or service, in practice, international trade in virtual water is particularly relevant only to agricultural commodities.

Worldwide virtual water imports are estimated at 1600 km^3/year, or 22% of total consumption (Lefevre and Vazken, 2016). It is very pretentious to say that these quantities of water have really changed countries. On the other hand, virtual water import can be an economic response to water scarcity if the agricultural product is irrigated with remarkable water efficiency. Equatorial countries receive enough rainwater and yet some still import. The import of virtual water can be beneficial for countries that lack water or land resources, but are economically rich and able to support high bills over many years. This is particularly the case in the Arab Gulf countries or countries such as Japan.

Proponents of this thesis suggest that importing countries will be able to reduce their food deficit by favouring high value-added production, or develop other vectors of the economy, whose export or exploitation makes it possible to finance agricultural and food imports. Clearly, the strategic product must be redefined with regard to water consumption in view of the benefit it generates. For example, a country can produce and export roses to buy wheat, or build golf courses to promote tourism and the added value is used for food imports. However, in this seductive allegory, the strategic product is ignored and water is presented as a common product.

Some authors argue that transferring water from the agricultural sector to other sectors of the economy is a cost-effective policy and the water transferred can create 70 times greater economic value (Ohlsson, 1999) in (Turton, 2000). The large surpluses generated by the transfer of water from the agricultural sector to other sectors of the economy can then be used to generate the virtual water volumes needed for the country.

For water-scarce countries, it is suggested that it is easier for them to obtain one tonne of cereals for capital than the 1000 m^3 of water that was needed to produce it. A barter of water for capital that makes these countries food policies essentially dependent on the import of agricultural products that contain large quantities of virtual water. Agricultural products, unlike clean water, can easily be traded over long distances. For example, international trade in agricultural goods can in many cases affect local water management.

And, according to this analogy, this import thus becomes a water resource, to be added to local endogenous water resources, thus contributing to improving water availability. Virtual water is even credited with achieving global water savings by producing food where every drop of water is most effective (Hoekstra and Hung, 2005).

Experiences related to virtual water trade

This is the case in the Philippines, a country that follows this theory and finances its food imports from virtual water exports (Hoekstra and Hung, 2002), its local production is mainly export-oriented. Government subsidies do not go to rice cultivation, but to the production of orchids, eucalyptus, mangoes and asparagus. All this is at the expense of local ecosystems, investments in them are not profitable in the short term, and are far off the list of priorities of a country that must generate income to finance its imports.

According to Hoekstra and Chapagain (2008a) in WTO (2010), Thailand is experiencing water shortages partly because it uses too much water to irrigate rice fields for export. Kenya is also depleting its water resources around Lake Naivasha to grow roses for export. Virtual water trade can therefore exacerbate water scarcity problems (WTO, 2010) rather than mitigate them

This dialectic, which is simple and seductive, is purely theoretical, it puts into equation only two variables: the water resource and the agricultural product, grouped under the term of water productivity, expressed in kg/m^3. While a human being needs to drink 2 to 5 liters of water per day and requires 25 to 100 liters for domestic uses, he needs 1000 to 6000 liters per day to feed himself. This invisible fraction of water, used to produce food, is 37 to 57 times larger than the visible fraction (Turton, 2000) but is integrated into the cost of the product.

Virtual water was valued not by volume of water but also in dollars of commodities produced, such as 1 USD of wheat or cotton corresponds to 5 m^3 of water (waterfootprint.org).

Falkenmark in Roch and Gendron (2005) describe the emphasis on the virtual water trade strategy as simplistic. Beyond the confusion caused by the transition of water from a vital social, environmental and economic good to an economic good alone, remarkable distortions make us forget that water is an area of power par excellence. Green water is certainly free, but blue water is a rare good that cannot be free. In the same way, the limits of water resources can be partially compensated by financial resources, the mastery of appropriate knowledge and the availability of energy.

