**BEST: International Journal of Humanities, Arts, Medicine and Sciences (BEST: IJHAMS)**
**ISSN (P): 2348–0521, ISSN (E): 2454–4728**
**Vol. 3, Issue 1, Jan 2015, 43–48**


# VIRTUAL WATER AND WATER FOOT PRINT: SIGNIFICANCE AND IMPLICATIONS

**DR. MOTHI GEORGE**

Assistant Professor, Department of Economics, Government College, Ambalapuzha, Kerala

## ABSTRACT

The water consumed in the production process of an agricultural or industrial product has been called the virtual water. If one country exports a water intensive product to another country, it exports water in virtual form. The water footprint of a nation is defined as the total volume of freshwater that is used to produce the goods and services consumed by the people of the nation. the virtual-water content of a crop is described in terms of green, blue water and grey water. The virtual-water concept can be directly related to the protection of water resources considering the intergenerational aspect. The import of virtual water via imported food and export of other commodities requiring less water will help water-scarce nations to maximise the value of their limited resources.

**KEYWORDS**: Virtual Water, Water Foot Print, Green Water, Blue Water, Grey Water.

## INTRODUCTION

The concept of virtual water was introduced by Tony Allan in the nineties who defined it as the water embodied in food crops that are traded internationally (Allan 1998) and since then it has received more and more attention from people concerned with water management and especially with water related to food production. Increasing intersect oral competitive demand for water, the need for feeding an ever-growing population and the danger of increased water scarcity in many regions of the world provide some very important reasons to review the way water is consumed and managed and also how human needs are considered. it is estimated that around 2 to 4 litres of drinking water per day to satisfy the biological needs of a human being and about 1000 times of it to produce the food which makes it the biggest consumer of water. This makes the concept of virtual water so important in a discussion involving food production and consumption. Producing goods and services generally requires water. The water used or consumed during the production process of an agricultural or industrial product is called the virtual water contained in the product (A.Y. Hoekstra 2003). The term virtual is used to convey the fact that most of the water used in the production of a product is not contained in the product. Virtual water is called as the embodied water in a product, as the water needed for the production of the product and also as embedded water or exogenous water, which refers to the import of virtual water into a country which will add to the country's endogenous water (Haddadin, 2003). For example, a country that imports 1 million ton of rice is importing, and therefore increasing its water resource by, 1 billion $m^3$ of water (Renault, D. 2003). The need for a more clear and precise quantitative definition led to the emergence of two different approaches, one from a producer's perspective where the virtual water content is defined as the volume of water that was in reality used to produce the product. This took into consideration the production conditions, including place and time of production and water use efficiency. For instance, producing one kilogram of grain in a hot arid country may require two or three times more water than producing the same amount in a humid country. The second approach takes a user perspective while defining the virtual water content of a product as the amount of water that may have been required to produce the product at the place where the product is needed which is also known as consumption-site definition (Chapagain & Hoekstra 2004).The production-site-specific definition can be useful when employed at a global or at a multinational perspective is taken and the net virtual-water flows between importing and exporting countries are important. This comes handy, when the focus is on whether or not virtual-water trading contributes to global water savings. On the other hand, from the point of view of a single country, the consumption-site specific definition is more relevant. For any country the amount of water it could save by importing the product is the amount that is required to produce it and for a water-scarce country this is of primary importance. The local opportunity costs can be estimated by calculating this amount of water. (Wichelns 2004). Another interesting approach was put forward by Hoekstra Renault, who considered the virtual water content of a good substitute of the product under consideration. As an example, he intends to apply the principle of nutritional equivalence, which calculates the virtual water content of an alternative product having the same nutritional value (Renault2003). The notion of virtual-water trading brings on the idea that water-scarce countries should increasingly meet their food requirements by importing crops from water-rich countries (Horlemann & Neubert 2007), which will save the amount of water that would have been required to produce the crop locally (WWC 2004). The importance of virtual-water trade is mainly about the water savings that are generated in the countries that import agricultural products as it makes water available for other beneficial uses (Chapagain et al. 2006).This can lead to improved trade policies which will ensure food security and the utilisation of scarce and precious water resources to their maximum social and economic benefit.

The idea of water footprint was introduced in the early 2000’s in similar lines to the ecological footprint concept which was introduced in the 1990s as a need arose to have a consumption-based indicator of water to use along with the traditional production-sector-based indicators of water use (Hoekstra and Hung, 2002). The ecological footprint quantifies the area needed to sustain people’s living while the water footprint indicates the water required to sustain a population. The water footprint of a nation is defined as the total volume of freshwater that is used to produce the goods and services consumed by the people of the nation. Since not all goods consumed in one particular country are produced in that country, the water footprint consists of two parts, firstly, use of domestic water resources and use of water outside the borders of the country. The water footprint of a crop is a similar concept to virtual water and it accounts for the direct and indirect use of water in the production of a commodity such that water use is estimated across the entire production and supply chain. Thus, the water footprint of a crop may include the amount of water required to grow a crop as well as any water used in processing and cleaning the crop prior to consumption. It also includes the quantity of water polluted in producing the crop, through fertiliser and pesticide inputs.

