WWF

MÉXICO

2012

This publication was done in collaboration with

AgroDer

SAB MILLER

THE WATER FOOTPRINT OF MEXICO IN THE CONTEXT OF NORTH AMERICA

INDEX

INTRODUCTION

If we could only see 4% of what goes on around us, surely there would be many things we wouldn't perceive; we wouldn't notice that they are really there, nor would we even be able to do something with or for them.

This happens with water. Saving it and using it efficiently is something we have known for many years: closing the water tap while soaping, avoiding washing our cars with hoses, and using only a glass of water to brush our teeth. However, water for household consumption (that which we see running in front of our eyes while washing our hands or dishes, watering the garden, or using it otherwise at home) represents only 4% of the water we use in our daily routines.

When exchanging products and services, large quantities of water are also exchanged. Everything we eat in a day, the clothes we wear, the energy we consume, as well as all the products we are in contact with, required water in different quantities for their creation, production, or generation. Therefore, when marketing products, we are also marketing the water involved in their manufacturing processes.

The impact that human activities have on water resources has been accounted for in many different ways. An integrated vision must consider as part of our consumption the volume of water we draw from surface and groundwater bodies, the rainwater we use for growing crops, which evaporates due to storage systems and polluted water.

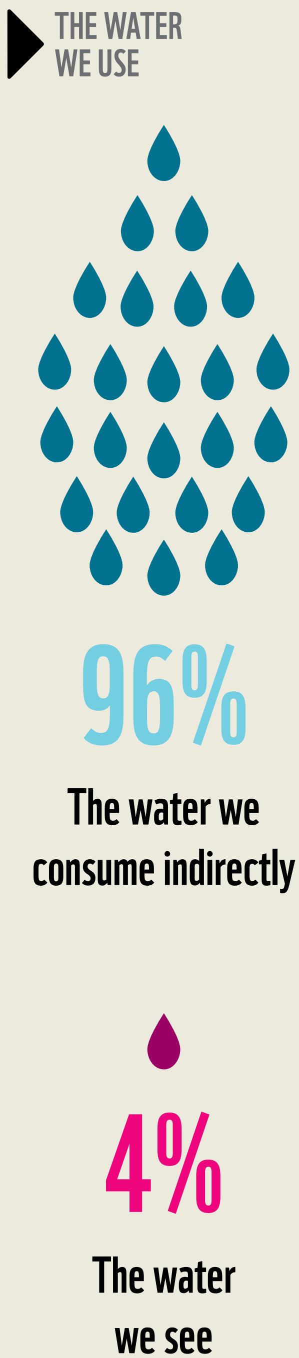
The moment when water is consumed and the place where it is obtained are imperative: the value and impact of water during the rainy and drought season will be different, just as there is a difference between a tropical area with year-round rainfall and a desert with great extensions lacking any ponds or rivers.

When we sum the total of water consumption within a region, we find places where its inadequate allocation has negatively affected ecosystem health. Given that it lies at the end of the water cycle allocation process, after public consumption, agriculture, industry or energy generation, often when its been fully distributed.

It is essential to take all these elements into account to understand the conditions under which water is consumed by society and, accordingly, develop awareness of the considerable impact that our exploitation of this resource has on its availability, and on ecosystem health. From this approach we will be able to explain why water stress and shortage are such common topics, and why water has turned into a matter of discussion around the world.

CHAPTER 1
YOU CONSUME MORE WATER THAN YOU SEE

WHAT IS A WATER FOOTPRINT AND WHAT IS VIRTUAL WATER?

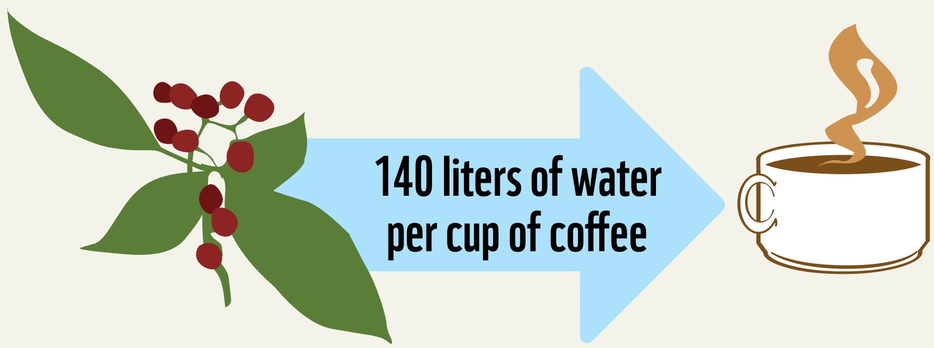


We need water to survive; it is an essential part of our beings; however, the water we drink is not the only type we consume; we also use water while bathing, washing the dishes, cleaning, watering, cooking, and many other activities which imply seeing water running in front of our eyes every day. All this represents a high degree of consumption; nevertheless, it only makes up the direct use and represents a minimum ratio of our total water usage.

Apart from our direct usage, every time we eat, or use a product or service,we indirectly utilize the water involved in their production process, where most of the water we use is located.

When we realize that we consume most water indirectly, it is necessary to quantify the volumes of water "hidden" behind every product's manufacture or elaboration.

For example, when we drink a cup of coffee, we generally think that we consumed 125 ml of water. However, growing the grain required water from rainfall or irrigation, the same as for the drying, roasting, grinding and packaging processes. In average, 140 liters of water were needed for our cup of coffee during its entire elaboration process. This amount of water is known as virtual water (VW).



It is also necessary to consider that there are production processes that pollute water even though they don't consume it (like car washing or discharging waste waters), and some others that do use water, but send it back to the ecosystem in the same place where it was initially extracted, without being contaminated (like hydroelectric plants). The fact that water is not evenly distributed throughout the world and over the months and years is another important element: there are times and places with more droughts, and others with more rainfall.

The concept of water footprint (WF) was created with the intent to take all these elements into account and be able to assess the implications of commodity trades in terms of water. This concept encompasses all the water we garner for our activities, causing alterations in the planet's water cycle. The WF can be applied to products, regions, organizations or people, and it may refer to production or consumption as well.

VIRTUAL WATER AND WATER FOOTPRINT

Virtual Water

The water used through a process chain to elaborate a final product is called the VW of a product.

Water Footprint

The WF is an indicator of all the water we use on our daily lives; that which we use to produce food, to carry out industrial processes, to generate energy, and that which we contaminate through the same processes.

It allows us to know the volume of water utilized by an individual, a group of people or consumers, a region, a country, or humanity as a whole.

Amount of virtual water in common products

Product	Miligrams or Grams	Virtual Water (liters)
Cotton shirt	250 g	2,000
A4 sheet of paper	80g/m²	10
Microchip	2g	32
Pair of shoes	Bovine skin	8,000
Cup of coffee	125 ml	140
Glass of orange juice	200 ml	170
Glass of milk	200 ml	200
Egg	40 g	135
Glass of wine	125 ml	120
Glass of beer	250 ml	75
Tomato	70 g	13
Hamburger	150 g	2,400

Source: Hoekstra, A. and Chapagain, 2006.

BASIC DIFFERENCES BETWEEN WATER FOOTPRINT AND VIRTUAL WATER

WF is a concept that refers to water used through the creation of a product.

In this context, we can also talk about the "content of virtual water" of a product, instead of its water footprint. However, the WF has a wider application. For example, we can talk about a consumer's WF through the WF of every product and service consumed; or about a producer (businesses, manufacturers or utility suppliers) through the WF of the goods and services they elaborate.

The concept of WF does not only refer to "volume" as the "content of virtual water". A WF is a multidimensional indicator that explains thoroughly the place of origin, the source (color) and the moment when water is used and sent back (to the place of origin or elsewhere).

WHAT DOES THE WATER FOOTPRINT CONSIST OF?

WATER SCARCITY AND WATER STRESS

Water Scarcity, according to UN-Water, is the moment during which the cumulative impacts from every user affect the supply and quality of water to the point where the demand from every sector, including the ecosystem, cannot be fully covered or met.

According to A.Y. Hoekstra, Blue Water Scarcity is defined as the existing proportion between the blue water footprint and the availability of water of the same color. Blue water encompasses the natural runoff (through rivers and ground water) of a basin, excluding its environmental water requirements.

Water Stress, according to UNEP, happens when the water demand surpasses its available quantity during a certain period, or when the quantity is so poor that its usage is restricted. Water stress causes the deterioration of fresh water resources in terms of quantity (over-exploitation of aquifers, shrinking of rivers) and quality (eutrophication, saline intrusion, contamination, among others).

The WF takes only fresh water into account and is made up of 4 main components:

- Volume
- Color/classification of water
- Place of origin of water
- Moment of water extraction

In identifying these data, we have the basis to analyze a water footprint, which also has to consider local elements to bring a real and useful context to the concept. It helps us to assess the impacts on time and space of water extraction, and its return as treated or waste water, the repercussion to the hydrological regime, the ecological importance of the area, the water productivity, the prevailing scarcity or water stress conditions, the local water usage and the access population has to that resource, the impacts on the lower basin, and other criteria that may focus on the maintenance of a sustainable and equitable balance of water in each hydrological basin.

The WF considers the place where water comes from and, according to it, classifies it in 3 kinds or colors: blue, green and gray. The opportunity costs, the management and the impacts on each of them vary enormously from one to the other.

BLUE WATER

Water found in surface water bodies (rivers, lakes, estuaries, etc.) and in underground aquifers is referred to as blue water. The blue water footprint relates to the consumption of surface and ground water of a certain basin; consumption is then understood as extraction. In other words, if the consumed water goes back intact to the same place from which it was taken for a brief period, it is not considered a WF.

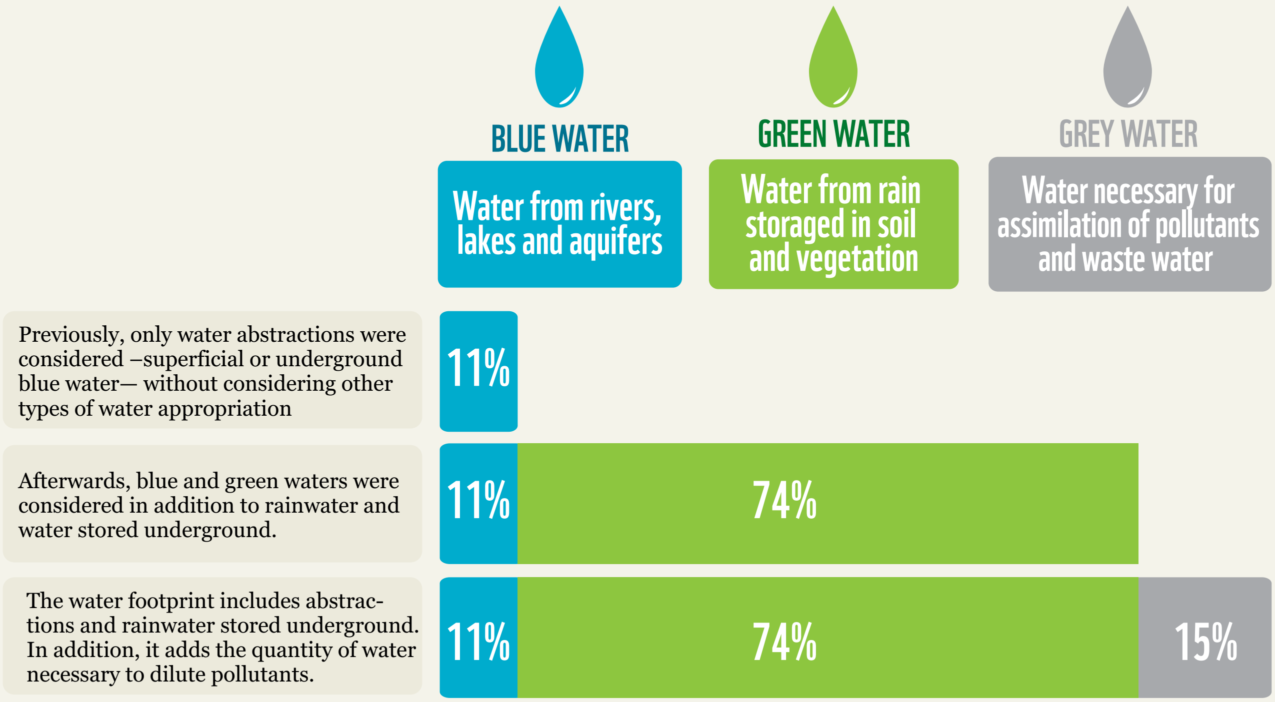
GREEN WATER

It is the rainwater stored into the ground as humidity, as long as it doesn't turn into runoff. Likewise, the green water footprint focuses on the use of rainwater, specifically on the soil's evapotranspiration flow used in agriculture and forestry output.

GREY WATER

It refers to all the water contaminated by a process. However, the grey water footprint is not an indicator of the quantity of contaminated water, but rather of the quantity of fresh water necessary to assimilate the load of pollutants given their well-known natural concentrations and the current water quality local standards.

The sum of green water, blue water and grey water required for a product or service within its every process of elaboration will be its water footprint.



WHY DOES THE WATER FOOTPRINT MATTERS?

This concept brings a wider approach that allows us to visualize and consider the real water consumption in human activities, and to relate it to factors, such as trade, that were formerly considered external. Thus, it allows us to change the way in which water issues have been addressed globally through the concept of virtual water, which incorporates an analysis of water flows implicit in the exchange of commodities.

In turn, it intends to be a planning tool for the water resource management which, by adding itself to the rest of the existing indicators, may bring a comprehensive vision of the impact human population has on the environment and the ecosystems. As an element in the design of plans, policies, programs and projects at all levels, it underpins the decision-making process according to the current needs of different regions.

It is also useful to raise awareness of the water effort that our lifestyle entails. It enables a deep insight into the impact of consumption patterns from a region or country to the place where the imported goods are produced.

HOW IS THE WATER FOOTPRINT MEASURED?

For a product, it is the total content of blue, green and grey water involved in the whole process chain.

A person's WF is obtained by adding the WF from every product, good and service he/she has consumed and used.

A country's production WF is obtained by adding the blue, green and grey water gathered of all its agricultural production processes, as well as blue and grey water from industrial production processes and domestic usage.

A country's consumption WF is everything produced for its consumption (excluding exports), and imported for general consumption.

The external WF refers to the proportion of a country's consumption which was produced in other country.

Virtual Water Transfer: It refers to the amount of virtual water transferred to other countries through commodity trade.

WHAT DOES IT HAVE TO DO WITH ME?

Our patterns of consumption and production involve lots of water, and maybe they affect other regions within a country or the world.

The eating habits, consumption patterns and lifestyles (transport, technology, entertainment, accommodation, and hobbies) determine the magnitude of our individual water footprint; in other words, the amount of water we need to keep living the way we do. We must consider that, invariably, the amount of water used in a process was consumed at the expense of another possible use, or of the water required by ecosystems.

The main factors determining the water footprint of a region or country are the following:

- Agricultural practices
- Inhabitants' eating habits
- Inhabitants' consumption patterns
- Type of industry and level of technology

Source: WFN, 2011

IMPORTANT CONCEPTS

The **non-consumptive** use of water refers to the water volume which, after being used, is returned to the same body of water from which it was originally extracted, with the same quantity and quality; in other words, it is uncontaminated. For example, to generate hydroelectric energy, water is often returned to its original source after being used; even in some ways of navigation and recreation, water is not extracted, remaining in its original river or lake, with its original quality and quantity.

The **consumptive use** refers to water extracted from its source which does not return with its full original quality and quantity. Irrigation is a consumptive use, because water is incorporated to crops and evapotranspired, and most of it does not return to its original source. Human supply is also a consumptive use. The measurement used to calculate flows of virtual water and water footprint is focused on consumptive usage.

