Water Footprint Assessment: innovation tool in Brazilian water governance

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ABSTRACT

The water resources require special attention all over the world.In this scenario, the Water Footprint gathers notoriety, once this fresh method displays clearly and in a detailed way the water use.Brasil has the biggest water reservoir available of the planet;still it does not deliver a proper administration of it.The national Law 9.433/97 known as “A Lei das Águas” (Water Law), has a series of mechanisms for its enforcement that can be assisted by the Water Footprint for its better understanding.Their compatibility has been verified and its application can contribute tomore efficient water governance in Brazil.

INTRODUCTION

In the past decades, water resources have been acquiring more and more the spotlight in global meetings due to the global population growth and the increasing of animal origin products in the diet, especially in developing countries. As well as the expanding demand for goods and services, which are fomenting an overwhelming pressure over the natural resources in an unsustainable way.Even not considering the climate change effects, the available fresh water will drop in half (50%) in 2050, due only to the population growth according to Ringler et al. (2010). Clark (2014), Nestlé’s president, considers water scarcity a far more urgent problem even than climate change.The water crisis can grow to be this century’s disputes spring, provoking yet war in extreme cases, as oil was in the last century (Walkmen & Pimmel, 2013).

In this context, notice was taken of the commerce of products that use considerable quantity of water during its production. It originated the idea of “Virtual Water”, defined as the amount of fresh water used in the manufacturing of a determined product (whether goods or services), i.e. the sum of all water used in each and all phases of the production. From this starting point, the concept of Water Footprint was created as the total volume of fresh water used during the manufacturing and consume of a determined product (whether goods or services), as

well as the direct and indirect use of water in the process of production (Silva et al., 2013).

The Water Footprint emergence came to be as an alternative consume measurement. It set that way an ambient sustainability indicator, once most of the water use comes from indirect consume and not direct one (Maracajá et al., 2012). The main advantage of this method if compared to other metrics is that it calculates the effectively consumed water and not just the captured water. Besides that, it includes the calculation of Green Water and Gray Water, and also takes in consideration the indirect components (Hoekstra et al., 2011). For these reasons, it is considered "the real use of water" once it makes possible a more widely view of the use of water resources, being able to gather subject-matters on scarcity, process efficiency, tension over the water quality, soil use planning and so forth it is possible to examine in a more comprehensively way relative topics on sustainability process (Leão, 2013).

Water is the fundamental prerequisite for all production systems, however as a research object, has received little attention especially in Brazil. The studies have highlighted the incompatibility between water availability and water demand (Hoekstra et al., 2012). Metrics as the Water Footprint are fundamental to evaluate the activities performance and relevant to guide producers and consumers in decision taking.

GOALS AND METHODOLOGY

This article's goals is to introduce the Water Footprint as an efficiency water indicator, verifying its international acknowledgment in private and public policies, to put up to debate its national applicability from the tools contained in the law nº 9.433/97 and to suggest the method as a potential appliance to help public management decision-making.

For that matter, an exploratory bibliographical survey was made on an evaluation of the Water Footprint and how it is being used in the world. The law nº 9.433/97 was studied in order for it and all its instruments to be properly applied. After the data was collected, a detailed comparison of the methodology in examination was carried out with each of the evaluation instruments and finalized with the conclusion on how the application of the Water Footprint as a tool of public management can bring benefits on public decision–making. It should be noted that this scientific research has not yet had the suggested practical application done.

HISTORICAL CONTEXTUALIZATION

In the 1990s a concept called "Virtual Water" was introduced by John Anthony Allan, a professor at the School of Oriental & African Studies at the University of London, who verified that most of the water used in the manufacturing of a product is not built in. Therefore Virtual Water was established as the fresh water volume used in the manufacturing of a product in addition to the water spent in the various phases of the production chain (Carmo et al., 2007).

From the formulation of this concept, a growing concern on the Virtual Water trade began, caused by export growth. In 2002 there was a meeting of experts to discuss the subject at Delf, in the Netherlands (Silva et al., 2013). During this event, Arjen Y. Hoekstra introduced the concept of Water Footprint, which has shown to be a more complete indicator, closer to reality whereas it refers not only to the water volume, but also to the source (Blue, Green and Gray Water), as much as the impact (Footprint Size) and its local conditions (Giacomin & Ohnuma, 2012).