The strong integration of agri-food oligopolies gives them considerable power in areas necessary for the survival of humanity. They take advantage of this opportunity to strictly control both the upstream (producers) and downstream (consumers) of agriculture (Grenada, 2010) by making them subservient to their benefit.

Analysis of the virtual water problem

The intensification of international trade contributes to the strengthening of multinational companies, which by their significant weight manage to capture an increased share of the added value between producers and consumers (De Schutter, in FAO 2013). Only a small part of the total value added goes to the farmer.

It is important to understand that the liberalization of trade in agricultural products creates competition between products with very different productivity levels (Griffon, 2006). Today, those who master technical and technological progress have the most competitive agricultural productivity, producing about 2000 t per worker compared to the least efficient with one tonne per worker per year. This 1/2000 report (Desgain and Oumou, 2008) is a productivity criterion that forms the basis of virtual water saving.

The underlying idea is that a massive increase in international trade in agricultural products would simultaneously reduce hunger for some and overproduction for others (Grenada, 2010). Faced with the asymmetries between the fragmented mass of agricultural products and increasingly concentrated processing and distribution structures, public authorities have an essential regulatory role to play.

If this is the case, countries with low agricultural productivity are condemned to always import all products and totally neglect their local agriculture. Algeria would then simply exchange oil for agricultural products.

It has long been known that one of the determining factors in agricultural production remains the availability of water. However, water resources, a necessary but not sufficient condition, are relatively limited and above all unevenly distributed in space and time. The water deficit itself raises several questions related to the cost of the resource, the choice of priorities, water policy, its management, the level of knowledge, etc.

Water shortages can be structural (aridity affecting Algeria, for example) or cyclical (climatic variability). The supply of water to agriculture depends on various factors:

- Climate with its annual and interannual variability that can result in excess water or dry periods, both of which are detrimental to agriculture.

- Facilities designed to secure water availability through storage (dams, groundwater), these facilities can be individual or global. In addition to these, there is also suitable equipment such as irrigation networks that are properly sized and skillfully managed.
- Water management policy, whose role is to arbitrate the allocation of fresh water resources between different users.
- The valorization of non-conventional water and the fight against water waste

Water resources are therefore scarce for physical (climate) or economic (investments and policies) reasons. The relative shortage is substantially influenced by population growth.

Water productivity is a function of all these factors and the water required to produce 1 kg of agricultural product varies greatly from one country to another and even between regions of the same country. For example, there are 3000 to 4000 liters of water for the production of only 1 liter of milk, 15000 to 100000 liters for 1 kg of beef and 500 to 600 liters for 1 kg of potatoes (Maetz, 2013) in (FAO 2013b). The same author adds that 27% of agriculture's water footprint is due to cereals, 22% to meat and 7% to milk.

In a first approach, virtual water is defined as water that has actually been used to produce a good (Hoekstra, 2003). In a second approach, virtual water is defined as water that would have been necessary to produce a good under the conditions of the country where it is consumed. These two definitions present an important difference, since the production of the same quantity of cereals can require two to three times more water in an arid country than in a country with a humid climate (Hoekstra, 2003). A problem with the second approach can arise when trying to calculate the virtual water of a good that cannot be produced by the importing country (Hoekstra, 2003). For example, it is not possible to calculate the water that would have been required to produce dates in Germany, since date palms cannot be grown in that country. In response to this problem, Renault (2003) proposes the principle of nutritional equivalence, which consists in calculating the water required to produce a food product that provides equivalent nutrients.

In the case of Japan, where it is the soil that is sorely lacking, the import of virtual water can be a temporary palliative while waiting for technological advances that can claim to ensure soil-free production. Can we then say that Japan imports virtual soil? Japan is a country that consumes a lot of fish and seafood products that do not require soil or fresh water.