Hot spots

Hot spots are identified based on 2 criteria:

1) The WF must be significant in that area and time of year

2) There must be water scarcity and contamination problems in that area during that period of time

IMPORTANT CONCEPTS

Environmental flow

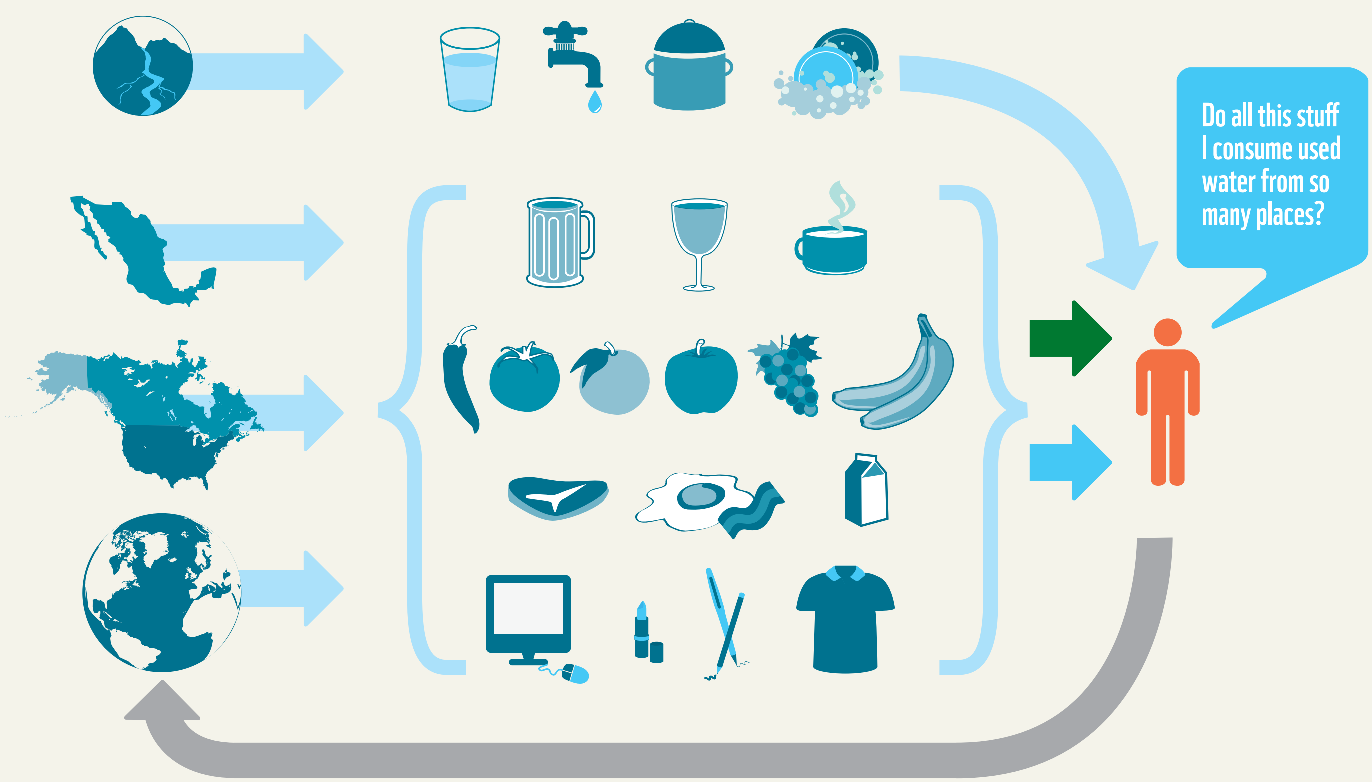
It is the water flow regime that ecosystems require to maintain their components, functions, processes and resilience, which provide environmental goods and services to society. Its conservation allows connectivity throughout the basin and ensures a long-term hydrological balance that, consequently, is vital for guaranteeing the availability of water for everybody.

If the water footprint surpasses the difference between the natural flow and the environmental flow, the area suffers from water stress. This may happen seasonally due to variations in flows from season to season. This way, hot spots can be identified; these are critical areas where it is necessary to restrict the use of water during months exceeding the limit.

Hydrological basin

It refers to a territory where waters flow to the sea through a network of beds converging into a single one, or a territory where waters form an independent unit different from others, even if they don't flow into the sea. The basin, along with aquifers, conform a management unit of the water resource.

WHERE DOES THE WATER WE CONSUME COME FROM?



WHERE DOES WATER COME FROM AND WHERE DOES IT GO?

Water destined to household consumption regularly comes from the same basin where the population lives. However, for big cities, transfers (hydraulic infrastructure carrying water from one basin to another) are increasingly common: water from farther basins is imported to meet the population's demand when it has exceeded the limits of local resource availability.

Water flows through trade as well; for example, when used for agricultural production. It is common to find fruits, vegetables, meat and any kind of food produced in other towns, states and even foreign countries. In this way, when marketing a product, the water used through its entire elaboration process is also being marketed. Utilities and industrial commodities are no exception, as the water required for their production flows around the world through their trade.

Therefore, the analysis of the water dynamics of a region can often be explained many miles away. The conditions shaped by the geographical context determine the degree of impact that a specific WF has in each area; in other words, a footprint of 100 m^3 per year in an area with abundance of water is different from those 100 m^3 per year in an area with scarcity of water. There will be a difference too if the extraction is made during the rainy season or during the dry season. The time and geography factors play a crucial role in WF.

CASE

CUATRO CIÉNEGAS

The natural reserve of flora and fauna *Cuatro Ciénegas*, located within the basin under the same name, is a desert area with an underground hydrological system with dispersed springs and streams with unique qualities, like the presence of fossil waters from approximately 200 million years ago (coming from the ancient Pangaea). It is home to endemic organisms, especially to microorganisms structured in living stromatolites –cyanobacteria which transformed Earth's atmosphere into an Oxygen-rich one. It is a living laboratory of evolution and the origin of life whose scientific relevance is invaluable.

At the same time, it is an area under water stress, as its average yearly extraction is of approximately 49 Hm^3 (48 of them for agricultural use), while the basin's average yearly recharge is of nearly 25 Hm^3. These characteristics make this area a hot spot.

Use of water: Management and Prioritization

The intensive production of forage crops (alfalfa, oat, barley, corn and sorghum) over 4,500 ha, mainly used as food for dairy cattle in the valleys of El Hundido and Ocampo, has meant an excessive water extraction in this system. For example, the WF of alfalfa in the region is of 276 m^3/ton of blue water, with a production of 118,772 ton/year in the area. This totals 32.7 Hm^3 of water every year. These figures exceed the level of recharge in the basin, resulting in a water stressed basin.

During the last 5 years, the milk production has decreased 70%, and the alfalfa production has decreased 13% between 2004 and 2010, despite the increase in the quantity of water extracted. Consequently, incomes have suffered a considerable dropoff; on the other hand, organisms dating from millions of years ago, invaluable to humanity, are disappearing.

Preference in the use of water has been given to agricultural production over an ecosystem with unique and invaluable characteristics.

An additional pressure to *Cuatro Ciénegas* is the severe drought affecting a large part of Mexico and the southern United States since 2011. The total desiccation of the most ancient pool in the system, Churince, was consequential to the combination of the drought, the natural variability, and the intensive use of water.

The use of water in agricultural production has an impact on every area around the world, but doing it in a region with a great environmental relevance, with water stress and scarcity, affects the survival of unique endemic organisms.

The relevance of the WF directly depends on the place where it is originated.

Agroder, with information from SIAP 2004-2011. FAOSTAT 2004-2011 and WFN 2011.

Photo: © Edward Parker / WWF Canon

COTTON: TRADE WITH A LARGE WATER FOOTPRINT

In average, 11,000 liters of water are employed to produce 1kg of cotton in the world, which makes it one of the crops with the highest water consumption. In 2009 the main producers were: China, 25% of the global total; the U. S. , 20%, and India, 15%. Mexico produced 278 thousand tonnes (26th place).

It is the product through which North America imports the largest quantity of VW, representing 45% of the U.S.'s imports, 41% of Mexico's imports and 27% of Canada's imports.

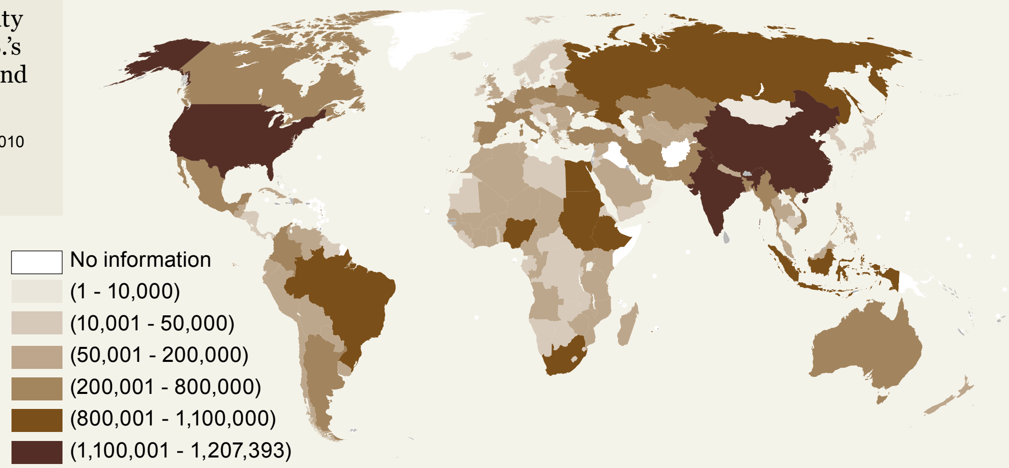
Source: AgroDer, with information from the WFN 2010 and FAOSAT 2011.

HOW DOES IT FLOW AROUND THE WORLD?

The productive activities of each country are different, and thus define its economic structure: there are nations with an agricultural, industrial, and services vocations.

The way each sector in each country gives water a productive use shapes their production water footprint. This indicator mirrors the quantity of water employed by a country when producing what it consumes and exports.

Production water footprint (Hm^3/year)



AgroDer SC with información from the WFN.

WATER FOOTPRINT AROUND THE WORLD

The world's water footprint is estimated to be 9,087 Km^3 a year:

- 74% green
- 11% blue
- 15% grey

92% is related to agricultural activities.

38% of the production's water footprint is located in only 3 countries:

- China (1,207 Km^3)
- India (1,182 Km^3)
- United States (1,053 Km^3)

China is the country with the largest grey water footprint (26% of the global total).

China (22%) and the U.S. (18%) have the largest water footprint of industrial production.

China, India and the U.S. have the largest consumption WF (1,368 Km^3, 1,145 Km^3 and 821 Km^3). This is due to:

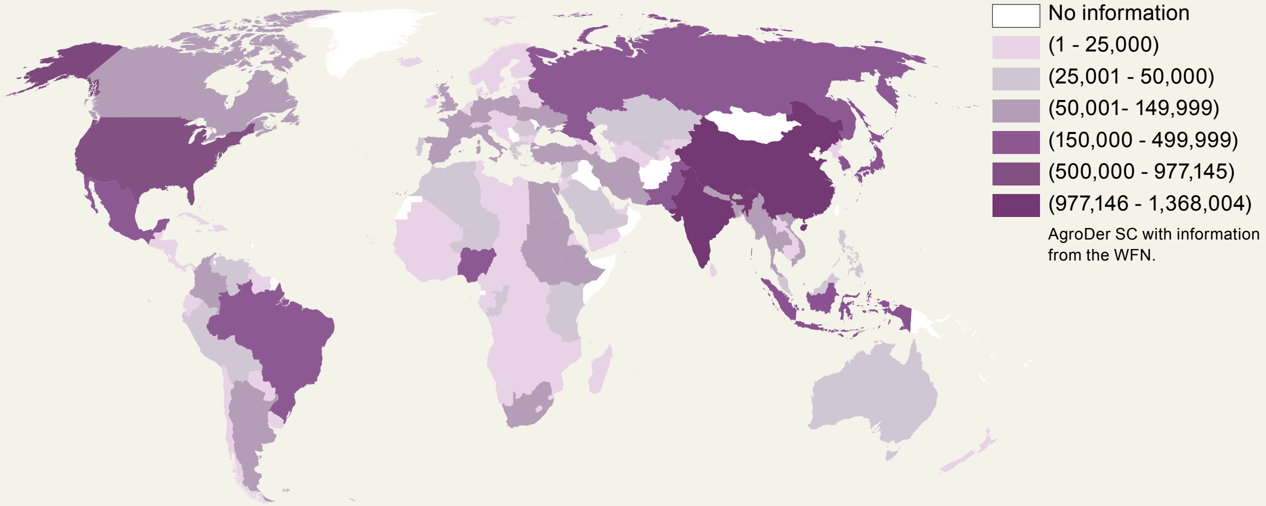
- Population size
- Consumption habits

WF of food worldwide is distributed as follows:

- 27% cereals
- 22% meat
- 7% dairy products
- 44% other products

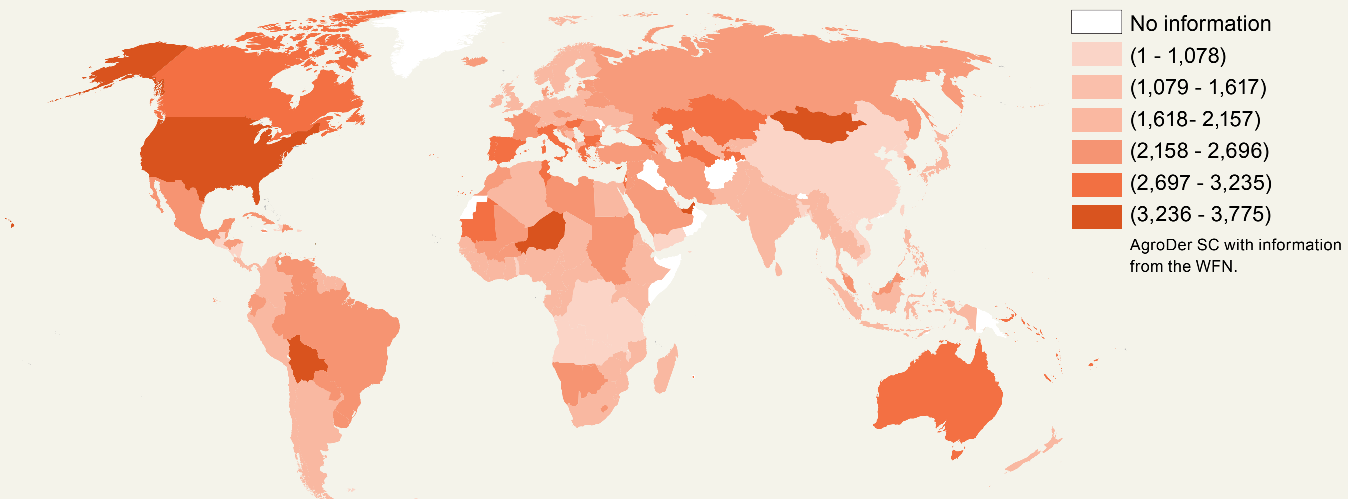
Consumption water footprint (Hm³ / year)

Given that each country has different consumption habits and customs, in food, goods and services, their water footprint varies within each region. Generally, nations with a greater number of inhabitants have a larger consumption water footprint.



Consumption water footprint (m³ / per capita / year)

By identifying the water footprint of consumption per capita, we can see how the consumption patterns of the respective country directly affect it, fired usually by the purchasing power of its citizens. Some exceptions occur when, despite having low levels of consumption, the products involved plenty of water in their elaboration processes. Such is the case of Mongolia, Nigeria and Bolivia.

