Chapter 9
Change in the Dietary Pattern and Water Security

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Abstract Food production and consumption are key activities in our societies. Paradoxically, despite the technological progress over the past 100 years, it has not been able to secure sufficient and healthy feeding for everyone. The validity of food crisis has placed the different dimensions of food consumption at the center of attention. The aim of this chapter is to relate theoretically and empirically, three of the considered dimensions: food sovereignty, water security, and change in the pattern of food consumption. In the first part, the theoretical discussion of the relationship of these dimensions is presented, placing at the center of the argument the concept of food security. The second part contains an exercise that estimates the effect of changes in food consumption, food sovereignty, and water security in Mexico in 1992 and 2010, using data from the national survey of household income and expenditure. The results indicate the importance of valuing more than one of the dimensions involved in the realization of the food right.

Keywords Food consumption patterns · Food sovereignty · Water security · Free trade

9.1 Food Sovereignty, Water Security, and Changes in the Dietary Pattern

In this section, the relationships between food security and sovereignty and their relation to changes in the dietary pattern and water use are presented.

9.1.1 The Debate on Food Security

Food security is a multidimensional concept that goes back to the 1970s in the context of the threat of a global food crisis. The initial focus in the World Food

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Conference in 1974[1] (FAO 2003: 45) centered on the availability problems and, with minor modifications, at the 1996 World Food Summit, the most complete definition of food security was created:

> Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (WFS 1996).

The international community gathered in Rome negotiated a series of agreements on the multiple factors that influence the right for food; these agreements are characterized by their complexity, ambiguity, and ambition.[2] However, the effective response focused on a single goal: to reduce by half the world's population in a poverty situation by 2015 (FAO 2003: 47).

In 2009, the World Summit on Food Security (WSFS) was held in the context of the main food international prices rising; as a result, the declaration of 2009 calls to halt the increase in the number of people suffering from hunger, malnutrition, and food insecurity. Inadequate efforts to achieve the goals of the 1996 Summit are recognized.

The 1996 Summit expanded the food security concept, but considered free trade as the most efficient way to achieve it; it is a significant difference from the food security concept in 1974, which noted: "[…] All States should strive to the utmost to readjust, where appropriate, their agricultural policies to give priority to food production, recognizing […] the interrelationship between the world food problem and international trade." (WFC 1974: 11). By contrast, the 1996, 2002, and 2009 declarations establish that trade is a key element to achieve global food security, a premise that intercalates in the 2009 Summit with the reappreciation of local food production (WSFS 2009: 5).

Facing a food, health, and environmental crisis and a complete failure of the 1996 Rome Declaration, the Via Campesina social movement demands food sovereignty. The notion that opposes the wrong growing use of the food security concept that has favored the power of the largest agro-food companies, promotes free market and does not consider where the food comes from, by whom, and how are produced (GRAIN 2006: 2). It is declared that trade liberalization has imposed an agriculture where farmers have no place, because transnational companies

[1]The Universal Declaration on the Eradication of Hunger and Malnutrition of 1974 states that "The well-being of the peoples of the world largely depends on the adequate production and distribution of food […] establishment of a world food security system which would ensure adequate availability of, and reasonable prices for, food at all times, irrespective of periodic fluctuations […] of weather […] and should thus facilitate […] the development process of developing countries" (CMA 1974).

[2]Some of the commitments were to: eradicate poverty, strengthen peace, ensure gender equality, promote national and international solidarity, restrain 'excessive' rural–urban migration, have a proper diet, have food safety, have access to all health services and education, secure and lucrative jobs, equitable access to productive resources, sustainable development, recovery of traditional knowledge of indigenous communities, rural development, technological transfer and development, reducing damage from natural disasters, etc. (WFS 1996).

control almost all of the food chain (GRAIN 2006: 2), control that is the main cause of failure of the 1996 Summit commitments.

Food sovereignty has two meanings: it is the right of people to healthy and culturally appropriate food produced through ecologically sound and sustainable methods and their right to define their own food and agriculture systems (Nyéléni 2007: 1) and to define their own agricultural and food policies (FFS 2002: 1). It does not oppose international trade, but defends the option of formulating sovereignly trade policies and practices that serve better the rights of the population (FFS 2002: 14).