And what then can we say about trade in seafood products such as fish, whose average world consumption is 16.3 kg/individual/year (FAO, 2014), aquatic products, for which it makes no sense to evaluate an equivalent of fresh water necessary for their production? The virtual water equivalent is zero and this type of product could be the saving solution against water scarcity. Water-deficient countries with coastlines have a strong interest in developing this niche and redirecting their diets towards the calories and proteins of seafood products.

Cereal exporting countries are also proponents of genetically modified crops (GMOs), led by the United States, Brazil, Argentina, Canada and India (www.ogm.gouv.qc.ca), a criterion that distorts the comparison between two productivity levels.

The concept of virtual water theoretically applies to any good or service, but in practice; international trade in virtual water is mainly concerned with agricultural commodities, due to the fact that their production generates 70% of the world's freshwater withdrawals (FAO, 2014). And finally, this concept of virtual water is likely to extend to virtual soil, virtual carbon dioxide and even virtual solar energy.

Application of the concept of virtual water to the case of Algeria

The information on Algerian cereal cultivation is certainly known by all the cereal oligopoly in view of the considerable volumes imported over the past decades. It is self-evident that exporting countries deploy sophisticated strategies to keep Algeria as a sustainable and potential customer. And Ricardo's theory of comparative advantages is advanced via virtual water trade by organizations such as the World Bank, the IMF, the WTO...etc., real partners or even extensions of these oligopolies.

During 2014-2015, Algerian cereal production from a sole of about 3.4 Mha was only 37.5 Mq, with an average yield of 14 q/ha (ONFAA, 2015). In 2016, Algeria has only 27.8% autonomy in wheat, 20% in cereals and 10.23% in livestock feed (Ben Adjila, 2018). Of the 250 kg consumed annually per person, 150 kg are imported. For the 2017-2018 season, it is estimated that 2.7 Mt of production will be produced on a 3.5 Mha sole planted mainly with wheat and barley.

Table 1 is based on cross-referenced data from several sources: CNIS (2017), ONFAA (2015), Actualitix (2018), FAO (2013, 2013b), BM (2012) to provide an overview of cereal trends: needs, national production and imports in Algeria.

Table 1: Cereal production, needs, areas and imports

Year	2012/ 2013	2013/ 2014	2014/ 2015	2015/ 2016	2016/ 2017	Average
Population Mhab	38.34	39.11	39.87	40.60	41.70	
NeedsMt	9.58	9.77	9.96	10.15	10.42	9.97
Cereal production (Mt)	4.91	3.45	3.75	3.44	3.50	3.81
Imports (Mt)	9.6	11.7	12.3	13.6	13.2	12.08
Virtual water km^3	9.6	11.7	12.3	13.6	13.2	12.08 T=60.4
Areas(Mha)	3.3	3.1	3.1	2.7	2.7	2.98

NB: Mhab: million inhabitants; Mt: million tonnes; km3: cubickilometres; Mha: million hectares.

While cereal production stagnated over the five years at around 3.81 Mt, with an average yield of 12.78 q, needs increased by 8.7% and imports by 37.5%. Due to the strategic nature of cereals in human food, the sector receives financial support from the State at all levels (farmers, flour mills, bakeries and citizens). It is the intermediaries who benefit most from this generosity by making huge profits, raising demand to a very high level. It should be noted that the volumes imported in cereals exceed those relating to requirements. This inadequacy can be explained by the quantities intended for the strategic stock. The cost of cereal imports fluctuates between USD 3.43 billion in 2015 and USD 2.71 billion in 2016 (CNIS, 2017).

The volumes of virtual water corresponding to these cereal imports over the five years are estimated at a total of 60.4 km^3 with an annual average of 12.08 km^3 per year. Such volumes of green water needed for such imported quantities actually correspond, under Algerian conditions, to the production of the 3 Mhaareas, receiving an average annual rainfall of 402.6 mm. And these volumes of water supposed to be won are totally illusory, because the negligence or fallowing of this sole has not brought anything to the country.