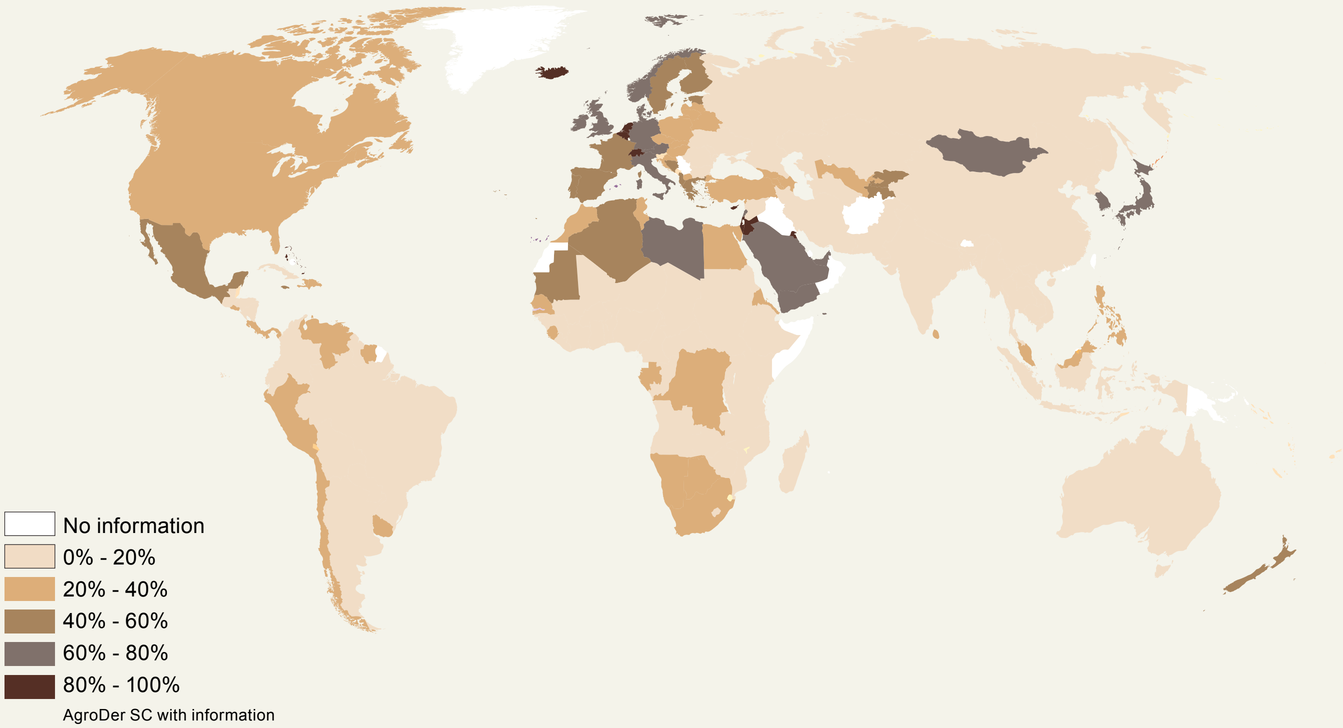


International trade enables the access to products that are not produced within the consumer's place of origin, or that could have a better quality or a lower cost by being produced in another region, which makes them more attractive to the consumer.

The water used in products manufactured in each country and consumed inside it is referred to as internal water footprint. Many countries import diverse goods in order to satisfy their consumption needs, indirectly importing the water used to produce them. This import is called external water footprint, which is the amount of water required to elaborate consumed products originally made in another country. The impacts of this water consumption remain entirely in the product's place of origin, and, more often than not, importing countries do not take responsibility or suffer the consequences of the impact the WF has in the basin of the producing country.

The higher the proportion that locally made products have on the WF of a nation over imported products, the more self-sufficient the country is in terms of WF. On the contrary, if the proportion of WF of imported goods is higher, the country will be more dependent on water from other regions in the world.

External water footprint (% of the total consumption WF)



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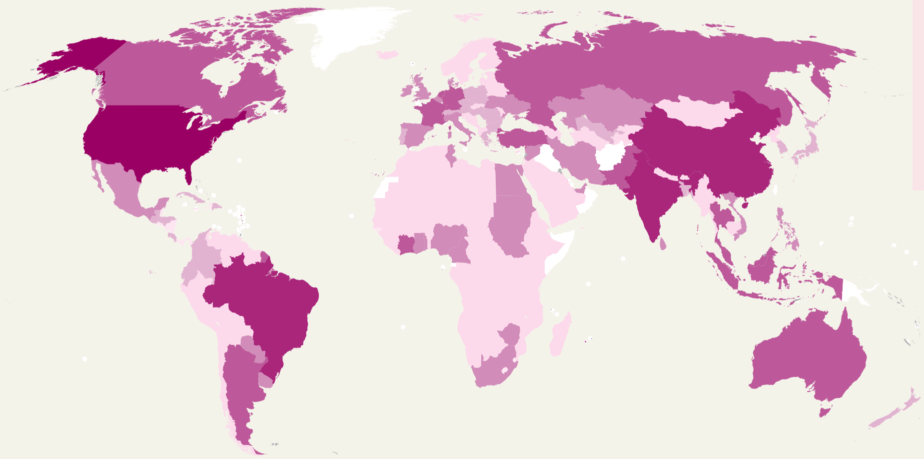
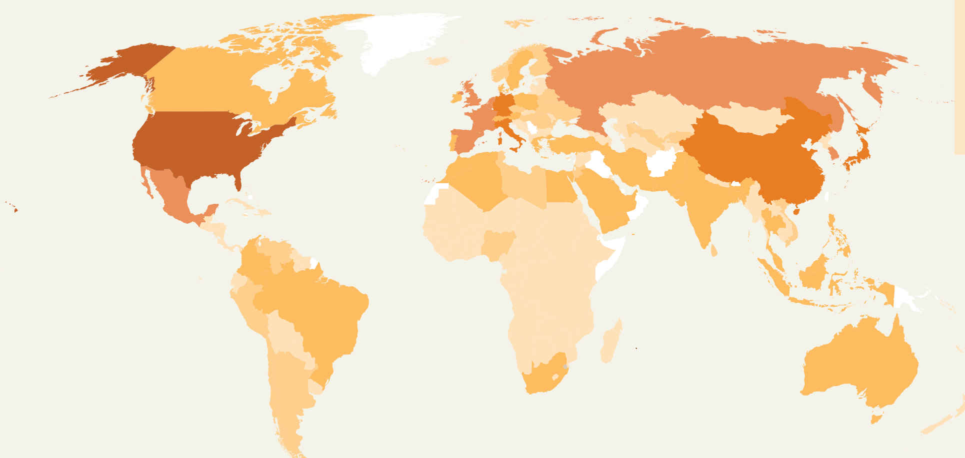


Virtual water exports (Hm^3 / year)

Due to their economic and political structure, some countries export large quantities of products to different regions in the planet, being substantial water exporters as well.

- Sin información
- (1 - 10,000)
- (10,001 - 50,000)
- (50,001 - 200,000)
- (200,001 - 800,000)
- (800,001 - 1,100,000)
- (1,100,001 - 1,207,393)

AgroDer SC with information from the WFN.



Virtual water imports (Hm^3 / year)

A country can be a virtual water exporter and importer at the same time, as a result of its international transactions.

- No information
- (1 - 5,000)
- (5,001 - 10,000)
- (10,001 - 50,000)
- (50,001 - 100,000)
- (100,001 - 200,000)
- (200,001 - 234,091)

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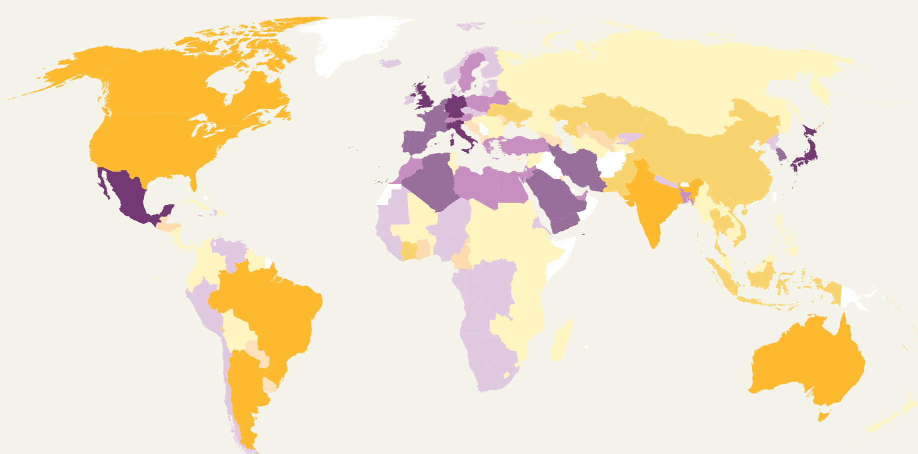


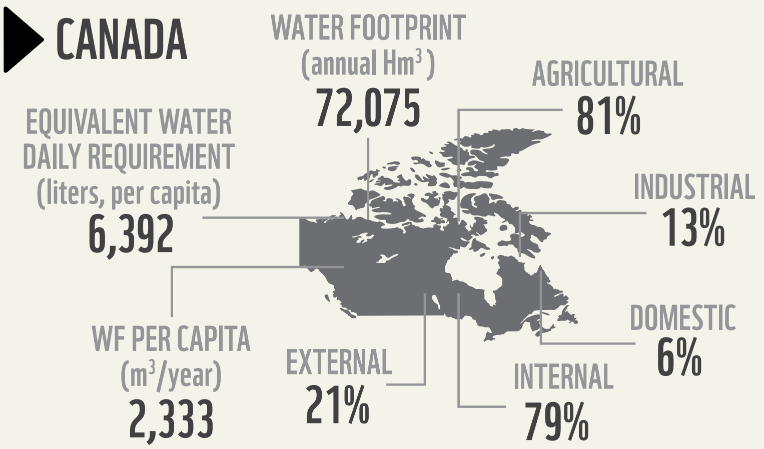
Virtual water balance (Hm^3 / year)

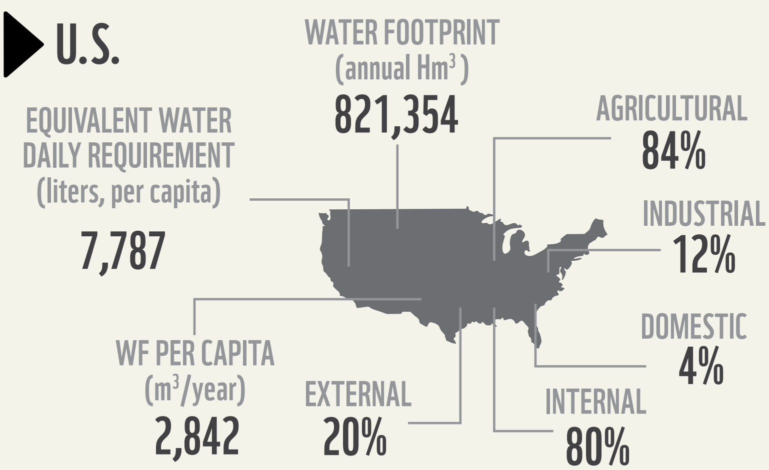
There are countries that are net exporters of virtual water and others that are net importers of it. They differ from each other according to their water balance. A positive balance means that there is more water imported that exported.

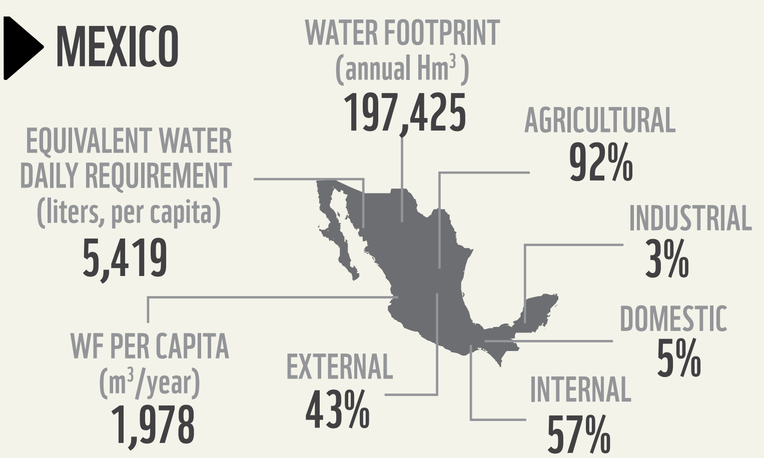
- (–98,000 - –50,000)
- (–49,999 - –15,000)
- (–14,999 - –5,000)
- (–4,999 - –1)
- No information
- (1 - 5,000)
- (5,001 - 10,000)
- (10,001 - 50,000)
- (50,001 - 116,754)

AgroDer SC with information from the WFN.

WHAT HAPPENS IN NORTH AMERICA?







AgroDer SC with information from the WFN.

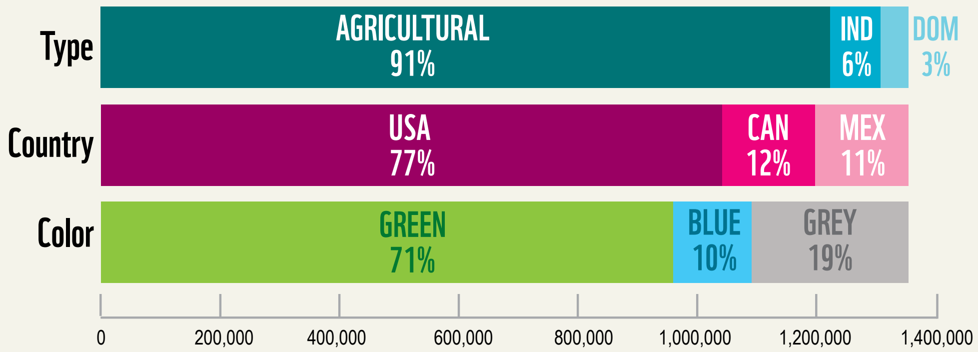
NORTH AMERICA IN NUMBERS

		Mexico	U. S.	Canada
Population (millions)		114	313	34
Average Age		27.1	36.9	41
Growth		1.10%	0.96%	0.79%
Rate Migration		-3.24	4.18	5.65
Urban Population		78%	82%	81%
Life Expectancy		76.47	78.37	81.38
Literacy		86.1%	99.0%	99.0%
GDP (trillions of $US)		$1.57	$14.66	$1.33
GDP per capita		$13,900	$47,200	$39,400
GDP by sector	Primary	4%	1%	2.20%
	Industrial	33%	22%	26.30%
	Services	64%	77%	71.50%
Population below the line of poverty		18.20%	15.10%	9.40%
Exports	*(billions of $US)*	$299	$1,289	$393
Imports		$306	$1,936	$401

		Mexico	U. S.	Canada
Area (thousands of km²)		1,964	9,827	9,985
Land		1,944	9,162	9,094
Bodies of water		20	665	891
Coastline (km)		9,330	19,924	202,080
Land use	Arable land	12.7%	18.0%	4.6%
	Crops	1.3%	0.2%	0.7%
	Others	86.1%	81.8%	94.8%
Cultivable area (ha)		63,000	230,000	8,550
Total renewable water resources (km³)		457	3,069	3,300
Ext. of fresh water (km³/year)	**Totals**	78.22	477	44.72
	Dom.	17%	13%	20%
	Ind.	5%	46%	69%
	Agro.	77%	41%	12%
	Per capita (m³/year)	731	1,600	1,386
Access to water		94%	99%	100%

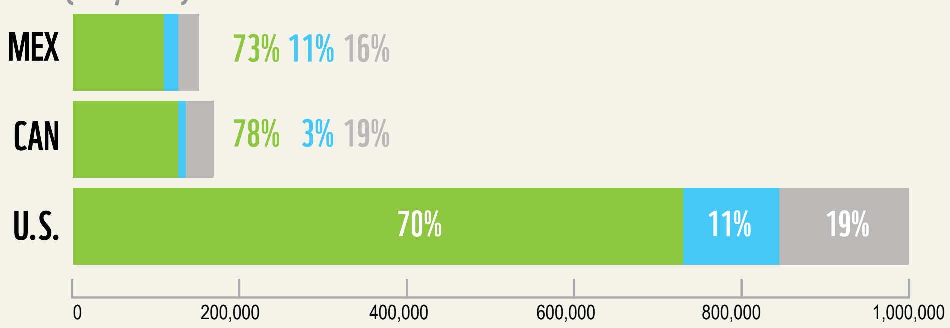
PRODUCTION WATER FOOTPRINT IN NORTH AMERICA
BY TYPE, COUNTRY AND COLOR (Hm^3/YEAR)

NA= 15% of the global production WF



North America (NA) represents 14.5% of the global surface, the 7.5% of its population and 27% of the GDP (WB Databank, 2012). In this region, 15% of the global production WF is located, mostly originated by the agricultural sector.

