http://dx.doi.org/10.24212/2179-3565.2017v8i3p118-128

RISUS - Journal on Innovation and Sustainability
volume 8, número 3 - 2017
ISSN: 2179-3565
Editor Científico: Arnoldo José de Hoyos Guevara
Editora Assistente: Lívia Lopes Aguiar
Avaliação: Melhores práticas editoriais da ANPAD

WATER GOVERNANCE: THE FUTURE OF GROWTH WITH FOOD AND WATER

Governança da água: o futuro do crescimento com alimentos e água

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Abstract: Forecasts for the next four decades are warning about shortage of water and food, particularly in developing economies. The demand for food will increase because of population growth, especially in developing economies. The problem is reinforced by the lack of water and reduction in food production. Today the consumption of water for food production is high because people do not realize that this is a scarce resource and that can definitely missing. We must create a policy for the management of water and that people are informed that it is not possible to use the feature without any control. The governance of water is important to establish ways and use control mechanisms and implementation of the resource in the various production processes. The waste during the manufacturing process is very high because: a) there is no control on the amount that should be applied to each type of agricultural product; b) the irrigation process is still done by equipment spraying water in large quantities; c) as water is still abundant for the current agricultural production in producing countries, there is no investment in machinery or equipment that can reduce water consumption; d) government authorities in developing countries do not plan and do not make any kind of control on the use of water or water governance; e) the food production process is carried out intensively and in large areas, it produces a single product and this requires large amounts of water.
Key words: Water governance; GDP; Food; Water shortage

Resumo: As previsões para as próximas quatro décadas alertam sobre a escassez de água e alimentos, particularmente nas economias em desenvolvimento, nas quais a demanda por alimentos aumentará devido ao crescimento populacional. O problema tem se agravado pela falta de água e a disminuição na produção de alimentos. Hoje, o consumo de água para a produção de alimentos é alto porque as pessoas não percebem que este é um recurso escasso e que definitivamente pode faltar. É necessário criar uma política para a gestão da água e alertar as pessoas de que não é possível usar recurso sem nenhum controle. A governança da água é importante para estabelecer formas de usar e instalar mecanismos de controle do recurso nos vários processos de produção. O desperdício durante o processo de fabricação é muito alto devido a que: a) não há controle sobre a quantidade que deve ser aplicada em cada tipo de produto agrícola; b) o processo de irrigação ainda é feito por equipamentos pulverizando água em grandes quantidades; c) à medida que a água ainda é abundante para a produção agrícola atual nos países produtores, não há investimentos em máquinas ou equipamentos que possam reduzir o consumo de água; d) as autoridades governamentais dos países em desenvolvimento não planejam e não fazem qualquer tipo de controle sobre o uso da agua ou sua governança; e) o processo de produção de alimentos realizado de forma intensiva e em grandes áreas produz um único produto (monocultura) e isso requer grandes quantidades de água.
o **Palavras-chave:** Governança de agua; PIB; Alimento; Falta de água

Recebido em: 10/08/2016
Aceito em: 01/09/2017

INTRODUCTION

This article proposes a discussion around the issue of water use, today without any control by the consumer. The world population is now close to 7.5 billion and continues to grow. Population growth must accompany the increase in food production and this presses the use of available resources, water is perhaps the most basic resource; and already in countries like Yemen 50% of the population struggle daily to find or buy enough clean water to drink or grow food (Ward, 2014.

The waste during the manufacturing process is very high because: a there is no control on the amount that should be applied to each type of agricultural product; b the irrigation process is still done by equipment spraying water in large quantities; c as water is still abundant for the current agricultural production in producing countries, there is no investment in machinery or equipment that can reduce water consumption; d government authorities in developing countries do not plan and do not make any kind of control on the use of water or water governance; e the food production process is carried out intensively and in large areas, it produces a single product and this requires large amounts of water.

In recent decades there has been more frequent climate change. Regions where the climate was defined by periods of regular rainfall began to have problems with the lack of it. This issue generated a pressure on this water resources, with consequent change in behavior the people because the water shortage is inevitable.