9.1.2 Food Sovereignty and Water Security

Agri-food is the biggest economic sector of the world, involving more transactions and employing more people by far than any other (GRAIN 2011). This places it at the center of ecosystem deterioration, not only because it is the most affected by environmental crisis, but because it is one of the main drivers behind it (GRAIN 2009).

The type of food consumed, the manner and place in which they are produced, and the process by which they reach the tables of consumers are factors that determine the use, wear, and contamination of natural resources. It is estimated that the global agri-food system contributes about half of all human-generated greenhouse gas emissions (GRAIN 2011: 2).

In the definition of food security, concern for the environment and food is found in the supply and temporality dimensions, i.e., it is required a sustainable access and use of resources to ensure a sufficient food supply at all times. But in recent years, it has been recognized the need to add, explicitly, an environmental sustainability dimension to the definition of food security (Cuéllar 2011: 5).

The attention to water resources, crucial in food production, has increased in recent years. About 70 % of all freshwater is allocated to the agricultural sector (Ercin et al. 2011: 722), and about 90 % of the water requirements of an individual is related to food production (Liu/Savenije 2008: 888). The right to food requires water availability in sufficient quantity and adequate quality, and to increase its productivity in the agri-food sector (FAO 2012: 1).

Studies of virtual water and water footprint (WFP) recommend that regions with low water availability can mitigate this shortage by importing water-intensive food (Liu/Savenije 2008: 896). The Food and Agriculture Organization (FAO) suggests that countries whose food consumption depends on local agriculture have an increased risk to suffer food insecurity due to lack of water (FAO 2012: 2).

In the food sovereignty definition, the relationship between environment and food is presented explicitly and it proposes to modify agri-food production toward a different production model, agroecology, which means to abandon intensive and large-scale production, use of agrochemicals, monoculture, and genetically modified organisms. In relation to water, it raises the need for "a truly democratic approach for the water resources management," "to return to the traditional

sustainable means to access and manage water," and "to ensure a more efficient and sustainable use of resources water" (FFS 2002: 7–8).

9.1.3 Changes in Dietary Patterns, Food Sovereignty, and Water Security

A dietary pattern is the set of products that a society considers appropriate to meet their dietary needs at a given historical moment. It is characterized by a particular combination and proportion of different sources of energy (calories) that do not correspond to a nutritional rationality or cost–benefit nor a social arbitrariness.

Changes in a dietary pattern may be: (1) substitution between food groups: legumes for animal products; (2) replacement within a food category: milk for egg within animal products; (3) substitution within a product category: substitution of pork for beef; and (4) replacement of agricultural products for industrial products (Malassis/Ghersi 1992: 66).

Changes in a dietary pattern can be explained by eight variables: (1) budget constraint: income and prices; (2) information availability; (3) time availability; (4) working and life conditions: duration and intensity of working day, urbanization degree, and transportation time; (5) goods production and trade: food market, agricultural public policy, free trade, etc.; (6) social differentiation pressure; (7) cultural constraints; and (8) need restriction. This list of variables is neither exhaustive nor presented in a hierarchical order.

Food preferences or consumption habits are determined socially and culturally and they enter in food security and sovereignty with two attributes: sustainability and nutrition. In recent years, it has been recognized the significant impact of food consumption patterns on the water needs of a society (Liu/Savenije 2008: 887). The amount of water used for food depends, to a large extent, on the dominant dietary pattern, and its changes will affect the pressure exerted on water and other resources needed in food production.

The food transition that occured in the twentieth century, first in the developed countries and then in the periphery, has had a strong impact on environment. This transition, known as "postwar food regime" (Friedmann 1994) and led by the United States, is extremely intensive in natural resources and is characterized by the replacement of cereals and legumes for animal products as the main source of energy and protein (Cepede/Lengelle 1953).

The current global context of the new food system has driven changes in the dietary patterns of societies that affect food sovereignty because of the pressure it exerts on natural resources and nutrition quality.