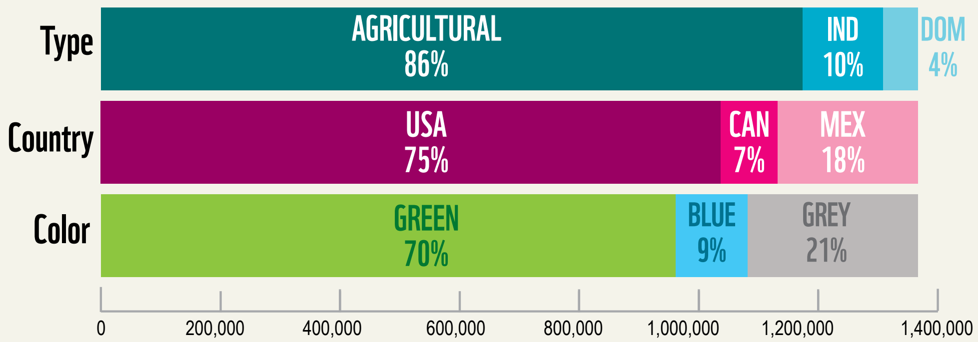
WATER FOOTPRINT BY SIZE AND COLOR
(Hm^3/YEAR)



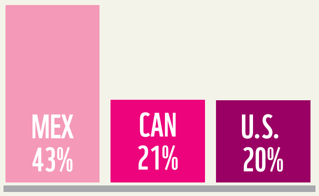
Three quarters of the population, 40% of the surface and 83% of the GDP in North America belong to the U.S. (WB Databank, 2012). Similarly, 77% of North America's Production WF is originated in the U.S. The agricultural use is the one with the highest proportion, primarily of green water.

CONSUMPTION WATER FOOTPRINT IN NORTH AMERICA
BY TYPE, COUNTRY AND COLOR (Hm^3/YEAR)

NA = 12.8% of the world



Regarding consumption, NA represents 13% of the total global WF. In turn, the U.S. represent the highest proportion in NA, with 75%.

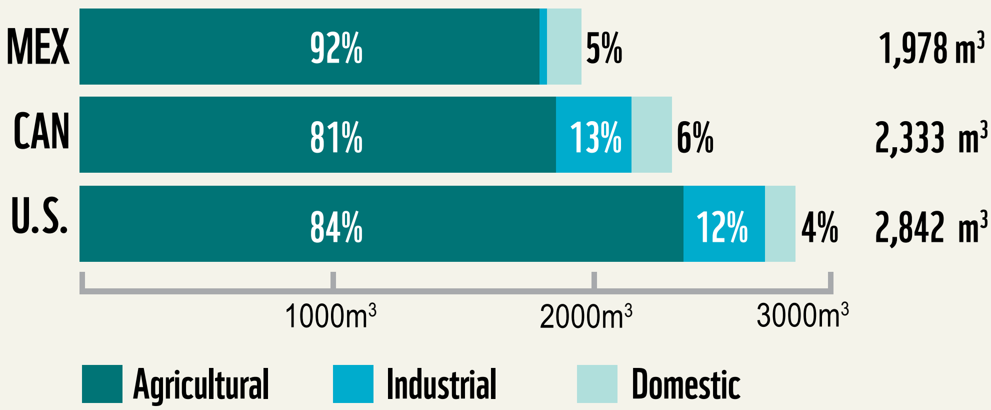


EXTERNAL WATERFOOTPRINT

Consumption is different in every country, and its dependence on international trade is different too. Canada and the U.S. are mostly self-sufficient (importing only 20% of their consumption WF), whereas Mexico depends 43% on what is produced abroad.

WATER FOORPRINT PER CAPITA IN NORTH AMERICA

m^3/YEAR SORTED BY TYPE



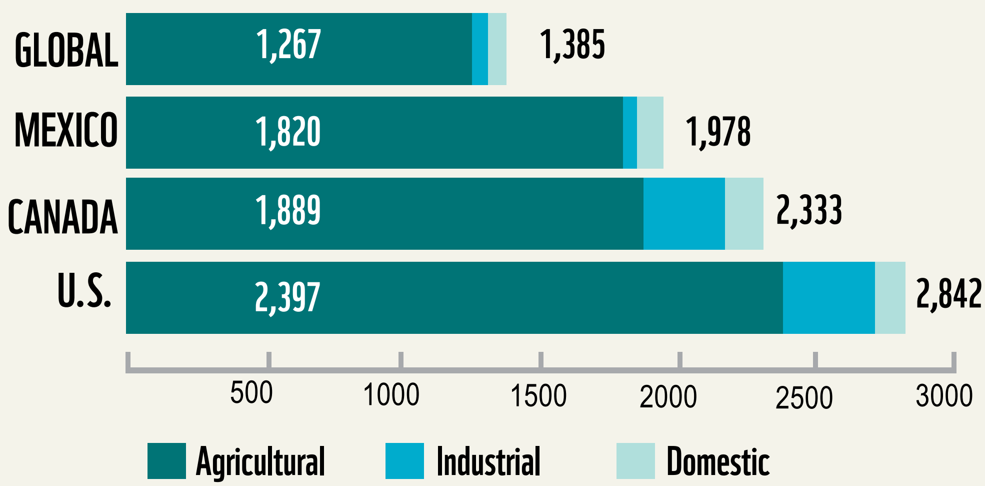
AgroDer SC with information from the WFN.

CONSUMPTION WATER FOOTPRINT PER CAPITA

Our consumption WF consists of what we eat, drink, and use. Globally, the consumption WF per capita is estimated in 1,385 m^3/year. The three North American countries are located above this average: the U.S. ranks 8th, Canada ranks 20th and Mexico ranks 49th for this indicator. The agricultural product consumption constitutes most of our WF as individuals.

WATER FOOTPRINT PER CAPITA

m^3/YEAR



WATER FOOTPRINT PER CAPITA

Consumption habits in Canada and the U.S. are very different from those in Mexico. In the former, diets include more water-intensive products (mainly meat) and fewer grains, which imply a higher WF per capita than in Mexico.

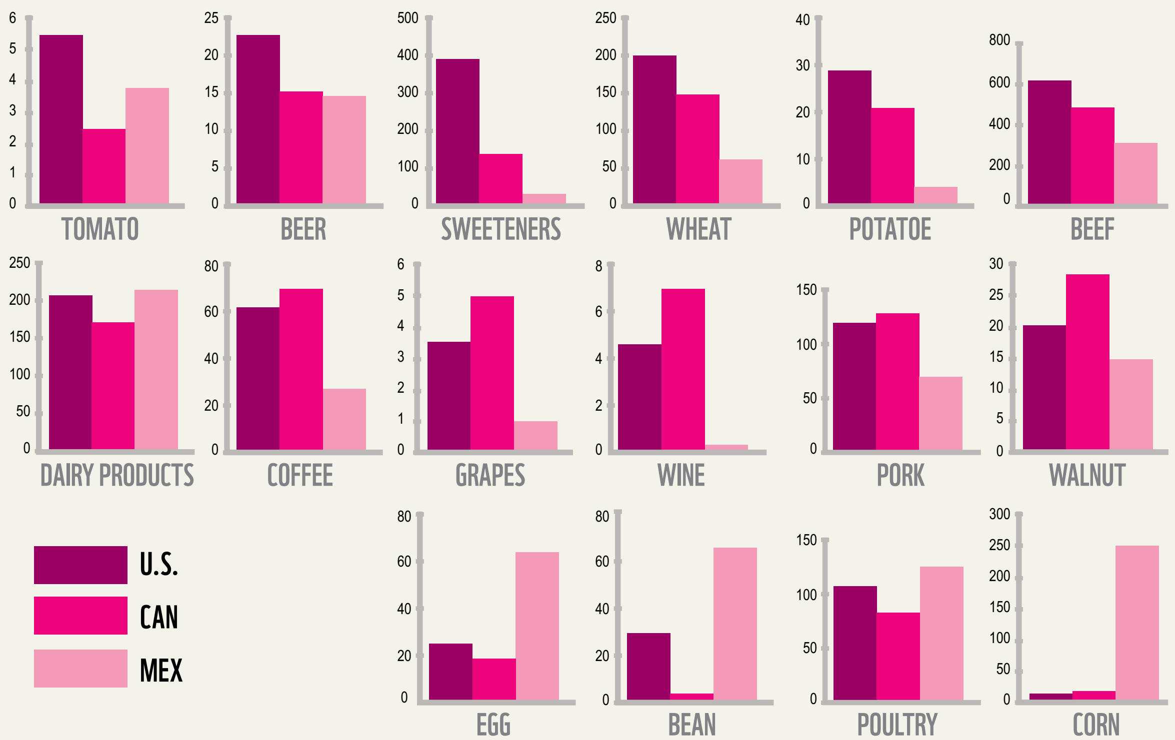
CONSUMPTION OF SELECTED PRODUCTS KG/PER CAPITA/YEAR

Product	Global	NA	CAN	MEX	USA
Apple	9.1	**25.0**	**20.3**	6.4	**25.5**
Bean	2.4	**3.0**	1.2	**10.8**	3.2
Beer	26.3	**86.2**	**84.1**	58.7	**86.4**
Coffee	1.2	**4.4**	**7.2**	0.8	**4.1**
Grape	3.9	**8.7**	**10.8**	2.1	**8.5**
Corn	**16.8**	13.3	19.5	**122.9**	12.6
Potato	31.7	**57.0**	**69.6**	17.5	**55.7**
Tomato	18.0	**43.7**	**31.7**	19.2	**45.0**
Wheat	65.9	**85.2**	**88.9**	35.5	**84.8**
Wine	3.7	**7.3**	**11.0**	0.2	**6.9**
Beef	9.6	**40.4**	**32.8**	18.2	**41.2**
Pork	15.1	**29.5**	**27.4**	13.6	**29.7**
Poultry	12.6	**49.4**	**37.5**	29.4	**50.7**
Egg	8.6	**14.0**	11.0	**18.4**	**14.3**
Milk	50.1	**119.3**	35.5	**91.1**	**128.3**
Cheese	2.8	**14.7**	**12.7**	2.2	**14.9**

AgroDer with information from FAOSTAT.

North America exceeds the global average of consumption per capita in all the main agricultural products but corn. When comparing the countries from NA, Mexico overtakes United States and Canada exclusively in the consumption of egg, corn, and bean. Apart from the volume consumed in every product, the product's origin, and its WF influence the calculation. All these differences in the consumption per capita are reflected in the water footprint.

WATER FOOTPRINT PER CAPITA FOR SELECTED PRODUCTS (m^3/YEAR)



FLOWS OF VIRTUAL WATER IN NORTH AMERICA

MAIN VIRTUAL FLOWS OF WATER AMONG NORTH AMERICAN COUNTRIES

Canada exports:

To the U.S, 27,556 Hm^3 in bovine animals, oilseeds, cereals, porcine animals, sugar and stimulants.

To Mexico, 5,298 Hm^3 in oilseeds, cereals, bovine animals, porcine animals and pulses.

The U.S. exports:

To Canada, 15,175 Hm^3 in oilseeds, cereals, bovine animals, stimulants, sugar and fruits.

To Mexico, 71, 063 Hm^3 in oilseeds, cereals, bovine animals, porcine animals, sugar, pulses and dairy products.

Mexico exports:

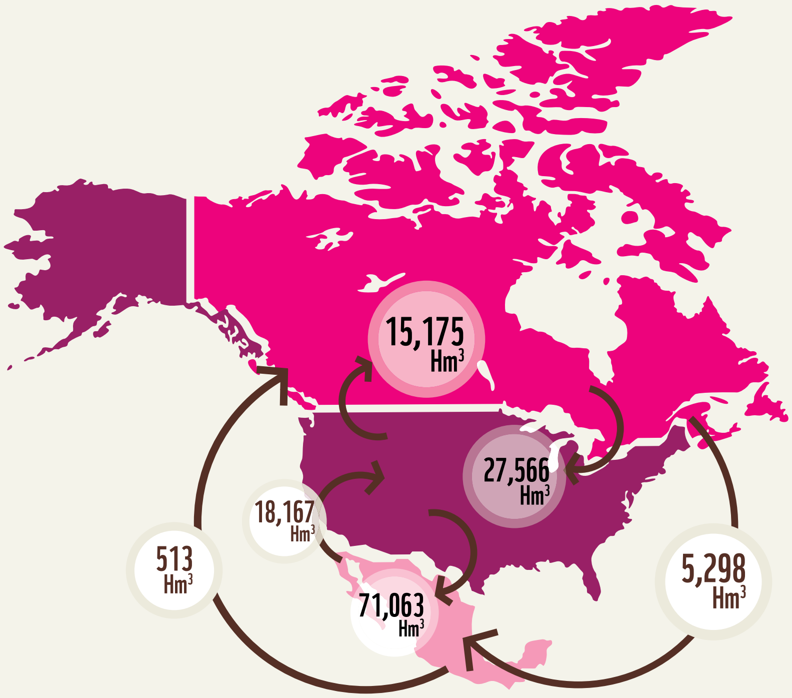
To Canada, 513 Hm^3 in stimulants, oilseeds and fruits, primarily.

To the U.S., 18, 167 Hm^3 in oilseeds, stimulants, bovine animals and fruits, primarily.

The virtual flows of water of the three countries are different: Canada and the U.S. import more industrial products than Mexico, where there highest proportion of imports belongs to agricultural products.

North America is a good example of water flow taking place in international transactions. Through trade in different products, 137,772 Hm^3 flow among them annually; these figures represent 13% of the region's WF.

VIRTUAL WATER FLOWS WITHIN NORTH AMERICAN NATIONS RELATED TO AGRICULTURAL PRODUCTS



AgroDer with information from the WFN, 2011.

The highest flow of virtual water takes place between the U.S. and Mexico. Water exports from the former to the latter, only in agricultural products, correspond to 71,063 Hm^3 per year; while, conversely, correspond to 18,167 Hm^3. There is a lower flow between the U.S. and Canada, although Canada exports to the U.S. nearly twice the amount it imports from it. Trade between Mexico and Canada is unrepresentative, but Canada exports to Mexico ten times what it imports from it.

Likewise, China has been growing as a NA's commercial partner, mainly as a supplier of products. In consequence, an important part of the WF of the three countries is originated in the Asian country, primarily for the U.S. (its main import supplier) and Canada.

CHINA EXTERNAL WATER FOOTPRINT

CHINA AS NORTH AMERICA'S TRADING PARTNER: SUPPLIER OF EXTERNAL WATER FOOTPRINT

China positioned itself as the second biggest global economy in 2009. It ranks 2nd among the countries supplying external WF to the U.S. and Canada, and 3rd to Mexico. Since the same period the NAFTA was created (1994), trade between China and NA has been growing exponentially: 1,000% to the U.S., 1,400% to Canada, and 9,000% to Mexico. Consequently, there is a negative balance of trade between these three countries and China.

