

# **Understanding Water Footprint and Virtual Water Trade: Managing Water Resources in a World of Scarcity**

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## **Abstract**

Water scarcity is a growing global challenge, and it is becoming increasingly important to manage water resources effectively. The water footprint and virtual water trade are two concepts that have emerged as potential solutions to this challenge. The water footprint is a tool for measuring and managing water use in different sectors, while the virtual water trade is a way for countries with water scarcity to import water-intensive goods and products from countries with abundant water resources. This article provides a comprehensive overview of the concepts of water footprint and virtual water trade, including their definitions, methodologies, benefits, limitations, and controversies. The article also discusses the challenges and opportunities associated with managing water resources in a world of scarcity, and highlights the importance of adopting a holistic and integrated approach to water management.

## **Introduction**

Water is an essential resource for life on earth, and its scarcity is one of the major challenges faced by humanity today. In recent years, there has been an increasing concern about the impact of human activities on water resources, including the depletion of aquifers, pollution of water bodies, and the effects of climate change on water availability. The concept of the water footprint has emerged as a tool for measuring and managing water use in different sectors, including agriculture, industry, and households. Additionally, the virtual water trade has gained attention as a way to manage water scarcity through international trade of water-intensive goods.

This article aims to provide an overview of the water footprint concept and the virtual water trade. It will describe the main methods used to calculate the water footprint, the different types of water footprint, and their applications in different sectors. It will also discuss the virtual water trade, including its benefits and limitations, and the controversies surrounding this approach.

## **Water Footprint**

The water footprint is a concept that was introduced in 2002 by Arjen Hoekstra, a professor at the University of Twente in the Netherlands. The water footprint is defined as the total volume of freshwater used to produce a product or service. It includes the water used in the production process, as well as the water consumed or polluted during the production process. The water footprint can be measured at different scales, including the individual, household, company, and national levels.

The calculation of the water footprint is based on the concept of water scarcity. Water scarcity is defined as the imbalance between the demand for water and the available water

resources. Water scarcity can be caused by natural factors, such as droughts and climate change, or by human activities, such as water withdrawals for irrigation, industry, and domestic use. The water footprint takes into account the availability of water resources in a particular region and the amount of water required to produce a product or service in that region.

The water footprint can be divided into three types, which are:

**Blue water footprint:** the volume of surface and groundwater consumed or polluted during the production process.

**Green water footprint:** the volume of rainwater consumed or polluted during the production process.

**Grey water footprint:** the volume of freshwater required to dilute pollutants to meet water quality standards.

The blue water footprint is the most widely used type of water footprint and is often used to measure the water use of agriculture, industry, and households. The green water footprint is mainly used to measure the water use of crops grown in rain-fed areas. The grey water footprint is used to measure the environmental impact of water pollution.

## **Applications of the Water Footprint**

The water footprint has several applications in different sectors, including agriculture, industry, and households.

**Agriculture:** The water footprint is used to measure the water use of crops and livestock production. It can be used to identify the crops and livestock that are most water-intensive and to develop strategies for reducing water use in agriculture.

**Industry:** The water footprint is used to measure the water use of industrial processes and to identify opportunities for reducing water use and improving water efficiency.

**Households:** The water footprint is used to measure the water use of households and to identify ways to reduce water use through behavior change and the adoption of water-efficient technologies.

## **Virtual Water Trade**

The virtual water trade is a concept that was introduced in the early 1990s by Tony Allan, a professor at King's College London. The virtual water trade refers to the trade of water-intensive goods and products between regions or countries. The virtual water trade is based on the idea that countries with water scarcity can import water-intensive goods and products from countries with abundant water resources, instead of producing them domestically.

The virtual water trade is calculated by estimating the amount of water used to produce a particular product or commodity in a particular region or country. The virtual water content of a product is defined as the volume of water used to produce one unit of that product. For example, the virtual water content of one kilogram of wheat produced in a water-scarce

region might be higher than the virtual water content of one kilogram of wheat produced in a water-abundant region. The virtual water trade can provide several benefits to countries with water scarcity, including:

**Reducing water use:** Countries with water scarcity can reduce their water use by importing water-intensive goods and products from countries with abundant water resources, instead of producing them domestically.

**Enhancing food security:** The virtual water trade can help to ensure food security in countries with water scarcity by enabling them to import food from countries with abundant water resources.

**Generating income:** Countries with abundant water resources can generate income by exporting water-intensive goods and products to countries with water scarcity.

The virtual water trade has several limitations and controversies, including:

**Unequal distribution of benefits:** The virtual water trade may benefit countries with water scarcity at the expense of countries with abundant water resources. Countries with abundant water resources may be exporting their water resources to other countries without receiving sufficient compensation.

**Environmental impacts:** The virtual water trade may result in environmental impacts, such as increased water use in water-abundant regions and increased greenhouse gas emissions associated with transportation of water-intensive goods and products.

**Social impacts:** The virtual water trade may have social impacts, such as displacement of local farmers and communities in water-scarce regions as a result of increased imports of water-intensive goods and products.

**Lack of transparency:** The virtual water trade may lack transparency, and it may be difficult to trace the origin of water-intensive goods and products.

## **Conclusion**

Water scarcity is a major challenge faced by humanity today, and the water footprint and virtual water trade are two concepts that have emerged as tools for managing water resources. The water footprint is a useful tool for measuring and managing water use in different sectors, including agriculture, industry, and households. The virtual water trade is a potential solution for countries with water scarcity to import water-intensive goods and products from countries with abundant water resources. However, the virtual water trade has several limitations and controversies, and it should be approached with caution to ensure equitable distribution of benefits and to minimize its environmental and social impacts.