The World Health Organization (WHO) refers to the health changes in the developing countries and poor populations as the "double burden of diseases," a combination of hunger and malnutrition with a rapid onset of chronic-degenerative diseases that have become a serious epidemic (WHO-FAO 2003: 20). The

qualitative deterioration of food intensifies the contradiction among populations "forced to underconsumption" and "forced to overconsumption." But now, underconsumption does not present itself only as "absolute hunger," but also as "hunger relative" and "negative hunger," in the form of cheap food and cheap or empty calories (Araghi 2009).

9.2 Virtual Water, Food Sovereignty, and Change in the Dietary Pattern in Mexico

In recent years, Mexico has faced different problems related to food: degradation, overexploitation and pollution of water resources, obesity and diabetes, as well as an increase dependency on food imports, among others.

Based on a household survey, the effects of dietary pattern changes on food sovereignty and water security are discussed to estimate the impact of the dietary pattern modification and increment of food imports in water requirements per capita and at national level.

9.2.1 Characteristics of Food Consumption Changes in Mexico

Food consumption characteristics can be analyzed using two approaches: apparent demand and surveys of household income and expenditure. This research chooses the latter because it allows to build dietary patterns from household consumption perspective. The years 1992 and 2010 are analyzed using information from the National Survey of Household Income and Expenditure (ENIGH in Spanish) made by the National Institute of Statistics and Geography (INEGI in Spanish), which is representative at the national level.[3]

Food was divided into nine groups, from which consumption was reduced in five of them: legumes (−25 %), dairy (−13 %), cereals (−8 %), fruits (−7 %), and tubers (−4 %); and increased in four of them: beverages (204 %), vegetables (21 %), egg (16 %), and meat (15 %) (ENIGH 1992–2010). The trend of postwar food pattern—the increase in animal products over cereals and legumes—is still present in the Mexican dietary pattern. This trend 'replaces' cheap agricultural calories (cereals and legumes) for expensive agricultural calories (animal products, fruits, and

[3]The following changes were made in order to handle a single unit of measure: milk and fermented milk drinks: 1 l = 1.032 kg; bottled beverages: 1 l = 1 kg. Differences were validated using mean difference tests (test T) with a confidence level of 95 %. The quantities obtained are the ones consumed per capita per year for a possibly nonexistent "average Mexican home."

vegetables); it is striking the fall in consumption of dairy and fruits, as well as the increase in beverage consumption.

Beans are the main legumes consumed in Mexico; historically, it constituted the complement of corn, so that the maize–bean combination provided most of the energy, protein, and fiber in the Mexican diet. In the period of study, bean consumption presents a significant reduction.

The intake reduction of milk explains the decrease in the dairy group consumption, although cheese, cream, and fermented milk beverages increased significantly. In Latin America, the proportion of energy obtained from cereals declined from 52 % in 1995 to 45 % in 1999 (Bermúdez/Tucker 2003). The fall in cereal consumption is explained by the reduction in corn consumption and, particularly in corn products other than tortillas; despite this, maize is the main cereal consumed in the country. Other studies show that wheat consumption—especially in the form of white flour—has increased in relation to other cereals (Ocampo/Flores 1992), while the consumption of tortillas, rice, bread, and pasta remained constant.

The survey contains information about 18 different fruits; the top three are: banana, apple, and orange, which represented 60 and 40 % of total fruit consumption in 1992 and 2010, respectively (ENIGH 1992–2010). Tubers are the last food group that showed a reduction; potato, the main food of this group, presented a drop in consumption.

Beverages are the 'food' group whose consumption increased more; this is due to the increase in nonalcoholic beverages, especially bottled water and soft drinks. Soft drinks and other processed beverages are called "empty food" because their only function is to supply energy in the form of carbohydrates, without any other nutrient. The rise in soft drinks consumption reflects the impoverishment process of the diet because the refined sugars and flours are cheap sources of energy and they are assimilated more rapidly by the body (Ocampo/Flores 1992: 270). It is possible that the reduction in milk consumption is associated with the increased consumption of soft drinks (Rivera et al. 2008: 175).