Production of Crops occurs either under purely rain-fed conditions or under irrigation and so the source of water has an important role in evaluating water savings and opportunity costs linked with virtual-water trading. Very often, the virtual-water content of a crop is described in terms of green, blue water and grey water. Green water refers to the water available in soil that is derived directly from rainfall. Since, there is very little economic or social value that can be derived for any use other than agriculture, the opportunity cost of using green water for crop production is relatively low. So, it is generally regarded that using green water for agricultural production is highly beneficial to a country. In addition to that, rain-fed agriculture does not contribute very much towards water scarcity, since it does not take water from rivers, dams and lakes. Blue water on the other hand refers to the water contained in rivers, dams, lakes and aquifers. Blue water typically has a far higher opportunity cost than green water, especially in a country where there is waters scarcity. Blue water has many alternative uses, such as domestic drinking water, recreation and industry. Irrigated agriculture diverts blue-water resources to crops and impacts directly on the amount of water resource and therefore has the potential to have a significant impact on water scarcity. The grey-water is rather a late entry into the list and indicates the degree of freshwater pollution that can be associated with a process and is defined as the volume of freshwater required to absorb a pollutant load in order to meet existing water-quality standards. This also means that polluted water is unsuitable for certain uses and that amount of water is unusable. In the case of agriculture, the grey-water content will be considering the impact of fertilisers and pesticides on water quality.

The Policy on Resource Directed Management of Water Quality has put forward six enabling principles of sustainable development which includes protection of water resources, optimal water use, equity between generations, current equitable access, environmental integration and good governance (DWAF 2006). The virtual-water concept can therefore also be directly related to the protection of water resources considering the intergenerational aspect. The principle of optimal water uses or choosing the best alternative use, is enabled by a series of principles, which includes virtual-water use. This places the use of virtual water explicitly in the context of sustainable development. The concept of virtual water gives a number of approaches so that water is used in the most appropriate way in the public interest. It is also in line with the principles of integrated water-resource management. Protection of water resources is also an issue that may affect decisions relating to optimal water use. For example, the best alternative use for water in a particular area may be by the associated aquatic ecosystems, in so doing maintaining their integrity. A degree of protection from potential human impacts may be required to achieve this. As economic growth and development increases, the natural resources of our planet come under ever-increasing stress and pressure. it is important to identify ways in which scarce resources can be protected or used more efficiently. Water is unevenly distributed over the globe and many countries face the problem of water scarcity. Food security can be defined as access by all people at all times to enough food for an active, healthy life (World Bank 1986). National food security is a vital goal for every country and agriculture is the largest single user of liquid freshwater worldwide. The import of virtual water via imported food and export of other commodities requiring less water will remain a valid concern for water-short nations seeking to maximise the value of their limited resources (Qadir et al. 2003). These two reasons emphasise the importance that must be placed on the virtual-water concept and crop production in a country. Food security has often been interpreted as requiring self-sufficiency in food production (WWC 2004) which unfortunately creates a sense of national security by minimising reliance on other countries to satisfy food requirements. It is a fact that in an effort to achieve this, many countries like Israel, Libya and Jordan have used water unsustainably and have literally run out of the resource. Food requirement can be met through importing the bulk of food requirements from other countries, provided that the country is capable of doing so. To achieve this, the social adaptive capacity of a country is vital for alleviating water scarcity and for providing food security through virtual-water trading. Reducing local agricultural productivity for adopting virtual-water policy will result in a loss of income and jobs in the sector. To compensate this loss, there should be sufficient diversification of the country's economy and it should be able to break away from its dependence on the scarce resource and more importantly move from productive efficiency to all ocative efficiency. Social Adaptive Capacity is the sum of social, economic and political resources available to respond or adapt to the changes imposed by the policy (Earle 2001). A suitable social adaptive capacity would involve (a) less local crop production and (b) increased reliance on the importing countries and alternative productive use of the water to generate income to pay for imported food.

A good consideration of the virtual-water concept may ultimately lead to a change in policy to import more food. Indeed, this may be inevitable in those countries where water has become so scarce that local crop production is no longer viable. It is clear that, it can only be successful under certain conditions. Within an agricultural context the implication will be that a country might increasingly export high-value commodities and increasingly import low-value commodities. High direct production costs would be passed on to the importing country as higher prices. Many products put on the world market at a price which does not properly include the cost of the water contained in the product So, it would require the exporting country to take explicit account of environmental costs, such as water use by developing appropriate concepts and tools which has some degree of economic sophistication (Hoekstra & Hung 2005). The importing country can on insist on the adoption of appropriate environmental management in the exporting country as done by the E.U. It is only in these ways that virtual-water trading can truly hope to lead to global water savings.