The statistics on the theme: water, are still alarming. We are the XXI century, the figures indicate that at least 780 million people do not have access to clean drinking water; some 2.5 billion people lack access to safe sanitation systems. In developing countries the problem primarily affects children. With a simple solution to provide clean water and sanitation systems this problem could be avoided every year (Cooley et. al., 2013.

GDP – GROSS DOMESTIC PRODUCT

GDP - Gross Domestic Product should increase to keep pace with population growth. To maintain this growth in population was produced more food, clothing, medicine and other goods necessary for their survival. With this growing population will need to produce more and more food and other products. This growth will require greater use of all available resources, especially water for food production.

The agriculture sector is the largest consumer of water worldwide and water is a key ingredient either directly or indirectly in almost every good produced. After the global financial crisis in 2008, the world has recovered and the movement of goods between the countries increased. This confirms that globalization is still present, by such production and circulation of goods and services around the world (UNESCO, 2015.

When a country imports food from another country, it is also buying the water that was used to produce that food. So, when consumers buy food that country imported, he is taking home some of the water that the exporting country used to produce that food. The countries think of expanding world trade for the economy world is strengthened. The concern is the Increase in GDP and the higher the production of goods and services, higher will be the power of its economy. When negotiations are made between nations for the import and export of goods and services, the concern with production factors as technology or machine, for example, has been introduced. So, this is a common negotiation process has been repeated over very many years. We did not find a concern with the water that will be used for direct production or indirectly of products that are at stake (Cooley et al., 2013).

Table 1 GDP, Current Prices (billion USD)

Country	2013	2014	2015
United States	16,663.2	17,348.1	17,947.0
China	9,518.6	10,430.7	10,982.8
Japan	4,908.9	4,596.2	4,123.3
Germany	3,746.5	3,874.4	3,357.6
United Kingdom	2,712.5	2,991.7	2,849.3
France	2,811.1	2,833.7	2,421.6
India	1,863.2	2,042.6	2,090.7
Italy	2,131.0	2,141.9	1,815.8
Brazil	2,464.7	2,417.2	1,772.6
Canada	1,837.4	1,783.8	1,552.4
Korea	1,305.6	1,410.4	1,376.9

Source: IMF World Economic Outlook (WEO), April 2016

GDP at Current Prices or nominal GDP is the market value of goods and services produced in a country during a year. On the table are a GDP 2015, for example, USA a value 17,947.0 billion dollars, GDP a current prices, i.e., the price for goods and services by 2015 are value by prices 2015.

Table 2 Summary Results of Water Requirement Ratio and Comparison with Water Resources

	Total actual renewable water resources (km3/yr)	Irrigation water requirement (km3/yr)	Water requirement ratio (%)	Irrigation water withdrawal (km3/yr)	Pressure on freshwater resources due to irrigation (%)
Américas	**24 361.760**	**195.291**	**49**	**397.200**	**1.6**
Northern America	6 428.200	137.106	57	240.934	3.7
Central America and Caribbean	801.660	4.666	26	18.112	2.3
Central America	708.010	2.285	23	9.820	1.4
Caribbean: Greater and Lesser Antilles	93.650	2.381	29	8.291	8.9
Southern America	17 131.900	53.519	39	138.154	0.8
Andean	6 324.900	18.225	37	48.777	0.8
Guyana	363.000	0.695	39	1.793	0.5
Brazil	8 233.000	15.296	48	31.700	0.4
Southern America	2 211.000	19.303	35	55.883	2.5

Source: Irrigation water requirement and water withdrawal by country, November 2012 - http://www.fao.org/3/a-bc824e.pdf

The USA is the country that produces more goods and services in their territory and imports various products to supply the domestic market. The GDP has a value 70% higher than the second place is China in 2015.

Whereas agriculture uses 40% of water resources, we note that this volume of GDP is able to use a high amount of water for the production of goods and services both in the direct production process as in the indirect process.

Show the table 2 an estimated global water withdrawal (km3 per year, m3 per capita and as a percentage of total withdrawal) for Northern America the Water requirement ratio a 57%.