Imports coming from China are predominantly industrial, even without any trade agreement between NA and China.

China currently houses 9% of the U.S.'s external WF, 6% of Canada's WF and 2% of Mexico's WF.

AgroDer with information from WB Databank, 2012; Canadian International Merchandise Trade Database, 2004-2011; United States Census Bureau, 2004-2011; Secretariat of Economy, 2004-2011; WaterStat, 2011; FAOSTAT, 2011.

48% of Canada's external WF is located outside NA; similarly, only 40% of its exports go to the U.S. and Mexico. Canada's virtual water balance is negative, as it exports more than twice the amount of water it imports; this means that it does not depend on the virtual water it imports.

VIRTUAL WATER FLOWS CANADA

Type	Hm^3/ year	%
Agricultural	25,538	67%
Livestock	4,418	12%
Industrial	8,225	21%

IMPORTS
38,181 Hm^3

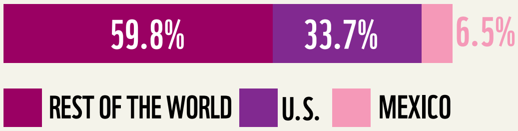
Type	Hm^3/ year	%
Agricultural	64,578	71%
Livestock	17,237	19%
Industrial	8,943	10%

EXPORTS
90,758 Hm^3

ORIGIN

BALANCE OF VIRTUAL WATER
-52,577 Hm^3

DESTINATION

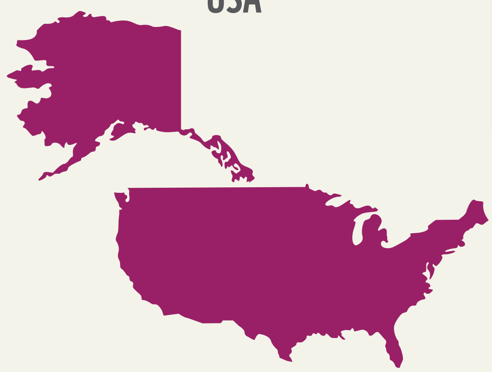


In the case of the U.S., 75% of its external WF is located outside NA. Its proportion of imports is similar to Canada's in their type of products. Regarding its VW exports, the largest amount of VW is related to agricultural products to countries apart from Mexico and Canada. Although a considerable volume VW is imported, its balance is negative, as it exports 40% more water that the amount it imports.

VIRTUAL WATER FLOWS USA

Type	Hm³/ year	%
Agricultural	158,787	68%
Livestock	25,027	11%
Industrial	50,277	21%

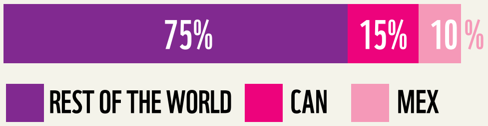
IMPORTS
234,091 Hm³



Type	Hm³/ year	%
Agricultural	251,919	80%
Livestock	36,982	12%
Industrial	24,771	8%

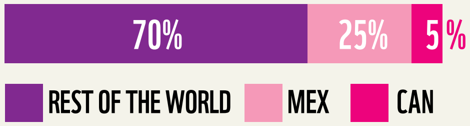
EXPORTS
313,672 Hm³

ORIGIN



BALANCE OF VIRTUAL WATER
-79,581 Hm³

DESTINATION



Unlike Canada and the U.S., Mexico has a greater dependence on imports. It has a positive virtual water balance, as it imports considerable volumes through agricultural products, coming primarily from the U.S.. From these three countries, Mexico is the only one whose main trading partners are located in NA, and whose virtual water balance is positive.

VIRTUAL WATER FLOWS MEXICO

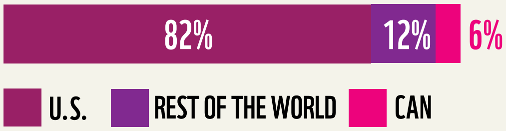
Type	Hm³/ year	%
Agricultural	70,822	77%
Livestock	15,881	17%
Industrial	5,595	6%

IMPORTS
92,298 Hm³

Type	Hm³/ year	%
Agricultural	20,540	79%
Livestock	2,448	9%
Industrial	3,117	12%

EXPORTS
26,105 Hm³

ORIGIN



BALANCE OF VIRTUAL WATER
66,193 Hm³

DESTINATION

IMPACT OF THE NORTH AMERICAN FREE TRADE AGREEMENT ON THE REGIONAL EXTERNAL WF

Mexico is the country with the largest number of trade agreements worldwide (12 with 43 countries). The most important one in terms of trade is the North American Free Trade Agreement (NAFTA), signed in 1994, which multiplied by five the trade value in the region (growing form $297 billion dollars in 1994 to $1.6 trillion dollars in 2010), representing 48% of the three countries' commercial activity.

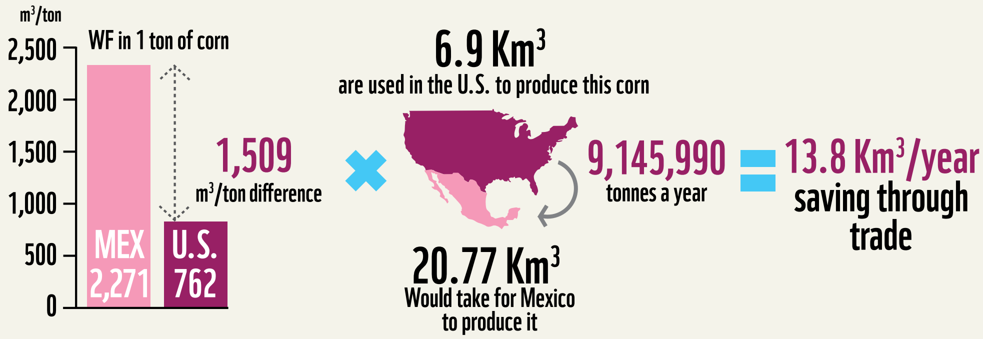
During this same period, our agricultural imports to the U.S. and Canada were increased nearly 500%.

Source: United States Census Bureau, 2003-2011; FAOSTAT, 2003-2011.

TRADE IN NORTH AMERICA AS A POTENTIAL WATER FOOTPRINT REDUCER

Regional trade may be seen as a way to reduce the WF of a nation: if a country produces a good or a crop, and supplies it to another country where it takes more water to be elaborated, this country is contributing to the reduction of the global WF.

SAVING WATER THROUGH COMMERCE: CORN FROM THE U.S. TO MEXICO



Through imports such as this one, Mexico reduces the use of its own resources to 83 Km³/year, rating 2nd in the countries with the highest trade-based water saving (only behind Japan, with 134 Km³/year).

INTERNATIONAL CORN TRADE

IS WATER SAVED?

Mexico is the biggest consumer of corn worldwide (123 kg/capita/year) and the U.S. is the main producer. Demand continues to rise and 30% of the Mexican consumption is provided through imports, representing 7% of the total virtual water imports; those coming from the U.S. (21,171 Hm³ of VW/year) have increased 556% since the beginning of the NAFTA, a period during which the Mexican production has increased 20%. The uses of corn detonate these changes: for the last 20 years, the consumption per capita of poultry meat has increased 300% in Mexico, triggering corn consumption (35% is used as a livestock input, mainly poultry). the U.S. extended its production 30% in 10 years: 40% of its corn is used to produce bioethanol (estimate, 2010).

In average, 900 liters of water are required to produce 1kg of corn. If Mexico produced the imported quantity of corn in its territory, it would generate a much larger WF: its green WF (1,852 m³/ton) is 72.4% larger than the U.S.'s, and its grey WF is 54% larger. From the corn-trade point of view, this exchange saves water.

However, if analyzed considering other factors, the result could be very different: in various regions of Mexico, corn has ceased to be grown and in turn, other considerably more profitable agricultural products have been sowed, some of them with a larger WF per hectare, like rice (8,400 m³/ha) and tomato (9,212 m³/ha). In consequence, the VW saved due to corn imports has translated into a larger regional WF.

AgroDer, with data from FAOSTAT, 2004-2010; SIAP-SAGARPA, 2011; SNIIM. Secretariat of Economy, 2010; National Corn Growers Association, 2011 and WFN, 2011.

ASYMMETRIES WITHIN NORTH AMERICA

This research explores the case of the water footprint in NA, with an emphasis in Mexico, and shows how the context of every country prevents them from being analyzed collectively, raising about the feasibility of establishing standarized water-management policies as an economic bloc.

Out of the 3 countries, Mexico is the most dependent on foreign water, and uses a higher proportion of blue water for agricultural production than the U.S. and Canada.

The NAFTA has had a great impact on North America's WF: trade and virtual water flows have increased drastically between these 3 countries since its inception. Mexico is the most dependent country on the regional water flows, as the U.S. and Canada are their main trading partners (87% of Mexico's external WF remains in NA).

Trade has grown exponentially and has become easier, faster and much more efficient among regions worldwide. Focusing local productions on specific markets has meant the subordination of land's productive vocation to economic utility. It is no longer about what can be grown sustainably, but rather what can be sold profitably, even when the production means a larger WF at the expense of other less-intensive water uses or ecosystems' health.

Economies of several nations are connected through agreements and trade flows: competitiveness leads some markets to produce wherever it is cheaper and more efficient. In some cases, it looks as if we were saving water: growing corn in the U.S. consumes less water than growing it in Mexico, and it seems at first glance as though both nations were saving water. However, it should be analyzed equally in terms of scarcity and water stress in the basins where it is produced.

Industry also takes part in this process: several countries have invested in Mexico with a view to the US market, taking advantage of the availability of a cheaper workforce and a shorter distance towards the destiny of the products. Therefore, the WF of industrial production in NA is also affected by trade dynamics. For this sector, close attention should be paid to the measures taken to mitigate the gray water footprint, which represents 12% of the total WF of production.

In Mexico, water has been distributed to create wealth above other ends; this wealth has been created where markets lie; in other words, it is used as a cheap input of the processes of a profitable business. Markets do not consider the origins of the water used to produce their inputs, nor how efficiently they have been used. The application of concepts encompassing the WF may enable the development of policies and standards regarding water management within the country; it can also provide information to consumers about water distribution among its different uses, and the efficiency and environmental responsibility of their suppliers.

WATER FOOTPRINT IN MEXICO

Its position in the world:
- 2° in balance
- 6° in imports
- 8° in consumption
- 11° in production
- 22° in exports
- 49° in per capita
- 57° in external WF

Production:
- 73% green
- 11% blue
- 16% grey

Consumption:
- 92% agricultural
- 42% foreign

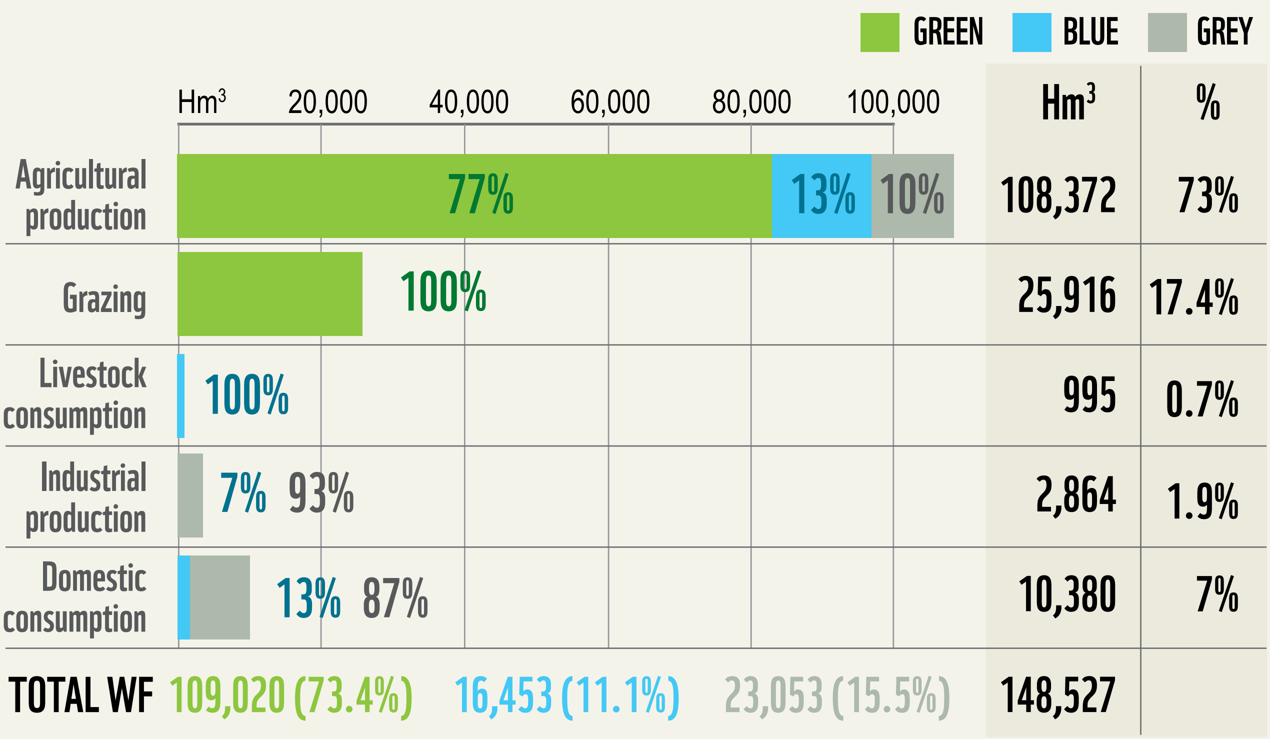
Per Capita:
- 17% beef
- 13% corn

MEXICO'S WF OF PRODUCTION

Mexico ranks 11th in the countries with the largest production WF worldwide. Agricultural production is the major component, followed by the livestock sector (grazing and production); together they represent the 91% of the production WF, mainly green water.

The production WF indicator is dynamic, as it changes every year according to the variability in the uses: agricultural production changes every year as new users arise in the industry, the efficiency of their processes varies and the cities see a rise in treatment plants and in population with access to drinking water and drainage systems.

MEXICO'S PRODUCTION WATER FOOTPRINT
SECTOR/COLOR/Hm^3 PER YEAR



AgroDer SC with information from the WFN, 2011.

THE EFFECT OF CLIMATE VARIABILITY ON THE MEXICAN WF

Droughts affecting most of the territory, as well as a large area of the U.S. and Canada, have brought changes in regional production and trade. In 2012, Mexico lost 6 million tonnes of corn and 120 thousand tonnes of bean that would have represented a WF of 56 thousand Hm^3 and 602 Hm^3 respectively.

In the case of corn, to fulfill the demand, an emergency 144 thousand hectares were sowed in Oaxaca, Chiapas, Campeche and Veracruz, states with a smaller WF (2,157 m^3/ton) than that of states where sowing was originally made (Chihuahua, Durango, Zacatecas and San Luis Potosí, with an average of 2,762 m^3/ton).