Vegetable consumption showed a significant increase; however, consumption of vegetables and fruits only represented 50 % of the recommended amounts for this type of food that provides vitamins.[4]

Meat consumption has been considered as an element representing development and modernization of societies, as well as an expression of their well-being; however, excessive consumption causes health problems associated with chronic-degenerative diseases (cancer, diabetes, and heart problems) and environmental degradation. The study of the WHO-FAO (2003) notes that "the number of people fed in a year per hectare ranges from 22 for potatoes and 19 for rice to 1 and 2,

[4]Fruit and vegetable consumption recommended is 400 g per capita per day, a level that is associated with a lower incidence of obesity, cardiovascular disease, diabetes type II, and different cancers (Ramírez-Silva et al. 2009: 575). The WHO indicates that at present, only a minority of the world population consumes the recommended amounts of fruits and vegetables (WHO-FAO 2003: 34).

respectively, for beef and lamb" (WHO-FAO 2003: 32). In Mexico, there has been an increase in the consumption of processed meats (sausages) and poultry, which is the main meat consumed in Mexico since the 1980s; the consumption of beef and pork has reduced.

The change in food consumption of Mexican households from 1992 to 2010 is not a dietary transition in itself, but a substitution between food groups: there is an increase in beverages, sausages, meats, poultry, egg, and vegetables; there is a decrease in cereals, legumes, milk, and fruits. There is also substitution within food categories by reducing milk consumption in dairy products and corn consumption in cereals, and increasing processed meat consumption in meat.

Modification of dietary pattern is associated with the increment in chronic-degenerative diseases that the country is facing; from 1999 to 2006, Mexico had the highest growth, worldwide, in overweight and obesity, and deaths caused by diabetes increased to 843,654 in the period 2000–2012 (EPC 2012). While there are multiple factors causing obesity and diabetes, various studies identify an obesogenic environment after the trade opening, which is closely related to the dietary changes presented: increased consumption of soft drinks, processed meats, dairy products, and refined flour (EPC 2012; Clark et al. 2012; Santos-Baca 2012).

9.2.2 *Virtual Water of the Mexican Dietary Pattern*

Virtual water (VW) is defined as the water volume used to produce a unit of food in the place where it was produced or, alternatively, the water volume that would be required to produce food at the site where it is consumed (Hoekstra/Chapagain 2007: 36) (Table 9.1).

Table 9.1 Summary of different scenarios

Mexico	1992		2010	
	Per capita (m^3/year)	National (million m^3/year)	Per capita (m^3/year)	National (million m^3/year)
Scenario 1	698	60,647	678	76,121
Hypothetical scenario A			698	78,399
Scenario 2	660	57,323	641	72,080
Hypothetical scenario B			677	76,012

Source The authors
Scenario 1: Food sovereignty 1992 and 2010
Hypothetical scenario A: Food sovereignty without change in dietary pattern 2010
Scenario 2: Trade openness 1992 and 2010
Hypothetical Scenario B: Trade openness without NAFTA

The estimate of the water amount in the main food consumed and produced in Mexico was based on the calculations of WFP (blue, green, and gray) of Mekonnen/Hoekstra (2010a, b), making equivalences between the classifications used in Mexico and those used by them (Table 9.2). Due to these equivalences, the results obtained may be under- or overestimated, particularly processed food with high VW (Hoekstra/Chapagain 2007: 39) may be underestimated. Data from Ercin et al. (2011) was used for soft drinks, modifying the source of the sweetener, and utilizing data for Mexico.

VW analysis of the main food consumed in Mexico is analyzed from two scenarios; in the first one it is assumed that all food is produced internally, i.e., there is food sovereignty (Scenario 1). This leaves out the effects of international trade on the water amount that is actually used in the food consumed according to the country of origin. The second scenario considers the international trade effects with the assumption that all food imports come from the United States. In both scenarios, the food VW is the same in both years; it is the average of the period 1996–2005, ignoring changes in productivity and technology in food production. The increase in population, which is very important to understand the magnitude of VW associated with the food diet, is considered in both scenarios. Additionally, two hypothetical situations corresponding to 2010 are presented in each scenario: food sovereignty without change in the dietary pattern and free trade, but without the North American Free Trade Agreement (NAFTA). The objective is to estimate the impact that dietary pattern changes and increasing dependence on food imports have on water requirements per capita and at national level.