The promoters of the concept of virtual water have a completely different reasoning, the calculation carried out by Hoekstra and Chapagain 2008a in WTO (2010), shows that the agricultural sector in Algeria used between 1977-2001 an average volume of water of 23 km^3/year but achieved water savings through imports of agricultural products of 46 km^3/year.

Despite the government's efforts to reduce food dependence on imports, the cereal sector remains in a state of flux between the import option and the local production option. There are several ways to reduce this dependence, starting with increasing the area planted and eliminating fallow land. Improving green water productivity can be achieved by selecting planting periods according to the rainfall regime of each region, each cereal species and the nature of the soil.

Studies (Smadhi and Zella, 2012) based on the analysis of statistical data on annual rainfall in northern Algeria, have shown that it is responsible for only 44% of low levels of yield. Of course, rainfall is an essential determinant, but the technical and scientific contribution is predominant.

Several options can claim to provide a solution to the situation of food dependence in Algeria, such as extending the area planted to 6 Mha with the current level of productivity (17 q/ha), or maintaining an area of 3.3 Mha and increasing the yield to 27q/ha (Zella et al., 2017) to improve the technical itinerary. The level of fertilizer use in Algeria is among the lowest in the world. The import option is eroding the productive effort and the whole corollary of agricultural improvement, which in the long run creates laziness in the production segment. The impact on the rural world is disastrous with creeping desertification and a permanent rural exodus.

Also, relying on the vagaries of the global market to feed the population puts these countries at the mercy of embargoes, price increases, import restrictions in the event of major crises and unpredictable shortages. Isn't food sovereignty the best guarantee of national sovereignty?

To be credible, this approach implies a whole reflection on the legitimacy of water uses, in particular the needs to be met with an increasingly scarce resource. Water is not only an economic good, it is also a universal good essential to life and its management cannot be purely economic in the name of profitability.

CONCLUSIONS

This work of analyzing and quantifying virtual water relating to cereals imported by Algeria in recent years has shed light on this new concept. An invisible but increasingly introduced parameter in the assessment of countries' water balances. In this case, it shows the volumes of virtual water transported with cereal imports. It appears that Algeria imported from 2012 to 2017 a total volume of about sixty billion cubic meters of virtual water for a dozen billion each year. However, these volumes of water did not constitute a comparative advantage or actual water flows that could be added to the country's water balance. The reason is that Algerian cereal production is produced in a rainy regime and that rainwater from set-aside areas is totally lost.

This article does not purport to provide a solution to Algeria's water deficit but rather to shed light on the logic and issues underlying the various issues raised. He insists on the new visions of water quantification extended to the notion of water footprint. It may be more important to assess virtual water flows in the case of an import-export balance for agricultural products. In many cases, the concept of virtual water has proven to be a tool for analysis and decision support. But it is imperative to be careful not to be dictated its political choice of agricultural development by international institutions whose overly liberal market economy is the new roadmap.

REFERENCES

ALLAN J.A. (2001b). Virtual water-economically invisible and politically silent: a way to solve strategic water problems, International Water and Irrigation Journal, Vol.4, Issue 21, pp. 29-31.

BEN ADJILA S. (2018). What is it beyond the deception of numbers? Daily El Watan, from 5-01-2018, Algeria.

BESSAOUD O. (2016). Food security in Algeria. CIHEAM-IAM, Montpellier, France, 84p.

BLOUIN G. (2011). L'eau en commun : La conception moderne de l'objet eau, Ed. PUQ, 164p.

BOUZOUNI O. (2008). Study on the impact of basic food prices on poor Algerian households, WFP-PAM-FAO, 93p.

CHAPAGAIN A.K., Hoekstra, A.Y. (2008a). The global component of freshwater demand and supply: An assessment of virtual water flows between nations as a result of trade in agricultural and industrial products, Water International, Vol. 33, Issue 1, pp. 19-32.

CNIS (2018). Database of the National Centre for Statistical Information, Algerian Customs.