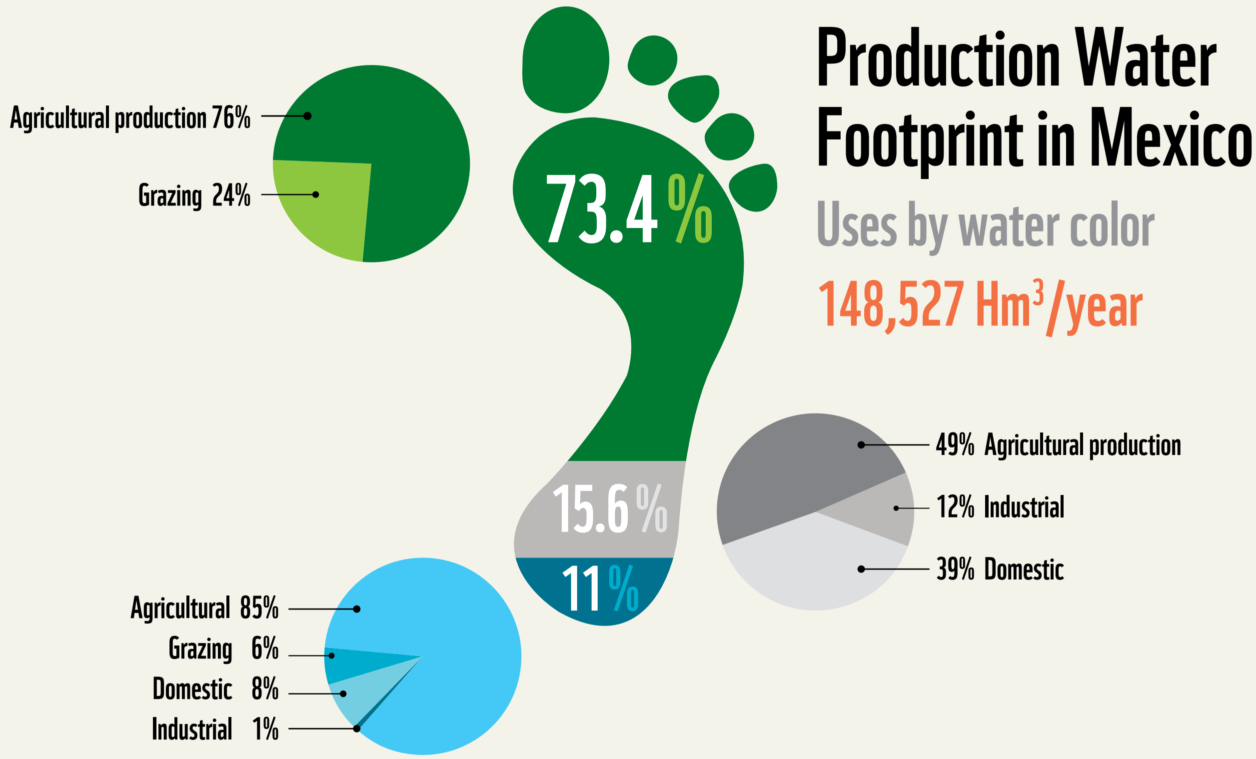
At the same time, Mexico will import more bean than usual to cover the demand.

During the period 2001-2009, Mexico imported in average 100,000 tonnes of bean (a WF of 500 Hm^3 per year). By 2012, it is expected to at least double this amount of imports, which implies duplicating the external WF related to bean.

AgroDer with information from SAGARPA, 2012; WFN, 2011 and FAOSTAT, 2011.

Most of Mexico's green WF is linked to agricultural activity (76%), while grazing accounts for 24%. With respect to blue water, 85% is attributed to agricultural irrigation, and 1% to industrial use. Practically half of the grey water is linked to agricultural production, 39% to domestic use and 12% to industrial use.

AgroDer with information from the WFN, 2010.



CASE

SAN PEDRO MEZQUITAL (SPM) RIVER

Being one of the few rivers streaming freely in the country, the flow of the San Pedro Mezquital river, between the states of Durango and Nayarit, sustains several ecosystems in its path, including the largest wetland in the Mexican Pacific, Marismas Nacionales, declared a Biosphere Reserve and wetland of international importance on the Ramsar list.

The fact that the river streams freely does not mean that its water lacks of productive purposes, agriculture being the essential one. More than 50 different crops cover 280 thousand ha (88% rainfed, 12% irrigation).

Within the Irrigation District 52 SPM-Durango (21 thousand ha), 23 crops are grown every year, the largest being maize (54% of the total area), oat, alfalfa, wheat, chilli, nut and bean. Nearly 7,000 hectares are grass, which are not considered in the analysis.

In 2010, water concessions of the DDR52 distributed 169 Hm^3 of water to 3,122 agricultural users. This represents 4% of the natural SPM availability. The total WF of the products grown in this district is 203 Hm^3/year (71% green, 15% blue and 14% grey).

In this basin, water extraction respects the environmental flow, which exemplifies a case in which water footprint can still be managed to maintain itself under sustainable conditions. The environmental flow sustains ecosystems in its path, brings the resource to the lower basin, and provides water to fishermen, agricultors and stockbreeders. They use it productively too, making profits without deriving into a potential threat of scarcity or water stress.

		Surface		Water Footprint (Hm^3/year)				
Crop	Production (ton, 2010)	Ha	%	Green	Blue	Grey	Total WF	% Total
Maize-grain	45,442	7,154	51%	89.0	6.5	19.2	114.8	56.6%
Alfalfa	20,063	1,149	8%	25.6	5.5	6.5	37.6	18.6%
Nuts	1,464	811	6%	7.1	5.0	0.0	12.1	6.0%
Forage oat	3,002	718	5%	4.8	3.2	0.2	8.2	4.1%
Dry chilli	963	792	6%	3.1	3.7	0.2	6.9	3.4%
Wheat	3,114	891	6%	3.6	2.5	0.2	6.2	3.1%
Oat	3,642	967	7%	1.2	2.5	0.7	4.3	2.1%
Other 16 crops*	11,587	1,520	11%	10.4	0.6	1.3	12.4	6.1%
Total	**89,277**	**14,002**	**100%**	**144.7**	**29.5**	**28.3**	**202.62**	**100.0%**
				71%	**15%**	**14%**		

* Maize (forage), beans, triticale, maize (corn), sorghum, apple, lettuce, cabbage, squash, pear, onion, barley, cucumber, chickpea, coriander and carrot.

AgroDer 2012, with information from CONAGUA, WFN and FAOSTAT.

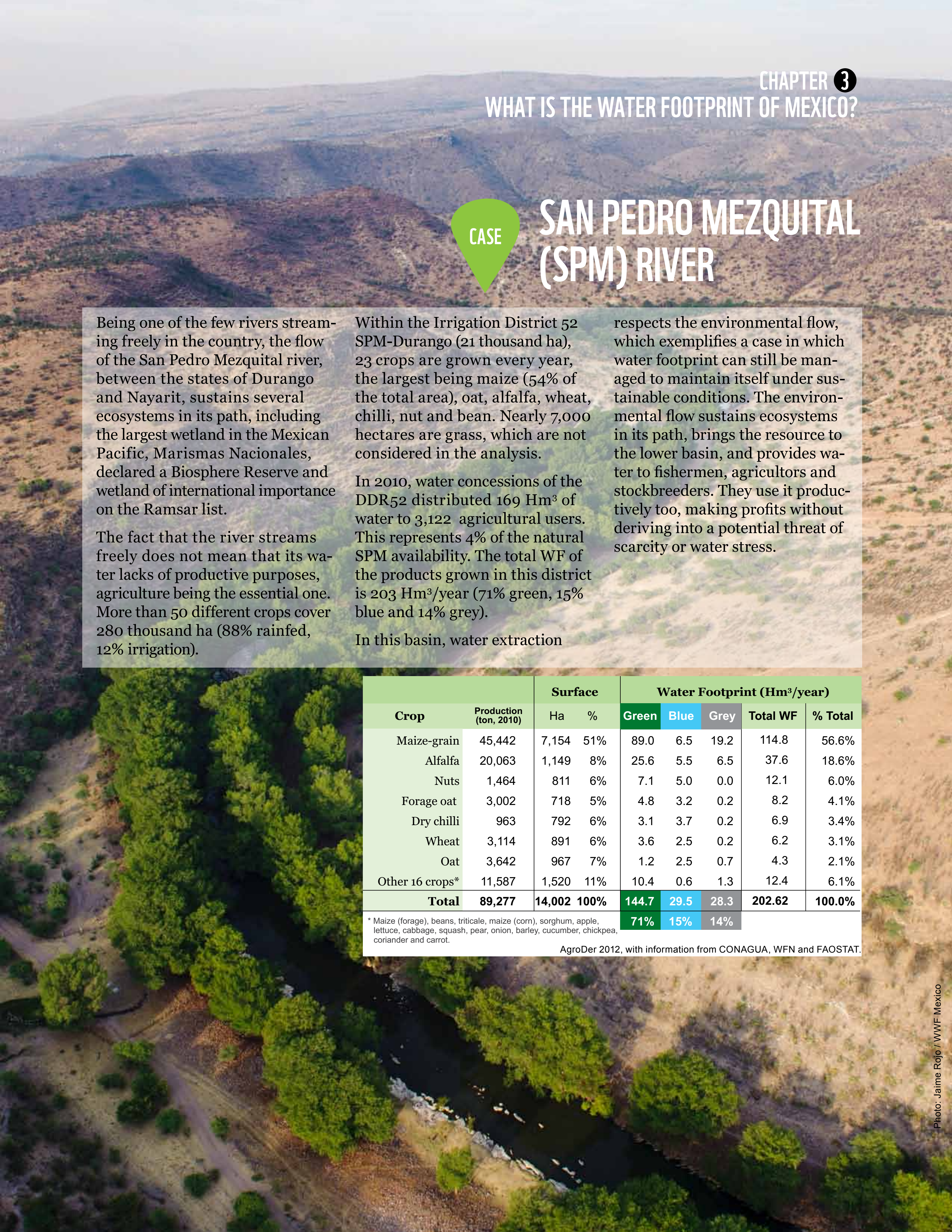
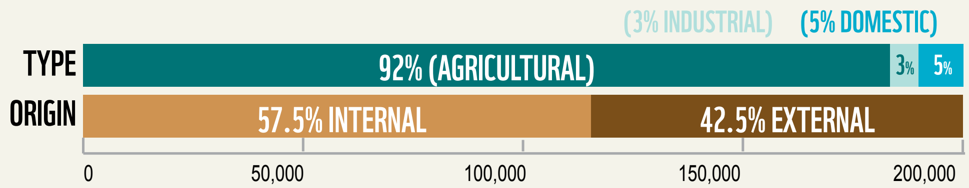


Photo: Jaime Rojo / WWF Mexico

MEXICO'S WF OF CONSUMPTION

The WF of consumption in Mexico is the 8th biggest worldwide, mainly due to its population size (11th most populated country). Of the total consumption, only 27% is industrial and 5.3% is domestic. At a national level, Mexico has a WF of 197 thousand Hm³.

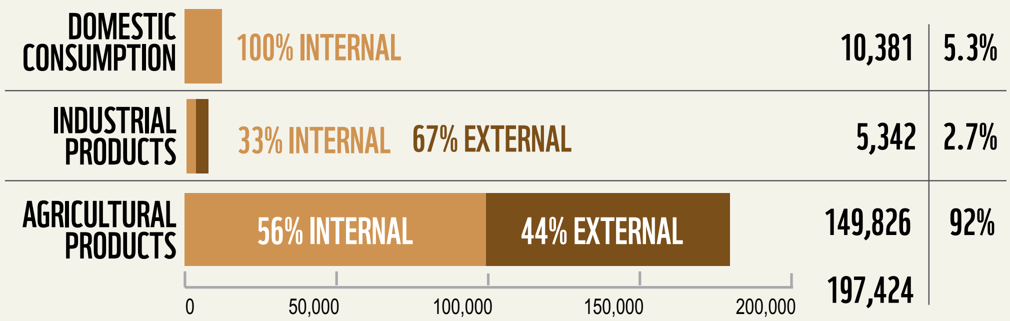
CONSUMPTION WF IN MEXICO
TYPE/ORIGIN
Hm³ PER YEAR
197,424 Hm³



AgroDer SC with information from the WFN.

58% of the consumption WF is internal. Mexico imports nearly half of its food, which is revealed in the external WF of agricultural products. For industrial products, 67% of the WF is external.

CONSUMPTION WF IN MEXICO
TYPE/ORIGIN
INTERNAL/EXTERNAL
Hm³ PER YEAR



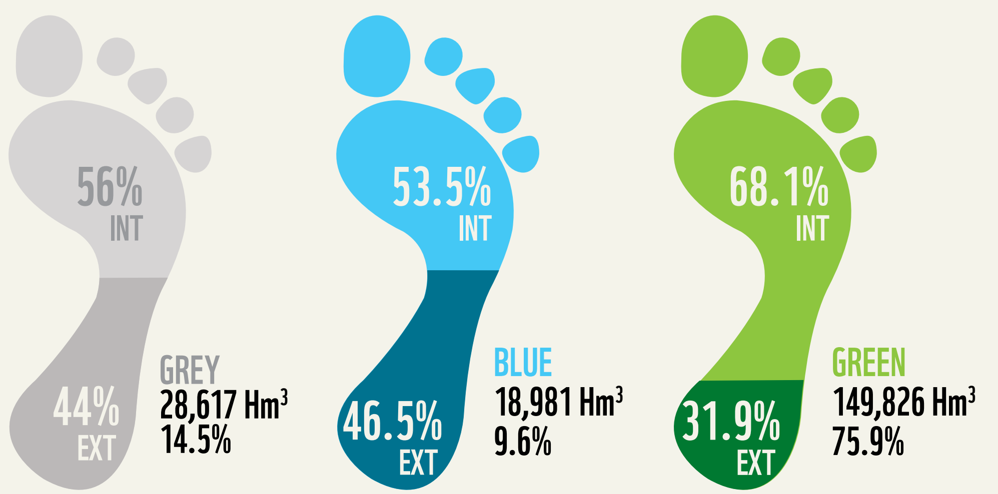
AgroDer SC with information from the WFN.

Food imports reflect a high volume of green water imports and a large proportion of blue water within the consumption WF.

Regarding the consumption WF per capita, Mexico ranks 48th worldwide, with 1,978 m³ per capita a year (higher than the global average of 1,385 m³ per capita a year).

CONSUMPTION WF IN MEXICO
INTERNAL/EXTERNAL
COLOR
Hm³ PER YEAR

TOTAL
197,424 Hm³



AgroDer SC with information from the WFN.