CONCEPT, IDIOSYNCRASIES AND RELEVANCE

Water Footprint is defined as the total fresh water volume used during the production and consumption of goods and services, likewise the direct and indirect consumption in the production process-chain (Silva et al., 2014). Although often used as synonyms, the concepts of Virtual Water and Water Footprint present a fundamental difference, according to Neto (2011); Virtual Water is an indicator from the production's point of view while the Water Footprint is an indicator from the consumption's perspective of the water.

It is an indicator that ponders the quantity, location, and period when it was consumed and polluted, considering all phases of production of a good or service (Hoekstra et al., 2011). It allows the effects of water scarcity to be monitored and for that matter is a candidate to be used as an evaluation tool in water management (Maracajá et al., 2012). It has a multidimensional frame since it shows the type of water use (consumptive use of rainwater, surface and underground water abstraction, and water pollution) directly and indirectly (Hoekstra et al., 2011).

The sustainability of the Water Footprint depends on local and temporal factors, taking into account the imminent characteristics of each region, whether in small (sub-basins, cities) or large scales (river basins, states, countries). For that matter, it is important for the study to be carried out with well-defined limits. For example, a large Water Footprint generates a small impact where there is great water availability, whereas in a place with scarcity, the smallest of Footprints would already have an enormous impact on site (Silva et al., 2013; Maracajá et al., 2012).

TYPES OF WATER FOOTPRINT

The Water Footprint is divided into three main components: Blue, Green and Gray Water. According to Hoekstra et al. (2011), each of these components can still be subdivided into more specific ones depending on the particularities of each study; still in this article, we will deal only with the main ones.

Blue Water refers to surface and/or subterranean freshwater and corresponds to one of the following four cases: (i) evaporation of water; (ii) water incorporated into the product; (iii) no return of water to the catchment area (water returned either to another area or to the sea); (iv) no return of water during the same season (water is withdrawn in the scarce period and it returns in the rainy season). According to studies carried out by Hoekstra & Chapagain (2007), the sector that accounts for the highest consumption of Blue Water today is agriculture, which corresponds to about

70% of that consumption, followed by the industrial sector that has its consumption around 22%, and only 8% of all consumption is due to domestic use.

Green Water is defined as the rainwater that is not withdrawn or stored in springs, but is temporarily stored in soil or vegetation. It represents the volume of rainwater consumed during the production and, therefore, is particularly relevant for agricultural crops based products because of evapotranspiration. The differentiation between Blue and Green Water is important due to the impacts of surface and groundwater use (Hoekstra et al., 2011).

Grey water indicates the degree of freshwater pollution associated with a production process and was defined by Hoekstra et al. (2011) as the volume of fresh water needed to assimilate the pollutant load, based on the natural concentrations and existing water quality standards. In Brazil, they are currently described in CONAMA Resolution No. 430 and No. 357.

Besides these components, the Water Footprint can be: Direct, when it refers to water consumption and the level of pollution generated directly by an activity; and Indirect, when it refers to consumption and the level of pollution associated with production processes. It comes to the closure that the Indirect Water Footprint is generally greater than the Direct Water Footprint; however, for being "invisible" it is often neglected (Silva et al., 2013).

INTERNATIONAL RECOGNITION

The Water Footprint concept has gained increasing space if compared to other methodologies. According to Pina (2010) it is the methodology of quantification of the water consumption with greater popularity in the scientific and business community today. One of the reasons for that is its easy understanding by the masses in general, showing it as a potential awareness tool (Kotsuka, 2013). Seixas (2011) and Hoekstra (2006) suggest the addition of information on the Water Footprint on product labels and thereby encourage market competitiveness and consequently improve the use of water resources in an increasingly efficient way.

It is important to emphasize the fact that the Water Footprint should not be interpreted as a number. For its complete evaluation, four phases must be fulfilled: a) scope definition; b) Water Footprint accounting; c) evaluation of the Water Footprint sustainability; d) responses formulation. It is not mandatory to carry out all of the steps; studies that go only until the calculation are common. Although for decision making, the other phases are the ones that will effectively be responsible for the proper management.