GDP growth will consume a greater amount of water for the production of food and other goods. If water consumption is not done within its own territory, the food that will be consumed by the population will have to be imported. When this food is imported, the country is buying indirectly certain amount of water that has been used where the food was grown (FAO, 2012).

POPULATION AND FOODS

Food production will be sufficient to support a global population of 9 to 10 billion in 2050, although food and nutritional insecurity will persist in many regions. With this sentence with a bit of doubt content that The United Nations World Water Assessment Programme (WWAP) under the theme Water for Sustainable Development (2015) wants the world to prepare for a possible shortage of water and food.

The lack of food will not be because there are no resources to produce as seed or machinery and equipment, for example. Lack of food can happen because of population growth and, especially, because in many areas there is no water to produce the food.

The population is growing worldwide and can achieve a total of 10 billion people in 2050. Many of these people will live in urban areas by pressing the production sector of goods and services to increase production.

The production of goods and services use water both directly and in an indirect way. If not created policies of water management, it is possible that a region has problems with water shortages, while in another region may be a spare in sufficient quantity to export to.

Table 3 Population Density – Ranks (people per sq. km of land area)

Country	2014	2011	2010	2009	Country	2014	2011	2010	2009
Macao SAR, China	**19073,1**	**18283,7**	**18000,9**	**17674,7**	**Mauritius**	**621,1**	**616,9**	**616,0**	**614,5**
Monaco	18811,5	18594,5	18422,5	18175,5	**San Marino**	526,6	515,6	511,5	507,2
Singapore	**7736,5**	**7363,2**	**7231,8**	**7125,1**	**Korea, Rep.**	**517,3**	**512,0**	**508,2**	**506,5**
Hong Kong SAR, China	6896,9	6734,9	6689,7	6640,8	**Netherlands**	500,9	495,0	492,6	490,1
Bahrain	**1768,7**	**1702,8**	**1655,3**	**1574,7**	**Rwanda**	**459,7**	**427,9**	**417,3**	**406,3**
Maldives	1336,7	1256,7	1223,3	1200,0	**Lebanon**	444,5	429,0	424,0	408,8
Malta	**1335,5**	**1300,8**	**1295,3**	**1289,0**	**India**	**435,7**	**419,6**	**414,0**	**408,4**
Bangladesh	1222,1	1178,5	1164,8	1151,6	**Burundi**	421,2	381,2	368,4	355,8
West Bank and Gaza	**713,4**	**652,3**	**633,1**	**615,0**	**Comoros**	**413,8**	**384,7**	**375,4**	**366,4**
Barbados	659,0	652,6	650,2	647,6	**Haiti**	383,6	368,1	362,8	357,5

Source: https://knoema.com/search?query=Population%20density

The city of Macau in China has a territory of 30.3 sq. km, i.e. little land space for many people, according to the Table 3. Data the population density in 2009 was 17.675 people per sq. km, rising to 19.073 people in 2014 with growth trend because the results of the GDP of China (even though below expectations) projects average growth of 7% annually.

Population growth causes an urban concentration because people need work and goods and services. As shown by the table data, the population density is growing every year and the need for water does not appear in statistical data or issue being discussed in the political environment or in the form of water management policies.

In Burindi country the problem is aggravated by the size of its limited territory to 27.830 square kilometers and a population density of 421 people per square kilometer. This represents a total of 10,816,860 inhabitants in 2014 and 11.8% were urban population. The increase in urban population is inevitable. If government officials do not prepare for managing water, the problem is greater because there is also a lack of food (IMF, 2016).

FOOD DEMAND AND WATER

By 2050 the world population expected to gain over 2.3 billion people. This means that the global demand for food will be pressed to increase grain production, for example. Although the growth rate of the population is decreasing, this represents an increase of almost two-thirds of the world population today (FAO, 2009).

Because of a number of influencing factors in the degree of development of some countries, a larger part of the total world population increase will be in developing countries. As the FAO report (2009), sub-Saharan Africa's population would grow the fastest (+114 percent) and East and Southeast Asia's the slowest (+13 percent).

The economic data projected by analysts to the growth of world GDP show that the developing countries will get a growth rate higher than the developed countries (The World Bank, 2014). This does not mean that the rates of malnutrition or starvation, especially for children in these countries will be lower than today.