9.2.2.1 Scenario I: Food Sovereignty

In Scenario I, it is assumed that all food consumed in Mexico is produced internally. In the analysis period, the per capita water requirement for food (CWRF) declined 2 %, from 697.9 m^3 in 1992 to 677.6 m^3 in 2010.[5] This reduction is due to changes in dietary patterns, especially to the decrease in consumption of beef and milk, both being water-intensive products, and an increased consumption of processed products (soft drinks, sausages, dairy drinks), whose VW is less or may be underestimated because of lack of information.

In 2010, five types of food accounted for 74 % of the total CWRF: tortilla (20 %), beef (20 %), milk (18 %), poultry (8 %), and egg (7 %). The most water-intensive foods are beef (14 m^3 per kg), cheeses (8.2 m^3 per kg), ham (8 m^3 per kg), pork (7.4 m^3 per kg), and sausages (6.8 m^3 per kg). However, by volumes consumed, only beef contributes significantly to the total virtual water.

[5]According to Liu/Savenije (2008), the per capita water requirement for food in China was 255 m^3 in 1961 and 860 m^3 in 2003. Hoekstra/Chapagain (2007) notes that in the United States it is 806 m^3. Both numbers come from an apparent demand approach.

Table 9.2 Virtual water content of the main food consumed in Mexico and produced locally

Food	Virtual water Mexico 1996–2005 (m^3/ton)					
	Equivalent HS Code		Green water	Blue water	Gray water	Total
Tortilla	1005 y 110220	Corn and corn flour	1,876	63	362	2,300
Bread	110100a	Wheat bread	293	491	163	947
Pasta	110100b	Dry wheat pasta	337	565	187	1,089
Cookies	110100	Wheat flour*	337	565	187	1,089
Rice	100630	White rice	1,788	503	234	2,525
Beans	70820	Green beans	228	71	111	410
Beef	20110-20230	Average different fresh cuts, refrigerated or frozen	12,780	645	498	13,923
Pork	1221-122b	Average different fresh cuts, refrigerated or frozen	6,123	744	583	7,450
Poultry	10599	Live poultry except poultry weighing more than 185 g	3,530	305	409	4,244
Ham	21011	Ham, shoulders, and cured pieces	6,635	815	632	8,082
Sausages	20610-20630	Edible offal of beef and pork**	6,248	366	284	6,898
Egg	40700	Shell eggs	3,224	294		3,518
Milk	2211-2213	Average of different presentations not concentrated nor sweetened	2,059	523	152	2,734
Cheese	40610-40630	Average fresh cheese, powdered or processed	6,876	593	761	8,229
Fermented milk drinks	40310	Yogurt	1,844	156	136	2,136
Tomato	70200	Fresh tomato	61	85	42	188
Onion	70310	Fresh onion	210	87	83	380
Carrot	70610	Fresh carrot	58	49	40	147
Potato	70190	Fresh potatoes	138	112	13	263
Banana	80300	Fresh banana	321	181	35	537
Apple	80810	Fresh apple	977	400	54	1,431
Orange	80510	Fresh orange	524	217	79	820
Bottled water	–	Water content and PET bottle	2	2	13	17
Soda	–	Hypothetical carbonated beverage	348	18	27	393

Source Data from Mekonnen/Hoekstra (2010a, b) and Ercin et al. (2011)
Corn: 50 % grain corn and 50 % cornflour
Soft drink: data from Ercin et al. (2011), except sugar, which was used from those of Mexico (sugarcane, sugar beet, and fructose)
Bottled water: contained water and PET bottle