Some companies that invest in ecological issues have seen this methodology as a marketing tool with the capacity to improve the corporate image. Multinationals are examples of the acceptance of the Water Footprint as a new tool in water management within their productive chains (UNILEVER, 2009; PEPSICO'S WATER REPORT, 2014; NESTLÉ, 2009).

In 2014 another document of international relevance was launched recognizing the Water Footprint as a tool in the management of water resources, ISO 14046:2014 containing principles and guidelines for the Water Footprint of products,

processes and organizations. Following the family of ISO 14000, which establishes guidelines for environmental management in companies, it is shown as an important regulatory instrument in private policies, giving even more credibility to the methodology.

The use of Water Footprint methodology in public policies is recommended by FAO and UNESCO and is already used in the public management of some countries. The most notorious case is in Spain, which became the first country in the European Union to adopt the Water Footprint assessment in the formulation of government policies. In September 2008, the Environment Spanish Ministry approved a regulation that includes Footprint analysis of the different socioeconomic sectors as a technical criterion for the elaboration of the Hydrographic Basins Management Plans (Aldaya et al., 2010; Ribeiro, 2014).

"A LEI DAS ÁGUAS" (WATER LAW) AND ITS TOOLS

Now a days, the Law No. 9.433 of January 8, 1997, which has instituted the Política Nacional dos Recursos Hídricos - PNRH (National Policy on Water Resources) is in force in Brazil. It Introduced water governance in conceptual, theoretical and operational aspects in our legal framework and allowed an ecosystemic vision of our resources (Wolkmer & Pimmel, 2013).

It defines water as public domain wealth and as a limited natural resource; it also provides that its management must afford its multiple use despite the priority being the human consumption. It established as a territorial unit for its implementation the Hydrographic Basins, governed by their respective Comitês de Bacia Hidrográfica - CBH (Hydrographic Basin Committees), which counts with the participation of public power, users and communities in order to achieve a decentralized and participatory management (BRASIL, 1997).

The PNRH aims to: ensure water sustainability, rational and integrated use of the resource and the prevention of critical events. The physical, biotic, demographic, economic, social and cultural diversities of the different regions of the country should be considered for its implementation, integrating water management and environmental management, articulating the water resources planning of the user sectors with those of land use and regional, state and national planning.

Law 9.433/97, in its fifth article, presents the tools for its implementation, shown in following topics:

- **Water Resources Plan:** A type of master plan for implementation and management of PNRH. Must contain current diagnosis, use and occupation of soil, balance between demands and availability of resources (in quantity and quality), rationalization goals, measures, programs and projects to be developed, the priority of granting of use and determination of guidelines and criteria for charging on water use.

- **Framing of Water Bodies in Classes According to Prevailing Use:** It aims to ensure water quality compatible with the intended use and reduce pollution costs

from preventive measures. Main Instrument to integrate the National Water Resources Policy with the National Environmental Policy.

- **Granting of Rights of Use of Water Resources:** It aims to ensure the quantitative and qualitative control of use and the right of access to water. They are subject to granting: derivation, abstraction, extraction, and discharge of effluents, hydroelectric use and any type of use that alters the regime in amounts that exceed that considered insignificant by CBH. It must prioritize the multiple uses of the water and it has a maximum validity of 35 years (it is passive of renewal and partial or total suspension, definitively or with term determined in some specific circumstances).

- **Charge for the Use of Water Resources:** Recognizes water as good, endowed with economic value. Expects to encourage the rationalization of its use and to pool monetary resources to finance projects and interventions foreseen in the water resources plans. It is not a tax or a fee, but an instrument intended to encourage users to use water more rationally. The values are primarily spent on improvements in the river basin where it was collected.

- **Information Systems on Water Resources:** It is a system of collection, treatment, storage and retrieval of information on water resources and factors involved in its management. It has the purpose of guaranteeing access to this information by all stakeholders in society and in keeping with this database, as well as gathering, consistency and dissemination of data on the quantity and quality of national water resources and providing for the elaboration of Water Resources Plans.