With this population growth trend, an increase in GDP of developing countries and reducing malnutrition levels and hunger, it is natural that there is a higher demand for food for both people and for animals. Then the Demand for cereals is projected to reach some 3 billion tons by 2050, up from today's 2.1 billion tons today.

Table 4 World Water Distribution and Countries Fresh Water Supply

	Water volume (million km³)	Percent of freshwater	Percent of total water	Countries fresh water supply
Total water	1 386		100.00	Brazil, Russia, China, Canada, Indonesia, U.S., India, Colombia, Peru, European Union and the Democratic Republic of Congo.
Freshwater	35,0	2.53	100.00	
Glaciers and ice caps	24.4	69.7	1.76	
Groundwater	10.5	30.0	0.76	
Lakes, rivers, atmosphere	0.1	0.3	0.01	
Saline water	1 351		97.47	

Source: FAO, 2002; World Bank, 2014

Water is a key chemical for the life of most living organisms. It is used at the beginning, during and at the end of a production process. It is estimated that the world contains about 1 400 million km3 of water. Of this water, 35 million km3 (2.5 percent) are freshwater (FAO, 2002).

The table shows that around 2.53% is fresh water, concentrated in large quantities in countries revealed in the last column. In many areas this feature is not easy to achieve because it depends on the geographical location (mountains and valleys) and the distance where the river or lake and the city, which in general are great consumers.

For example, the large amount of available water in the polar ice caps or glaciers or deep underground soil is not accessible for use. To remove the water from great depths, it is necessary to invest in machinery, equipment and workers to remove this water.

Table 5 Approximate Crop Water Requirements to Produce Food Harvested

Crop/Food	Water Requirement (kg of water per kg of food produced)
Potato	500–1500
Wheat	900–2000
Alfalfa	900–2000
Corn/maize	1000–1800
Sorghum	1100–1800
Soybeans	1100–2000
Rice	1900–5000
Chicken	3500–5700
Beef	15000–70000

Source: Kirby; Bartram; Carr, 2002

Agriculture is the production sector that consumes more water, around 93%. The industry consumes about 4% and the rest is consumed by the population. The values shown in the table are approximate, possible variations with reality is because of the irrigation process employed in the specific region, what kind of care with the handling of the product grown and the creation of animals (FAO-AQUASTAT) .

The table shows that the production of meat consumes 15,000 to 70,000 kg of water per kg of food produced. This consumption is high because the production method should be considered since the birth of the animal, the process of killing and final marketing (Kirby; Bartram; Carr, 2002).

The cultivation time, i.e. how long it takes to get the product ready for consumption, is crucial to the volume of water consumption. The greater the time between planting and harvest, the greater the amount of water needed to make the product ready to be taken to the consumer market.

WATER GOVERNANCE

The purpose of this article is to discuss the need for water governance because the consumer has to be informed that water is a scarce resource and the use must be rational and controlled. This feature, which is essential for the survival of people and animals, may be missing and problems for society will be compounded with the possibility of food shortages.

The reasons for the effective implementation of water governance are essential today because:

● The growth of world population continues fast and could reach 10.0 billion in 2050, with an increase of almost two-thirds of the world population today;

● Urbanization grows at the same rate of growth of the world population. For example, the least developed countries will be those with the greatest contingent of people who will live in cities and this presses the consumption of food and other products;

● The growth rate of GDP in developing countries will be higher than the rates of other countries, on average between 4-6% annually;

● Consumption in developing countries will continue to grow, even if malnutrition and hunger are not eradicated. The increase of people living in cities, the growth of GDP and population growth, are sufficient indicators to increased consumption of goods and services;

● Increase in income because of the intensification of globalization, the expansion in relations between governments, bilateral and multilateral trade agreements and ease of mobility features;

These factors were selected for the discussion of water governance. There are other factors that affect the economic order, some contribute to the generation of positive results on the quality of life, while others produce negative results.

The governance of water must be formulated by a number of measures that governs the use of this feature, making the application in the most rational and economical production process, both as regards the volume and the cost of the production process, as can be seen in table 6.