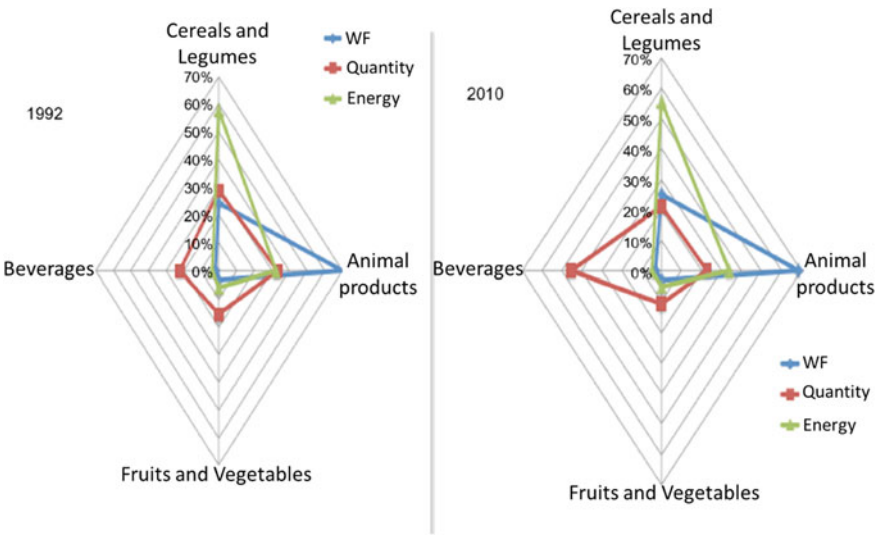

Fig. 9.1 Consumption pattern: amounts, energy contribution, and water footprint by food groups. *Source* Based on data from ENIGH (1992–2010), Mekonnen/Hoekstra (2010a, b), Ercin et al. (2011), and NUTRIPAC Program

Between 1992 and 2010, Mexican population grew at an annual rate of 1.6 %, accumulating a growth of 29 % in the period. The population grew from 86.9 million (M) people in 1992 to 112.3 million in 2010.[6] This increase caused the water required for food to change from 60.6 to 76.12 billion m^3 per year.

What would be the VW requirement associated with food if there has not been a change in dietary pattern? For a possible answer, the 1992 consumption pattern was multiplied by the population in 2010; with the 1992 dietary pattern, national CWRF in 2010 would be 78.4 billion m^3, suggesting that the change in the dietary pattern saved about two billion m^3 of water, water amount equivalent to that contained in the consumption of bread and rice in 1 year.

Figure 9.1 shows the relationship between quantities consumed, VW and energy contribution of the Mexican dietary pattern in 1992 and 2010. The food is organized into four groups: fruits and vegetables and the beverage group are characterized by a significant contribution in quantity, but no significant contribution in water and calories. The cereal group is calorie-intensive with medium contribution to the CWRF and quantity. Finally, animal products are water-intensive.

[6]The 1992 population datum is an estimate from the 1990 Census; the datum for 2010 is a result of the census of that year (INEGI).

9.2.2.2 Scenario II

Mexico takes a decisive step toward trade liberalization with the signing of NAFTA in 1994. From 1980 to 2010, the degree of openness of the agri-food sector increases and exceeds the degree of openness of the economy as a whole. Therefore, the dependency ratio[7] of the main food consumed in Mexico increased. Only three foods did not increase their import: egg, milk, and onion. In 2010, rice, wheat, sausages, and pork had the highest dependency ratios (FAO Stat). The increment in consumption of food produced elsewhere was the result of different production processes, qualitative and quantitative, thereby losing food sovereignty.

One objective of the agricultural chapter of NAFTA was to 'integrate' the food market of Mexico to that of the United States, an objective that was fulfilled. 80 % of agri-food imports come from the NAFTA region, particularly from the United States. It is possible to estimate the CWRF with the VW flow of the food imports from the United States, using the WFP of that country utilized by Mekonnen/Hoekstra (2010a, b).