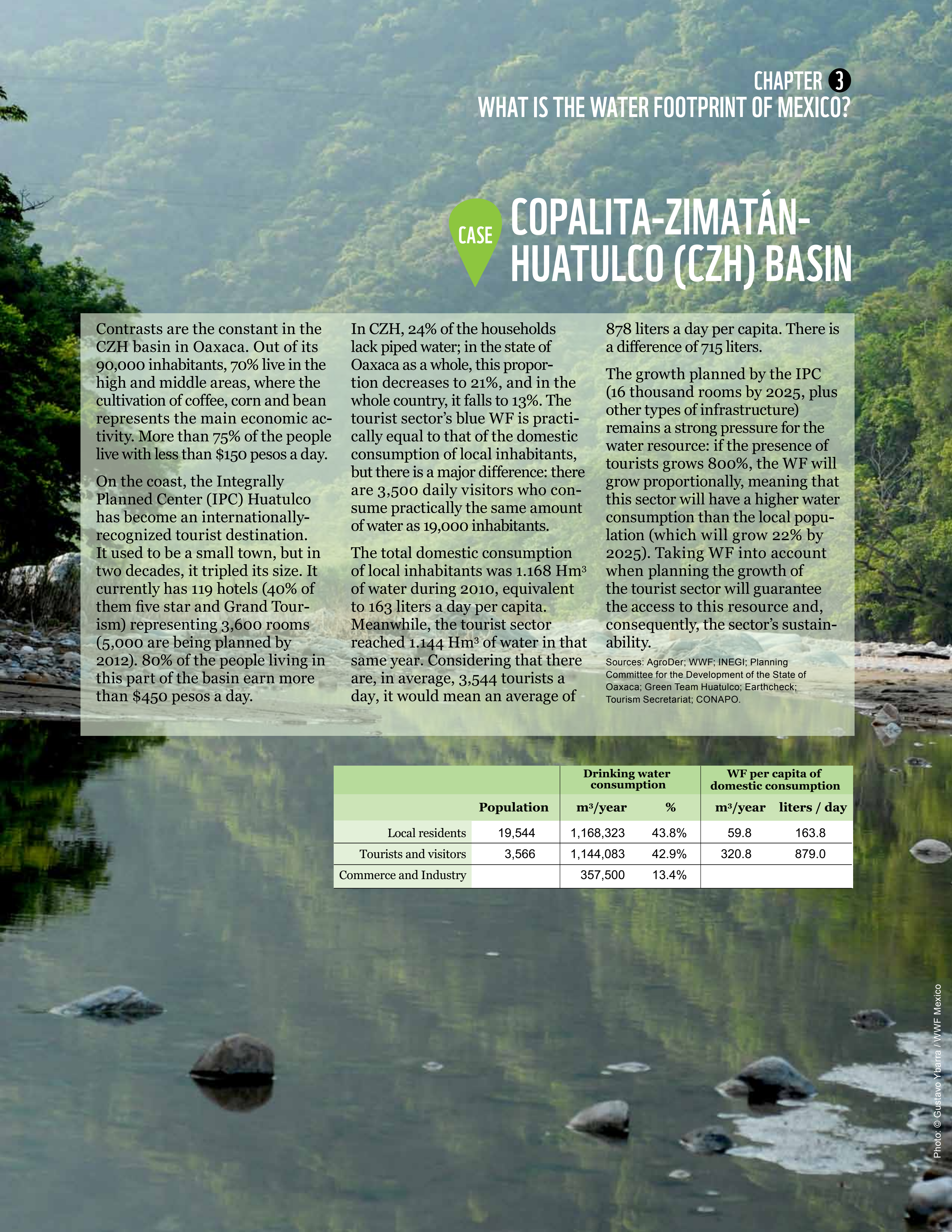


Photo: © Gustavo Ybarra / WWF Mexico

CASE

COPALITA-ZIMATÁN-HUATULCO (CZH) BASIN

Contrasts are the constant in the CZH basin in Oaxaca. Out of its 90,000 inhabitants, 70% live in the high and middle areas, where the cultivation of coffee, corn and bean represents the main economic activity. More than 75% of the people live with less than $150 pesos a day.

On the coast, the Integrally Planned Center (IPC) Huatulco has become an internationally-recognized tourist destination. It used to be a small town, but in two decades, it tripled its size. It currently has 119 hotels (40% of them five star and Grand Tourism) representing 3,600 rooms (5,000 are being planned by 2012). 80% of the people living in this part of the basin earn more than $450 pesos a day.

In CZH, 24% of the households lack piped water; in the state of Oaxaca as a whole, this proportion decreases to 21%, and in the whole country, it falls to 13%. The tourist sector's blue WF is practically equal to that of the domestic consumption of local inhabitants, but there is a major difference: there are 3,500 daily visitors who consume practically the same amount of water as 19,000 inhabitants.

The total domestic consumption of local inhabitants was 1.168 Hm^3 of water during 2010, equivalent to 163 liters a day per capita. Meanwhile, the tourist sector reached 1.144 Hm^3 of water in that same year. Considering that there are, in average, 3,544 tourists a day, it would mean an average of 878 liters a day per capita. There is a difference of 715 liters.

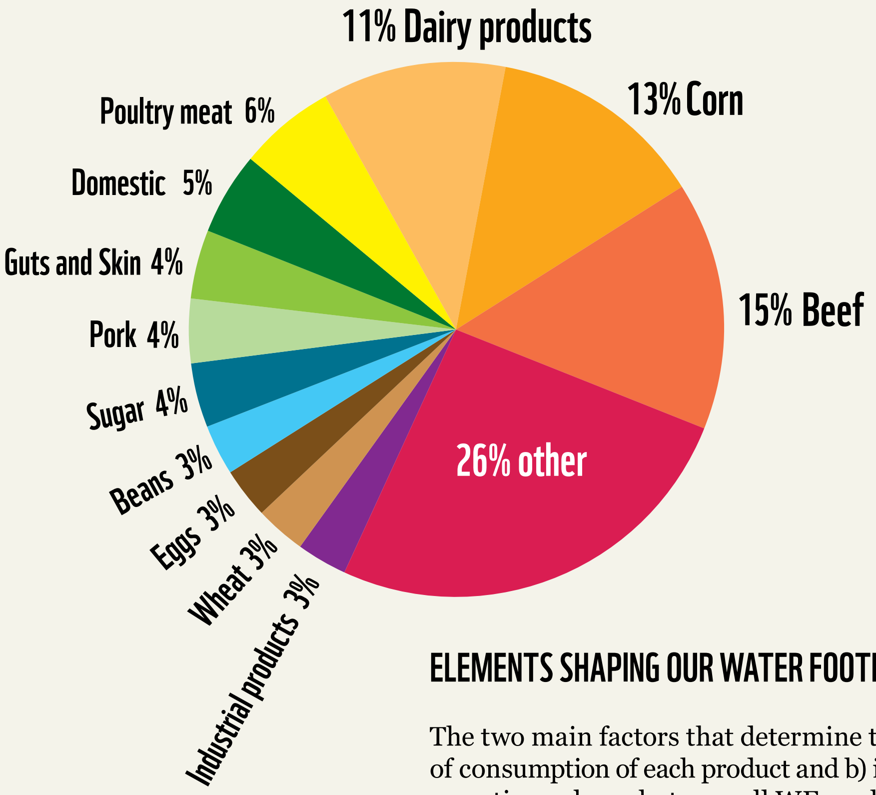
The growth planned by the IPC (16 thousand rooms by 2025, plus other types of infrastructure) remains a strong pressure for the water resource: if the presence of tourists grows 800%, the WF will grow proportionally, meaning that this sector will have a higher water consumption than the local population (which will grow 22% by 2025). Taking WF into account when planning the growth of the tourist sector will guarantee the access to this resource and, consequently, the sector's sustainability.

Sources: AgroDer; WWF; INEGI; Planning Committee for the Development of the State of Oaxaca; Green Team Huatulco; Earthcheck; Tourism Secretariat; CONAPO.

		Drinking water consumption		WF per capita of domestic consumption	
	Population	**m^3/year**	**%**	**m^3/year**	**liters / day**
Local residents	19,544	1,168,323	43.8%	59.8	163.8
Tourists and visitors	3,566	1,144,083	42.9%	320.8	879.0
Commerce and Industry		357,500	13.4%		

MEXICO'S WATER FOOTPRINT PER CAPITA

86% of a mexican's WF is conformed by food products and drinks, 6% by agricultural products (mainly furs and cotton), 5% by domestic consumption and 3% by industrial products.



CONSUMPTION WATER FOOTPRINT PER CAPITA PER PRODUCT IN MEXICO

AgroDer with information from FAOSTAT, SIAP and WFN.

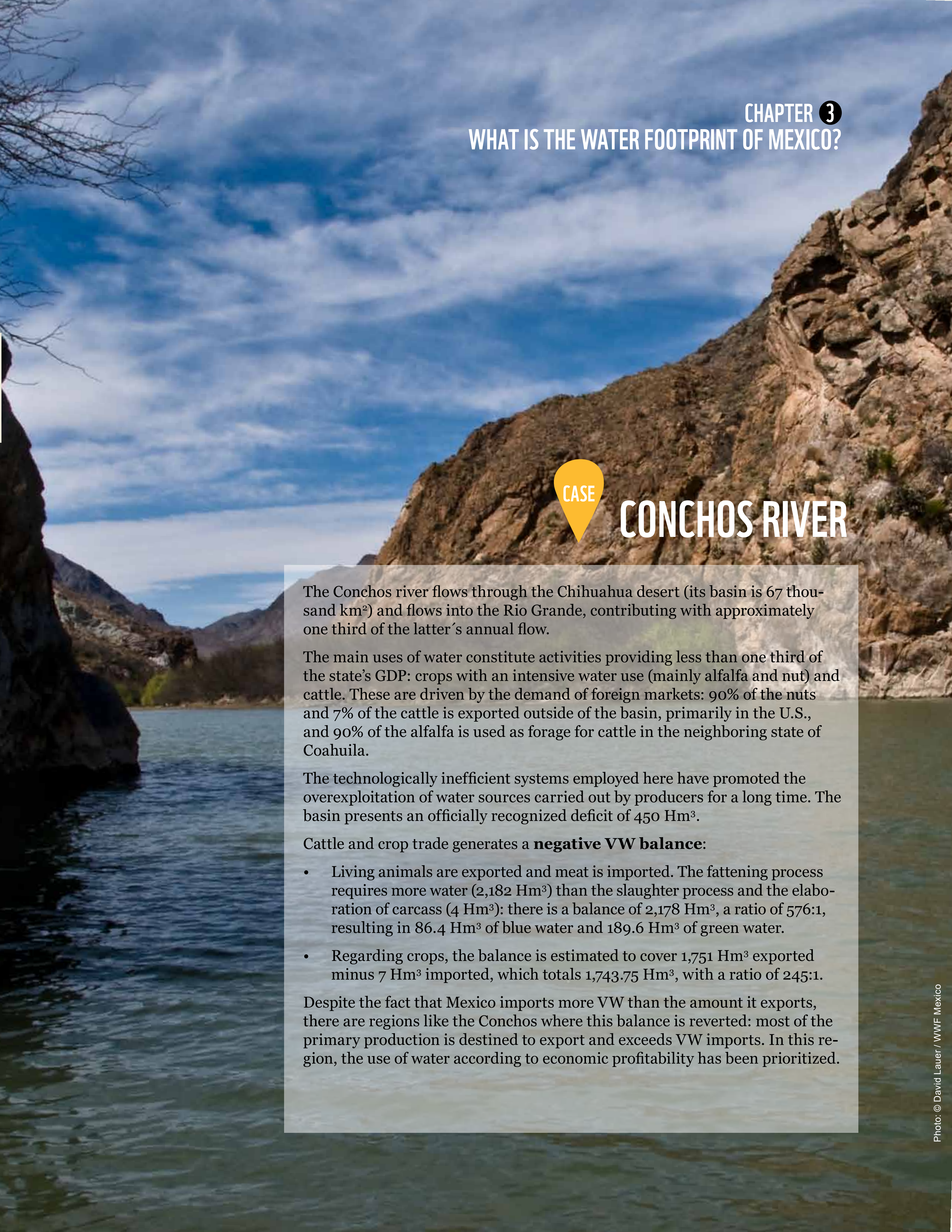
ELEMENTS SHAPING OUR WATER FOOTPRINT

The two main factors that determine the WF per capita are: a) the volume of consumption of each product and b) its WF. A product with a high consumption volume but a small WF per kg may suggest a smaller WF per capita than another product with a lower consumption volume but a larger WF per kg. For example, in Mexico, 15 % of our WF is due to beef consumption and 13% due to corn. Though we eat much more corn (123 kg a year per capita) than beef (18 kg a year per capita), the elaboration of 1kg of meat requires, in average, 10 times more water than 1 kg of corn. So, although we consume beef at a lower volume, its production suggests a larger WF.

Our external WF is located mainly in 3 countries:

- 80.9% U.S.
- 6.2% Canada
- 1.3% China

76% of virtual water imports are agricultural products, 7% livestock and 6% industrial, primarily vegetable oils, cereals and bovine. The main exports (grouped in FAO's categories) are vegetable oils and stimulants (coffee, cocoa and tea), as well as 12% related to industrial products.



CASE

CONCHOS RIVER

The Conchos river flows through the Chihuahua desert (its basin is 67 thousand km^2) and flows into the Rio Grande, contributing with approximately one third of the latter´s annual flow.

The main uses of water constitute activities providing less than one third of the state's GDP: crops with an intensive water use (mainly alfalfa and nut) and cattle. These are driven by the demand of foreign markets: 90% of the nuts and 7% of the cattle is exported outside of the basin, primarily in the U.S., and 90% of the alfalfa is used as forage for cattle in the neighboring state of Coahuila.

The technologically inefficient systems employed here have promoted the overexploitation of water sources carried out by producers for a long time. The basin presents an officially recognized deficit of 450 Hm^3.

Cattle and crop trade generates a **negative VW balance**:

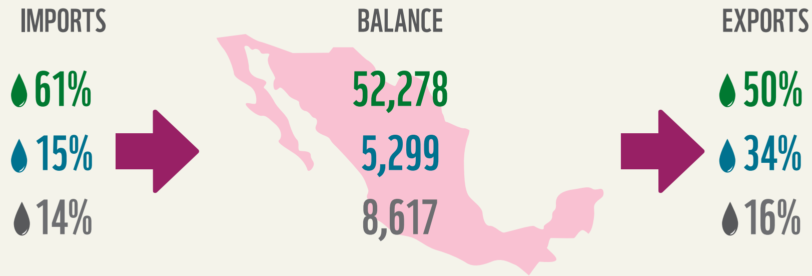
- Living animals are exported and meat is imported. The fattening process requires more water (2,182 Hm^3) than the slaughter process and the elaboration of carcass (4 Hm^3): there is a balance of 2,178 Hm^3, a ratio of 576:1, resulting in 86.4 Hm^3 of blue water and 189.6 Hm^3 of green water.
- Regarding crops, the balance is estimated to cover 1,751 Hm^3 exported minus 7 Hm^3 imported, which totals 1,743.75 Hm^3, with a ratio of 245:1.

Despite the fact that Mexico imports more VW than the amount it exports, there are regions like the Conchos where this balance is reverted: most of the primary production is destined to export and exceeds VW imports. In this region, the use of water according to economic profitability has been prioritized.

Photo: © David Lauer / WWF Mexico

The VW balance shows that, proportionally, Mexico exports more blue water (34%) than the amount it imports (15%), and receives a larger proportion of green water than the amount it exports.

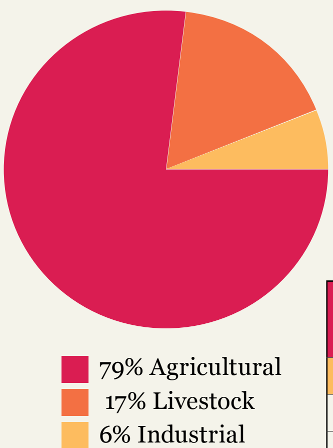
VIRTUAL WATER FLOWS BY COLOR (%)
BALANCE OF VIRTUAL WATER (Hm³)



Both imports and exports of virtual water are mostly driven by agricultural production.

Source: FAOSTAT 2000-2011 and AgroDer with information from the WFN, 2010.

VIRTUAL WATER IMPORTS
92,299 Hm³ / year



Hm³/year	Product
5,595	Industrial

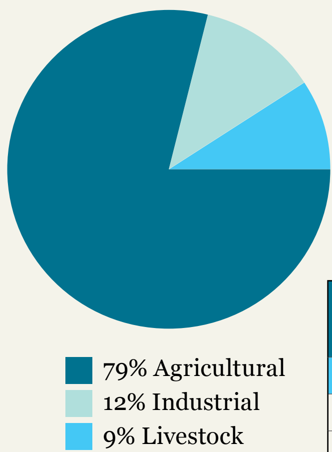
Imports of virtual water through agricultural production

Hm³ / year	Product
48,840	Vegetable oils
17,823	Cereals
1,015	Sugar
888	Pulses
869	Stimulants
503	Spices
374	Fruits
269	Nuts
80	Vegetables
63	Vegetable fibers
60	Roots and tubers
31	Tobacco
6	Forage
1	Others
70,822 Hm³	**Total**

Imports of virtual water through livestock production

Hm³ / year	Product
12,227	Bovine
1,503	Milk
1,289	Porcine
435	Ovine and Caprine
238	Equine
189	Poultry
15,881 Hm³	**Total**

VIRTUAL WATER EXPORTS
26,105 Hm³ / year



Hm³ / year	Product
3,117	Industrial

Imports of virtual water through agricultural production

Hm³ / year	Product
10,756	Vegetable oils
4,876	Stimulants
1,403	Fruits
1,096	Cereals
713	Sugar
703	Vegetables
329	Spices
239	Pulses
237	Nuts
163	Roots and tubers
22	Tobacco
1	Forage
1	Vegetable fibers
1	Others
20,540 Hm³	**Total**

Imports of virtual water through livestock production

Hm³ / year	Product
1,922	Bovine
224	Porcine
161	Dairy products
126	Equine
12	Poultry
3	Ovine and Caprine
2,448 Hm³	**Total**

CASE

TOMATO

Tomato is the most important vegetable worldwide in terms of production and trade.