DESGAIN S., OUMOU Z. (2008). Feeding the planet: understanding food sovereignty. Ed. Luc Pire, Brussels, pp. 11-29.

FAO (2013). The right to adequate food in food and nutrition security programs, 82p.

FAO (2013b). The State of Food Insecurity in the World: The Multiple Dimensions of Food Security.

FAO (2014). Food and nutrition in number, 245p.

FEDALA N., MEKIMENE L., MOKHTARI M., HADDAM A.E.M., FEDALA N.S. (2015). Bread consumption in Algeria: current situation, Endocrinology Annals, Vol. 76, Issue 4, pp. 570.

GRENADA F. (2010). The concept of food sovereignty in the light of the Niger issue, Master's thesis, Institute of Human and Social Sciences, University of Liege, Belgium, 108p.

GRIFFON M. (2006). Feeding the planet: for a doubly green revolution. Ed. Odile Jacob, Paris, France, 456p.

HOEKSTRA A.Y. (2003). Virtual water: an introduction in virtual water trade. International expert Meeting on virtual water trade, Value of water research report series No12, Delf, UNESCO-IHE Institute for water education, pp. 13-23.

HOEKSTRA A.Y., Hung P.Q. (2002). Virtual water trade: a quantification of virtual water flows between nations in relation to international crop trade, value of water research report series No11, Delf, UNESCO-IHE Institute for water education, 66p.

HOEKSTRA A.Y., Hung P.Q. (2005). Globalization of water resources: international virtual water flows in relation to crop trade, Global environmental change, Vol. 15, No. 1, pp. 45-56.

LEFÈVRE D., Vazken A. (2016). Water at risk: a resource to be preserved on a daily basis, Ed. Quae, 168p.

MADR (2010). Ministry of Agriculture and Rural Development, Press Conference of the Minister of Agriculture, Algeria.

ONFAA (2015). Algerian foreign trade balance sheet, INRAA, Algeria, 6p.

RENAULT D. (2003). Value of virtual water in food: principles and virtues, International expert Meeting on virtual water trade, Value of water research report series No12, Delf, UNESCO-IHE Institute for water education, pp. 77-91.

SMADHI D., ZELLA L. (2012). The pluviometrical deficiencies in the pluvial cereal regions in Algeria, African journal of agricultural research, Vol. 7, Issue 4, pp. 6413-6420.

TURTON A.R. (2000). A strategic decision markers guide to virtual water, Conference on Virtual Water, Maseru, South Africa, http://www.up.ac.za./academic/libarts/polsci/awiru

World Bank FAO (2012): The Grain Chain: Food security and wheat import management in Arab countries. 86p.

WTO (2010). Trade in natural resources, World Trade Report 2010, 256p.

YANG H., ZEHNDER A. (2002). Water scarcity and food import, A case study for southern Mediterranean countries world development, Vol.30, Issue 8, pp.1413-1430.

ZELLA L., SMADHI D., SEMIANI M., CHABANE A., FADJER Z. (2017). Agronomic Research Review, INRAA, Vol.2, No27, pp.92-101.

ZIMMER D. (2013). The footprint of water: the hidden sides of a vital resource, Charles Léopard Mayer, France, 107p.

SITOGRAPHY

www. actualitix.com
www.ogm.gouv.qc.ca
www.waterfootprint.org

ACRONYMS

WB: World Bank
MADR: Ministry of Agriculture, Rural Development and Fisheries, Algeria
FAO: Food and Agriculture organization
CNIS: Centre National de l'Information Statistique, Algerian Customs
UAA: Useful agricultural area
USD: US dollar
Mq: Million quintal
Mt: Million tonnes
WTO: World Trade Organization
IMF: International Monetary Fund
WB: World Bank
ONFAA: Observatoire National des Filières Agricoles et Agroalimentaires, INRAA, Algeria
MENA: Middle East and North Africa