Compared with Scenario I of sovereignty, in this new scenario the CWRF decreased 2.7 %, from 659.6 m^3 in 1992 to 641.6 m^3 in 2010, a reduction that is due to the changes in dietary patterns already mentioned and the increment in imports from the United States. When considering only data from 2010 and comparing the two scenarios (sovereignty and free trade), it is found that the increase in food imports caused a significant decline in VW content of tortillas, rice, beef, pork and poultry, ham, sausages, cheese, and apples. For wheat products, increased imports caused an increment in virtual water content.

The national CWRF in 1992 was 57 billion m^3 and in 2010, 72 billion m^3. In Scenario I, there was a 'saving' of about 2 billion m^3 of water associated with the change in dietary patterns. Now, it is possible to estimate the effect of trade openness by comparing data from Scenarios I and II. In 1992, the national CWRF, with imports, is lower in 3 billion m^3 than the CWRF of Scenario I of sovereignty; in 2010, this difference is of 4 billion m^3.

A second hypothetical situation (Scenario III) estimates the effect of NAFTA on national CWRF. The CWRF of consumption in 2010 is calculated with the degree of food dependence of the imports in 1992. If the share of imports with the level of 1992 had been kept, the CWRF of Mexico in 2010 would have been 76 billion m^3, this is 3.9 billion m^3 more than with the actual openness and increased imports resulting from the North American Free Trade Agreement.

[7]Degree of dependency: imports divided by internal production.

9.3 Conclusions

Food is a fundamental condition of any society; it must be met everyday to ensure the life of individuals. However, societies still fail to ensure a diet matching human dignity and flourishing for the entire population. The threat of a food crisis is still present and the efforts of international organizations to reduce poverty, inequality, and malnutrition, in all its forms, have been insufficient.

The current global food crisis is not an isolated phenomenon; it relates to health and environmental crises. The global agri-food system has caused the impoverishment of rural workers, the double burden of diseases and destruction, pollution and deterioration of ecological resources.

This study considers the proposal to make visible the role of water in the process of social reproduction and, in particular, in food sovereignty. It seeks to understand the interrelationship between water and food in the complex processes of changing dietary patterns and the way the supply of these foods is organized.

Results show that with the change in food consumption and trade openness, Mexico has 'won' in environmental terms by reducing virtual water requirements associated with food. However, when considering the other two dimensions of food sovereignty, it can be seen that this progress in the sustainability of the Mexican food system is accompanied by a deterioration in food that has caused a serious incidence in chronic-degenerative diseases. It has also caused a serious deterioration in the right to local food production and sovereign determination of food policy. The large increase in dependence on food imports has placed Mexico in a very fragile situation to changes in the global food market, particularly, to the increase and volatility of international food prices.

In the current environmental crisis, it is necessary to understand and appreciate not only nature but the complexity of social processes, their dynamics, and multiple powers that shape it.

The way the global agri-food system is organized has been subject to criticism because its mechanisms reproduce and perpetuate the inability of societies to guarantee the right to food, with dignity and justice. These mechanisms may be associated with the power of large agri-food corporations that are behind the loss of sovereignty and deterioration of food. These important economic and political powers hinder changes in the way food is produced, distributed, and consumed to eradicate hunger and improve health.

References

* indicates internet link (URL) has not been working any longer on 8 February 2016.

Araghi, Farshad. "Peasants, Globalization, and Dispossession: A World Historical Perspective", paper presented at the Annual meeting of the American Sociological Association, Hilton San Francisco, San Francisco, Aug 08, 2009.

Bermúdez, Odilia and Katherine Tucker. "Trends in dietary patterns of Latin American populations", *Cad. Saúde Pública* 19(1), (2003):87–99.

Cepede Michel and Maurice Lengelle. *Économie Alimentaire du Globe, essai d Interpretation*, Paris: Librairie De Medicis, Editions M.Th. Genin, 1953.

Clark, Sara, Corinna Hawkes, Sophia Murphy, Karen Hansen-Kuhn and David Wallinga. "Exporting obesity: US farm and tradepolicy and the transformation of the Mexican consumer foodenvironment", *International journal of Occupational and Environmental Health*, vol. 18, no. 1, (2012): 53–65.