Of the global total, 8% is produced in North America. Since the beginning of the NAFTA, Mexico and the U.S. have increased their consumption per capita between 16% and 19%. Mexico exports 133% (650 thousand tonnes approximately) more tomato than before the agreement took place, while the U.S. production has increased 35%, although it still does not satisfy its increasing local demand. Therefore the U.S. imports its deficit from our country. Mexico exports 1 million tonnes of tomato to the U.S. annually (representing 83% of its tomato's imports from this country), equivalent to half the national production.

As tomato is a highly profitable crop, Mexico's greatest producers have sufficient economic and political power as to cultivate in practically any region in the country where available water concessions exist, quickly migrating their production from one basin to another whenever required.

Most of the U.S. tomato production comes from greenhouses unified in technology and efficiency. On the other hand, producers in Mexico use a great variety of systems, generally less technical. Consequently, Mexico's WF in tomato (85 m^3/ton of blue water) is larger than the global average (63 m^3/ton), while the U.S.'s is 31 m^3/ton.

That said, more and more tomato is being produced in Mexico. As long as it continues to be a profitable business and has a safe market, these variables will be more important for the producer than the WF of its activity and the sustainable balance of any basin.

AgroDer, with information from the WFN, 2011; FAOSTAT, 2011.

Photo: *Creative Commons Attribution-Share Alike 3.0. Fir0002*, Wikipedia

WHAT LIES BEHIND THESE WATER FLOWS?

MEXICO:
AGRICULTURAL IRRIGATION HOLDS 77% OF THE TOTAL AMOUNT OF WATER GRANTED

The previous analysis gives us a broad vision of water flows through different economic activities in the world. They are influenced by characteristics that vary according to each zone and activity.

To understand the situation in Mexico, it is necessary to identify the main factors shaping our water footprint of both production and consumption. The water distribution, its different uses and the way they are prioritized are some of the factors influencing the dimensions and shape of our WF. Simultaneously, the openness of the mexican economy has had an irreversible impact on our dependence on trade flows with foreign countries.

ARE GOODS PRODUCED ACCORDING TO THEIR ADAPTATION TO THE PHYSICAL ENVIRONMENT OR TO THE COMMERCIAL SETTINGS?

Of all human activities, agriculture consumes the most water. In Mexico, agricultural irrigation holds 77% of the total amount of water granted of which 66% is surface water (CONAGUA, 2011). 85% of blue water is destined to primary production, the activity responsible for the generation of 50% of grey water.

There are 3 factors playing a major role in determining what to produce when we talk about agricultural products: water availability, pedological studies, and access to markets.

When the production involves a commercial purpose, the user will look forward to a higher economic utility for the amount of money he puts on each investment. Considering that an irrigated crop produces more than 3.5 times what a seasonal crop does (CONAGUA, 2011), which generally produces a higher profit per harvested ton of crop, it is common to find a large crop rotation from one season to the other in places that comprise facilities for irrigation, and availability of water. This is primarily due to the markets' dynamics, given that farmers guide their production towards the trends of the diverse niches they identify.

The leasing of lands that hold water concessions is also a widespread activity: the owner gets an annual return for yielding the surface and the water rights of his or her land to a third party that exploits them. These areas often suffer land degradation due to the excessive use of fertilizers and pesticides, which results in a larger gray WF.

WHAT DETONATES VIRTUAL WATER FLOWS BETWEEN NATIONS?

Currently, 22% of the consumption WF in the world is external. Trading companies between countries, large corporations and individuals are growing increasingly. The fall of custom barriers (through trade or free trade agreements), the harmonization of standards, the improvement in communications and transport, and the ability to make money transfers have detonated the global growth of international trade.

Several economies throughout the world have specialized in manufactures or services supplying foreign countries, harnessing its competitive and comparative advantages in relation to their production's country of destination. In addition, the investment from one country to another with the purpose of exporting to a third party is a constant among emerging economies.

In countries like Mexico, most exports are directed to the U.S., the main destination of their VW transfers. Conversely, the U.S. has made China its main supplier of industrial products, and other regions of the world its main suppliers of agricultural products (SRE, 2004-2010; the U.S. Department of Commerce, 2000-2011).

DOES CLIMATE CHANGE AFFECT OUR WATER FOOTPRINT?

The National Water Commission of Mexico (CONAGUA) predicts a decrease in Mexico's water availability due to the effects of climate change, and a high variability in the traditional patterns of precipitation, soil moisture and runoff. This will affect our availability of blue and green water in several basins. Their sustainability must start from policies and plans designed considering the analysis of WF of the different productive uses of water, taking into account their feasibility according to natural availability and environmental flow.

In merely 3 years, Mexico has lived contrasting and catastrophic situations:

- 2009: Mexico experimented its second worst drought in 60 years
- 2010: it has been the rainiest year ever recorded
- 2011: the most severe drought in 70 years took place

According to the federal government, at least 22 million Mexicans are vulnerable to extreme climatic events such as cyclones, floods and droughts. As a consequence of these phenomena, the country has faced fires, shortages in drinking water and losses in harvests and cattle, affecting production negatively (agricultural and industrial).

Food shortage is an externality of climate change, which is generally covered by imports, modifying the consumption and production WF, and the VW flows. The productive reconversion and the adoption of more efficient technologies will be necessary in many regions, as nobody knows the amount of water available next year. In this context, the nations that are capable of using water efficiently will be better prepared to face the challenges posed by climate change.

WATER FOOTPRINT: CONCEPTS AND APPLICATIONS

The study of the WF contributes to the knowledge of the real water flows through production and consumption, enabling the identification of its origin and destination, as well as the way it is used to satisfy needs or generate wealth. By combining it with other tools, it brings a broader view of the level of exploitation of the resource in different latitudes of the planet.

The WF analysis must not be interpreted as an isolated element: it is a tool oriented towards bringing basic information which, analyzed in the regional context along with other relevant indicators, may be useful for decision makers. Other factors to consider are climatic, hydrological and geographical, as well as the productive models used in the different regions, the local demographic evolution and the future scenarios.

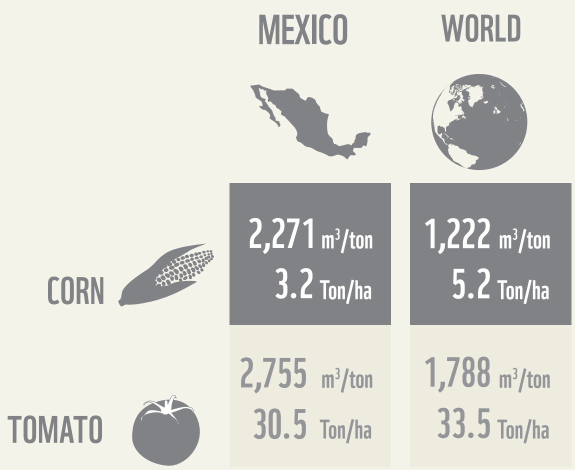
The production WF is mainly determined by the agricultural practices, their management, technology and performance; also by irrigation and climatic and hydrological variables. When production is focused on a specific market, crops are harvested under particular circumstances to comply with quality standards, display requirements and demand volumes of the target niche: the buyer sets the conditions, but not the characteristics of the production site, nor the availability of resources.

Conversely, the consumption WF is based on our way of life, our eating habits, the clothes we wear and the technology surrounding us at our jobs and households. The former are directly related to the purchasing power of every nation's inhabitants.

CONCLUSIONS

Mexico is the 11th country with the largest production WF, and the 8th in consumption WF in the world. This is due to its population size (11th most populated country) and its territory size (14th place). Although per capita consumption is relatively moderate (49th place, with 1,978 m^3 per capita a year), it ranks above the global average. However, a distribution curve would show the diversity of these types of consumption: 40% of the Mexicans have some degree of malnutrition or eating deterioration, reducing their food consumption per capita to less than that of the remaining 60%. (FAO)

Most of the Mexican WF, internal and external, is originated by agricultural products. The national food production is expensive in terms of both economic and water resources:

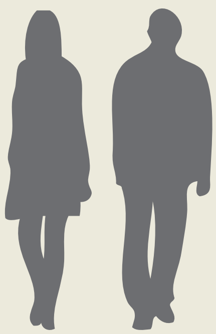


Regarding the global average, the crop yields in Mexico are lower and the WF per tonne is higher: we produce less with more.

Production is not always intended for local consumption: agricultural exports have grown increasingly during the last few years. Although we are classified as water importers, there are examples of products with large extensions of crops particularly intended for exports.

As a result, although large volumes of water (62,000 Hm^3 in 2009) and areas (22 million hr. in 2011) are intended for primary production, yields are insufficient to provide for the whole national population, and the water demand jeopardizes the sustainability of ecosystems.

GLOBAL WATER FOOTPRINT
THE WF GENERATED EVERY YEAR PER INHABITANT IS 1,385m^3



IMMEDIATE SCENARIO: 2012

The world has 7 billion inhabitants, to which 140 million are added each year. Every one of them leaves a WF of 1,385 m^3 a year in average. 90% of this footprint will be due to food (1,150 m^3). Paradoxically, 30% of this food will end up in the garbage (average of food wasted globally, according to FAO).

Mexico surpassed its growth expectations between 2005 and 2010. There are more than 113 million Mexicans, with a tendency towards adding 1,200,000 more inhabitants each year (INEGI, CONAPO). With the current consumption patterns, 1,978 m^3 will be required to meet the demand of goods and services of everyone yearly. This means an additional 2,374 Hm^3 each year with respect to the current consumption WF.

Although the sowed area in Mexico has not grown significantly (SIAP) in the last 10 years, the volume of water granted for irrigation has grown nearly 20% during that same period.

All of this takes place while 21 million Mexicans live in food poverty (CONEVAL, 2010) and 18% of the global population, along with 13% of Mexicans, do not have access to safe drinking water.

CHALLENGES

The heterogeneous water allocation in the planet is a natural condition. However, the inequitable distribution between its different uses has been a human choice. Several regions of Mexico face their worst drought in 70 years. At the same time, the demand for agricultural products grows at a more accelerated rate than the population, detonating the expansion of the agricultural frontier. In spite of counting with more water for irrigation and –in some cases— more technology, the yields per hectare in some regions are increasingly lower.

The diversion of river runways and the over-exploitation of bodies of water jeopardize the stream for the ecosystem and, thus, its conservation. In some urban areas, the excessive growth forces water's extraction from surrounding basins. Water harvesting is null in some regions, not all of the water is treated before pouring it back to bodies of water, and historically, water requirements for ecosystem functioning have not been considered.

A rise in agricultural productivity and efficiency by maximizing the productivity of each water drop, as well as a better collection and utilization of rainfall water may contribute to a reduction in WF and the pressure it exerts on basins.

In turn, the WF must contribute to the discussion about the productive reconversion and the use of water, considering the environmental flow, the land characteristics and the access to a technology that increases efficiency, especially in areas with scarcity or water stress.

In parallel, food security (understood as the physical, social and economic access to hygienically safe food in sufficient quantity and quality) must not be more compromised or stressed than it currently is.

AN ALTERNATIVE

More than often, governments focus their efforts on economic development, encouraging the industry, farming, livestock and generation of electricity, as well as the strengthening of social policies. Frequently, the proper water management and the health of the ecosystems are not a priority when implementing policies in support of these sectors.

One of the premises must be to obtain the greatest performance out of each drop of water destined to production with the ultimate productive efficiency, which must be translated as a better management of the water resource and a more equitable access to food, pursuing food security.

As these are only few of the problems, the equation implicitly brings the need to use our water resources intelligently and efficiently: to guarantee the environmental flow and food security.

The Alliance WWF-Gonzalo Río Arronte Foundation I.A.P, in collaboration with CONAGUA, has worked on the establishment of environmental flows in key basins. The results show that it is feasible to estimate a sustainable balance of water, represented by the establishment of an environmental basin that sets a balance between different goals of environmental conservation, social functions, and degrees of pressure over the resource. Moreover, there has been a detection of hydrological basins in the country with water availability and which, given their biological wealth, ecological importance, and little water pressure, present favorable conditions to establish water reserves to guarantee the flows for environmental protection (under the terms of the Law of National Waters).

The environmental flow, water footprint and water stress, among other tools and concepts, must pillar our planning of the use and distribution of water, prioritizing a balance between the population, production, and ecosystems.

ABOUT THIS STUDY

Through this joint effort and participation, SAB-Miller commits itself to the development of a Mexican agenda for the responsible management of water resources including research, promotion and broadcast, to benefit their responsible usage supporting future generations of Mexicans and all human kind.

Consultancy report elaborated by AgroDer S.C. and WWF Mexico.

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AgroDer is a civil society presenting consultancy, advisory and analysis services. We develop a wide range of studies and projects, collaborating with the public and private sectors, NGO's and producers' organizations. Our experience is supported by more than 280 projects made during the last 8 years (2004-2012) in each and every state of Mexico.

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WWF is one of the world's largest and most respected independent conservation organizations, with over 5 million supporters and a global network active in over 100 countries. WWF's mission is to stop the degradation of the earth's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

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METHODOLOGICAL NOTE

The current study is based on information about water footprint calculations from Water Footprint Network, using information of WaterStat Database.

The consulted annexes of Water Footprint of Nations Vol 1 and Vol 2 were:

- VIII and IX (WF of National Consumption)
- I (WF of National Production)
- II and III (Virtual Water Flows)
- IV and V (Virtual Water Savings)

The cartography was fully elaborated by AgroDer, with information from the databases included in these reports and from the WaterStat database.

The estimates of production and consumption water footprints were elaborated by AgroDer, using methodology of: Hoekstra, A.Y., A.K. Champaign, M.M. Aldaya, and M.M. Mekonnen. 2011. The Water Footprint Assessment Manual, Setting the Global Standard. Earthscan. London, Washington D.C. 199 p.

The main formulas used:

National Consumption Water Footprint
The consumption water footprint (cons WF) of a nation has 2 components, internal WF and external WF:

It includes direct and indirect consumption of both agricultural and industrial products.

$_{cons}\,WF = {}_{cons,\,dir}\,WF + {}_{cons,\,indir}\,WF$ (industrial)

Consumption water footprint per capita

$_{(cons\ per\ capita)}\,WF = {}_{(consumption)}\,WF/$ Total population of the country

National Production Water Footprint
It includes whatever is produced both for internal consumption and for exports.

$_{(production)}WF = {}_{(agricultural\ product)}\,WF + {}_{(livestock\ production)}\,WF + {}_{(industrial\ production)}\,WF + {}_{(grazing)}\,WF + {}_{(fresh\ water\ supplier)}\,WF$

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Through this joint effort and participation, SAB-Miller commits itself to the development of a Mexican agenda for the responsible management of water resources including research, promotion and broadcast, to benefit their responsible usage supporting future generations of Mexicans and all human kind.

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How to cite this publication:

> AgroDer, 2012. The Water Footprint of Mexico in the context of North America. WWF Mexico and AgroDer. México DF.

Design: Mariana López
Edition: Jenny Zapata
Translation to English: Tamara Mendoza and Jose Carlos Pons

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