BRAZILIAN LEGISLATION & WATER FOOTPRINT: RELATION AND APPLICABILITY

The use of the Water Footprint assisting the tools of management of the National Water Resources Policy may be interesting considering components that are not usually accounted for by the traditional water consumption approach. According to Leão et al. (2011), this relation makes it possible to identify the areas where the resource is most used and to define reduction strategies considering a geographically delimited region. The authors also emphasize the possibility of mapping the regions according to the pressure generated by the use of the water resources (Footprint Size).

Aldaya et al. (2010) understand that the assessment of Water Footprint and Virtual Water can provide relevant information to decision making, aiming at the occurrence of favorable environmental conditions and the adoption of more efficient water use mechanisms.

The first thing to be compared is the incentive of the tool to be used at the river basis subject, even if it can be used at different scales. In the Water Footprint manual, Hoekstra et al. (2011 devoted a whole chapter to this type of use and according to Law 9.433, the territorial unit for its implementation is the river basin.

Besides that, by relating the Water Footprint directly to each of the tools of the "Lei das Águas" (Water Law), it is possible to identify similarities that can be explored by technicians and decision-making agents.

By starting with the Water Resources Plan, where the Water Footprint can be used to identify points of interest in the river basin, since the methodology must be analyzed by taking into account the socioeconomic and environmental background of a region within a given range of time (Kotsuka, 2013). The previews knowledge of the region characteristics contemplated will make possible to analyze the relationship between supply and demand from the size of the calculated Footprint and Hotspots. These Hotspots would be points that demand more attention, needing care to not suffer from scarcity, wither due to a low supply or to the use and occupation of soils that may require greater demand than the one supported by the region.

Three tools that are related to one another and could use the calculation of the Water Footprint in a similar way are: i) classification of water bodies according to prevailing uses; ii) concession of the right to use water resources; and iii) charging for the use of water resources. First, we verify the similarity between the granting and the charge for use, which is complemented by the calculation of the Gray Water Footprint, since they consider CONAMA Resolution No. 430 as the standard in the discharge of effluents. Gray Water may also consider classification of water bodies to carry out their calculation, considering CONAMA Resolution No. 357.

In case of granting concessions, the Agência Nacional de Águas - ANA (National Water Agency) analyses quality and quantity indicators that are similar to those analyzed in Blue, Green and Gray Water calculations. It recommends the use of a data generation model called CROPWAT, developed by FAO which is the same used in Water Footprint calculations, together with a database compatible with a software called CLIMWAT. The calculation of the Water Footprint would be responsible for the quantification of the water volume while for the granting it would also be necessary the phase of evaluation of the Water Footprint. In this phase the impacts are evaluated and the possibility of the concession without water resources commitment.

Finally, we have the information system on water resources that can be an important database. There is still a lack of specific information on water consumption in certain regions during local production processes; the calculation of Water Footprints could then supply this demand for data if there was an incentive from the public management. With this, it will be possible to generate data that is available in the system helping in the creation of new plans and improving the management in a personalized way of those already existing.

The tool is also easily understood by the population and can provide users with information to sensitize them, simply by showing the amounts of water required for the production of various products and goods, thus stimulating more conscious consumption (Kotsuka, 2013).

CONCLUSION

Based on the previously mentioned observations, it can be verified that the current Brazilian water management is consistent with the proposal of use of the calculation methodology of the Water Footprint with the purpose of assisting in decision making. It also fits into each of the Water Law tolls, becoming an instrument that can enrich understanding and help Brazil's water governance.

The Water Footprint has already a standardized worldwide methodology and displays as an important tool of easy use and understanding, which makes it a potential indicator for the decision making in the management of the water resources in Brazil. It should bring the country to the spotlight for innovation once that have already seen the increasing trend of the use of this concept nationally and internationally.

The need to calculate the Water Footprint in a personalized way is emphasized, considering the environmental and socioeconomic characteristics of each region. The import of values obtained in another place makes the analysis fallacious, which will certainly affect the final result, invalidating the proposal for management improvements. There is also the importance of respecting and complying with all the steps of the methodology to obtain an integrated view of the water resources. Therefore, it is indispensable to deepen research in this area for generation and updating of data.

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