Cuéllar, Jose. Programa de seguridad alimentaria: experiencias en México y otros países, México: CEPAL-México, 2011.

*EPC-El Poder del Consumidor. *El fracaso al combate de la epidemia de diabetes y obesidad en México*, http://www.elpoderdelconsumidor.org/fabricaweb/wp-content/uploads/Muertos-Calderón-05_10_12.pdf, Accessed May 20, 2012.

Ercin, Ertug, Maite Martinez and Arjen Hoekstra. "Corporate Water Footprint Accounting and Impact Assessment: The Case of the Water Footprint of a Sugar-Containing Carbonated Beverage", *Water Resour Manage 25* (2011):721–741.

FAO (2012), Water and food security, FAO-UNWATER.

*Forum for Food Sovereignty. *Statement of the NGO/CSO Forum for Food Sovereignty*, http://www.redes.org.uy/wp-content/uploads/2008/09/declaracion_final_del_foro_de_las_ongs_y_movimientos_sociales_en_roma.pdf, Accessed March 4, 2012.

Friedmann, Harriet. "Distance and durability: Shaky foundations of the World Food Economy" in *The global restructuring of agri-food systems*, edited by Philip McMichael, 258–276. USA: Cornell University Press, 1994.

GRAIN. "Soberanía Alimentaria y sistema alimentario mundial", *Biodiversity* 47, 2006. http://www.grain.org/es/article/entries/1086-soberania-alimentaria-y-sistema-alimentario-mundial, Accessed June 16, 2012.

GRAIN. *Food and climate change: the forgotten link* http://www.grain.org/entries?utf8=&q=food, Accessed June 16, 2012.

GRAIN. *The international food system and the climate crisis,* http://www.grain.org/entries?utf8=&q=food, Accessed June 16, 2012.

Hoekstra, Arjen and Ashok Chapagain. "Water footprints of nations: Water use by people as function of their consumption pattern", *Water Resources Management* 21. (2007): 35–48.

INEGI. *Encuesta nacional de ingresos y gastos de los hogares,* México: INEGI, 2012.

Liu, Junguo and Hubert, Savenije. "Food consumption patterns and their effect on water requirement in China", *Hydrology and Earth System Sciences* 12, (2008): 887–898.

Malassis Louis and Gérard Ghersi. *Initiation a l'economie agro-alimentaire*, France: Hatier-Universites Francophones, 1992.

Mekonnen, Mesfin and Arjen Hoekstra. "The green, blue and gray water footprint of farm animals and the animal products", In *Value of Water Research Report Series* 48, Delft: UNESCO-IHE, 2010.

Mekonnen, Mesfin and Arjen Hoekstra. "The green, blue and grey water footprint of crops and derived crop products." In *Value of Water Research Report Series* 47. Delft: UNESCO-IHE, 2010.

NYELENI. *Declaration of NYELENI, Forum for Food Sovereignty*, http://www.nyeleni.org/, Accessed May 27, 2012.

Ocampo, Nasheli and Gonzalo Flores. "Mercado mundial de medios de subsistencia: producción, consumo y circulación de alimentos estratégicos, 1960–1990", Bach diss, Faculty of Economics, UNAM, 1994.

Pérez, Rosario. *El tratado de libre comercio de América del Norte y la ganadería mexicana*, México: UNAM, 1997.

Ramírez, Ivonne et al. "Fruit and vegetable intake in the Mexican population: Results from the Mexican National Health and Nutrition Survey 2006", *Salud Pública de México*, Supplement 4, (2009): 74–85.

Rivera Juán et al. “Consumo de bebidas para una vida saludable: recomendaciones para la población mexicana”, *Salud Pública de México*, vol. 50, no. 2, March–April (2008): 172–194.

WHO-FAO. *Diet, Nutrition and the Prevention of Chronic Diseases*, WHO Technical report series Geneva: WHO/FAO, 2003.

*****World Food Conference, *Universal Declaration on the Eradication of Hunger and Malnutrition 1974*, http://www2.ohchr.org/spanish/law/malnutricion.htm, Accessed October 30, 2012.