Table 6 Some of the Key Pathways of Water Governance

pathways	discussion
water agreements and laws	establishing international water agreements and laws:
water resource management	financing water resource management and service delivery efforts
establishing and socializing minimum	establishing and socializing minimum and best practices for water resource development and management
technology and knowledge transfer	facilitating technology and knowledge transfer and conducting education and outreach programs;
evaluating water-related data	collecting, monitoring, and evaluating water-related data

Source: Cooley *et. al*.,2013, p.13.

For the purpose to be achieved, the suggested measures should be practiced by all involved. The governance of water must have the participation of all countries because international trade of food, a lot of water is exported while imported by countries in the form of a type of agricultural product, for example, what is called virtual water. In fact to produce 1 kg of cow meat, 15400 lts. of water are needed (water footprint).

The transfer of technology and knowledge to transform brackish water or non-potable water in a water of enough quality for human and animal consumption should be the goal of all countries. When this water governance measure is implemented in its entirety, the amount of diseases decrease.

Agriculture consumes large quantity of water (97% on average), it is also responsible for contamination and spread of disease through the use of contaminated water during the process of agricultural production. Kirby; Bartram; Carr (2002) the concern about the impact of agriculture on the quality of water resources is often related to diffuse sources – contamination by agro-chemicals, nutrients and hazardous microbes (pathogens) in particular.

Countries need to come together to create guidelines for the governance of water as a way to reduce the impact on the prices of agricultural products in periods of lack of rain or climate change in the producing regions.

The climatic phenomenon El Niño and others of the same nature, has caused injury to the production of various agricultural products to countries like India, East Africa and Malaysia. Sugar and palm oil prices have increased because of a drought in India and Malaysia. An adverse market reaction occurred in East Africa, where in the region the prices of agricultural products remained stable because of high inventory levels prior (IMF, 2016). Even in California the period between late 2011 and 2014 has been the driest in California history since record-keeping began and very severely affecting food production in the US.

When the stock of agricultural products diminishes, the price increases and losses for the world economy because imports will be more expensive. The price increase should reduce the volume of international trade and recession in countries that depend on export income of agricultural product.

The governance of water is important as a means to reduce the impact of natural phenomena and other problems caused by consumption without water control. Create control policies consumption, impose measures to reduce withdrawal of water from rivers and other sources of drinking water and facilitate the exchange of knowledge to treat brackish or salt water; are some policies that should be part of the governance of water and should be shared and applied by all countries.

CONCLUSIONS

The water governance must be made by all involved, both producers and final consumers and governments of the countries.

The actors involved must recognize their role in the process. The producer and the final consumer are polluters and should be charged to use water as a scarce resource and that has a social cost for their production and application in the production process.

Prior to the implementation of water governance, the people involved in the primary production process and final consumers should use rationally and avoid waste in all stages.

The agricultural sector is the largest consumer of water. In many regions, the equipment used for irrigation is not appropriate, increasing the waste. Use the proper equipment, know the geography of the area to know the amount of water available and where it is located, how much rain and at what time it happens; these are some simple steps and does not depend on water governance, but the awareness of users. Increased efficiency in the use of water at all stages of the production process and in day to day tasks of the people, is an important step to avoid total shortage.

The water governance should be implemented because people should be charged for their mistakes. The countries should unite to establish water governance together because the growing international trade, with import and export of products that use water directly and indirectly. The water used in a given country ends up being exported at a low price in the form of an agricultural product, for example.

Forecasts for 2050 indicate that GDP growth of less developed countries will be higher than the other countries. Thus, the demand for goods and services is expected to grow with the same intensity and this is not only by increasing the supply of products or per capita income, the other justification will be the growth of the world population is expected to reach 10 billion.

Unlike the growth forecasts of GDP, the increase in world population and urbanization, the existing drinking water on the planet is a little over 2.5%. Much of it is salt water or is in the form of polar ice cap, therefore, difficult access. To turn sea water into drinking water is needed the use of technology and knowledge. Countries need to come together to undertake the transfer of technology and knowledge for the benefit of all. This is also another issue that the governance of water can handle.

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