The concept of virtual water considers the crop and the water and water quality that it needs. However, as noted above, a number of socio-economic and political components must also be considered. Wichelns (2004) notesthat “The virtual water metaphor, while not a sufficient criterion for determining optimal strategies, still serves an important role in gaining the attention of public officials. Once that is accomplished, the discourse can be extended to include consideration of opportunity costs and comparative advantages, as strategies are determined and policies are selected.” Specifically, policy makers are encouraged to evaluate the relative scarcity of key resources in the context of national goals (Wichelns 2001). The virtual water and water footprint concepts, therefore, emphasise that impacts on freshwater systems are inextricably linked to human consumption and the issues of pollution and water scarcity can be better understood by considering the production and consumption chain in totality.

**REFERENCES**

1. A.Y. Hoekstra (2003), Virtual water: An introduction, in Virtual water trade (2003), Proceedings of the International Expert Meeting on Virtual Water Trade, IHE Delft, The Netherlands 12-13 December 2002 Value of Water Edited by A.Y. Hoekstra, February 2003 Research Report Series No. 12
2. Allan, J.A. (1998), ‘Virtual water’: A strategic resource. Global Solutions to Regional Deficits. Ground Water 36(4): pp. 545-546.
3. Chapagain, A.K. and Hoekstra, A.Y. (2004) Water Footprints of nations. Vol 2. Value of Water Research Report Series 16. UNESCO-IHE Delft, The Netherlands.
4. Chapagain, A.K., Hoekstra A.Y. and H.H.G. Savenije (2006), Water saving through international trade of agricultural products. Hydrology and Earth System Sciences 10: pp. 455–468.
5. DWAF (2006), Resource directed management of water quality. Vol 1.2. Policy (1ed), Water Resource Planning Systems Series, Sub-Series No. WQP 1.4.2. Department of Water Affairs and Forestry (DWAF), Pretoria. [ISBN No. 0-621-36788-5]
6. Earle, A. 2001. The role of virtual water in food security in southern Africa. Occasional Paper 33. Water Issues Study Group, School of Oriental and African Studies, University of London.
7. Haddadin, M.J. (2003) ‘Exogenous water: A conduit to globalization of water resources’ in Virtual water trade (2003), Proceedings of the International Expert Meeting on Virtual Water Trade, IHE Delft, The Netherlands 12-13 December 2002 Value of Water Edited by A.Y. Hoekstra, February 2003 Research Report Series No. 12
8. Hoekstra AY, Hung PQ (2002), Virtual water trade: A quantification of virtual water flows between nations in relation to international crop trade. Value of Water Research Report Series No. 11, UNESCO-IHE Institute for Water Education, Delft, The Netherlands, http://www.waterfootprint.org/Reports/Report11.pdf.

9. Hoekstra, A.Y. and Hung, P.Q. 2005. Globalisation of water resources: international virtual water flows in relation to crop trade. Global Environmental Change 15: pp. 45-56.
10. Horlemann, L. and Neubert, S (2007), Virtual Water Trade: A Realistic Concept for Resolving the Water Crisis? German Development Institute, Bonn.
11. Qadir, M., Boers, T.M., Schubert, S., Ghafoor, A. and G. Murtaza. (2003), Agricultural water management in water-starved countries: challenges and opportunities. Agricultural Water Management 62: pp. 165-185.
12. Renault, D. (2003), 'Value of virtual water in food: Principles and virtues' in Virtual water trade (2003), Proceedings of the International Expert Meeting on Virtual Water Trade, IHE Delft, The Netherlands 12-13 December 2002 Value of Water Edited by A.Y. Hoekstra, February 2003 Research Report Series No. 12
13. Virtual water trade (2002), Proceedings of the International Expert Meeting on Virtual Water Trade, IHE Delft, The Netherlands 12-13 December 2002 Value of Water Edited by A.Y. Hoekstra, February 2003 Research Report Series No. 12
14. Wichelns, D. (2004), The policy relevance of virtual water can be enhanced by considering comparative advantages. Agricultural Water Management 66: 49–63
15. Wichelns, D. 2001. The role of 'virtual water' in efforts to achieve food security and other national goals, with an example from Egypt. Agricultural Water Management 49: pp. 131-151.
16. World Bank. 1986. Poverty and hunger: Issues and options for food security in developing countries. A World Bank Policy Study. World Bank, Washington, DC.
17. WWC. (2004), E-Conference Synthesis: Virtual Water Trade-Conscious Choices. World Water Council (WWC), France