Give Virtual Water a Chance!

An Attempt to Rehabilitate the Concept

Reaction to E. Gawel, K. Bernsen. 2011. Do We Really Need a Water Footprint? Global Trade, Water Scarcity and the Limited Role of Virtual Water. GAIA 20/3: 162–167

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Erik Gawel and Kristina Bernsen set out to review critically the concept of virtual water (2011, in this issue). They criticize the concept of virtual water and consequently view the policy advice and conclusions drawn in parts of the literature as problematic. The authors argue that the concept of virtual water is flawed for two reasons: first, because it does not contain important information on the traded virtual water (neither on the water scarcity of the exporting regions, nor on the sustainable use of the water used for production), and second, because the concept cannot be used to deduce whether a flow of virtual water from a water-scarce to a water-abundant region (or vice versa) enhances welfare or not, since there are scarce resources other than water, such as, e. g., land, capital, or labor, which are decisive in the production process of goods.

Since it is therefore problematic to say something about the quality and the welfare impact of trade of virtual water, Gawel and Bernsen continue to argue that the conclusions and the resulting policy advice of some authors cannot be trusted. The conclusions they criticize state, on the one hand, that trade of virtual water is problematic (from developing countries to developed countries and vice versa), and on the other hand, that the unequal distribution of the "global public good" water leads to problems. Based on these conclusions, both strands of the criticized literature call for trade barriers, either in the form of taxes or in the form of permits to prohibit virtual water trade.

In the following I try to rehabilitate the concept of virtual water by arguing that – while conclusions drawn in some papers based on the concept of virtual water trade might be misleading – the concept can still be useful. I also try to answer the question of what it takes to use and develop "virtual water" as a consistent concept from which it is possible to draw sensible conclusions and policy advice.

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Getting the Definitions Straight

The concept of virtual water and the water footprint are related, but they are not the same. In fact, there are three applications which derive virtual water contents and relate them to international trade. First, the concept of virtual water can be used for calculating how much water is saved (globally, nationally, or even locally) by international trading of water-intensive produced goods. Second, it can be used to create awareness about water consumption by calculating a water footprint which embeds how much water was used for the production of the goods consumed by individuals or nations. And third, it can be used to calculate virtual water trade balances.

There is one decisive difference between the first two applications and the third: Whereas the water savings and the water footprint do not reveal any information about where the virtual water consumed comes from and are therefore also not able to say anything about whether the water comes from a water-abundant or water-scarce region or whether the water has been used sustainably or not, using virtual water trade balances makes it potentially possible to derive such information. Criticism of the water footprint should therefore not automatically be applied to the idea of virtual water trade. In their article, Gawel and Bernsen do not distinguish between the concept and the applications of virtual water, but they treat all applications of the virtual water concept – the water footprint as well as the other applications – the same, thereby ignoring the important differences between these applications.

In the following I will only react to the concept of virtual water including those applications with information about the source of virtual water.

The Distinction Between Green and Blue Water

To make the most of the concept of virtual water another essential piece of information about the traded virtual water is necessary: the distinction between "blue" (surface and ground water) and "green" water (rainwater stored in the soil). Whereas green water – as important as it might be for ecosystem services such as carbon sequestration, biodiversity, or climate regulation – can only be used for agricultural goods (and evaporates back into the atmosphere after it has gone through the plant), blue water, which in the context of agriculture is mostly irrigation water, can also be used for a multitude of other purposes (both industrial and domestic).

Therefore, importing countries which, if they would not import, would produce agricultural goods with green water, do not actually save water when importing, as the green water not used for agriculture evaporates back into the atmosphere. On the other hand, countries exporting virtual blue water cannot use this water for industrial or domestic purposes. Ten percent of the water used for agricultural production is irrigation water (Hoff et al. 2010). This might not seem a lot, but it has to be considered that agriculture in water-scarce regions relies on blue water, because these are often regions with frequent dry periods in which no other source of water is available, and that these are the regions where overexploitation and unsustainable use of blue water is a problem. It therefore can be stated that only by distinguishing between green and blue water in the concept of virtual water it is possible to define the problematic or positive effects of virtual water trade.

As Gawel and Bernsen correctly point out, the unsustainable use of a scarce resource, whether to produce a commodity for export or for domestic uses, lies in the fact that the pricing of the scarce resource in question is wrong: water, for example, might be subsidized, and external effects such as the unsustainable use of ground water are not included in the price. Although it is true that water scarcity problems are local (and would not exist if the prices were right), the reasons for their appearance or worsening are driven not only by local management, but also by an external demand for agricultural goods. Understanding the effect international trade has on local water scarcity problems might therefore also help to solve problems of wrong water use on a local level. On the other hand, there are regions which are water-scarce and import virtual water. These regions are interesting, since they reveal the effectiveness of international virtual water trade.

The Derived Policy Advice Might Be Wrong, the Concept Is Not

In the light of the above arguments, the adaptation of a limited concept of virtual water to conclude the necessity of trade barriers for virtual water can lead to economically unsound policy advice. But the result should not be to condemn the concept, but to combine it with information on the water scarcity of the exporting region, the sustainability of its use and its "color". It should of course also be taken into account that the flow of the virtual water cannot solely be explained by comparative advantages, because there are other scarce resources which determine whether a good is produced for domestic use, export, or import.

Since international flows of virtual water are likely to increase, and water availability in many regions is predicted to decrease as a consequence of global climate change, it seems important not to dismiss a tool which could be helpful in understanding and interpreting the flows of virtual water and the effects these flows have on local water conditions.

Everything Comes Down to the Right Pricing

I totally agree that trade flows of virtual water cannot and should not always reflect water scarcity or abundance, since there are other scarce resources involved in the production of water-intensive goods, and it might very well maximize total welfare for water-abundant regions to import virtual water, while equally it might benefit all that water-scarce regions export virtual water. Our interest should be directed towards regions where water is scarce and is not used sustainably, and which still export virtual water, because these are the regions where trade has the potential to aggravate water scarcity and to worsen local living conditions.

While bearing in mind the potentially problematic economic interpretation of virtual water trade, this information could be integrated more effectively (e.g., complemented by information on other scarce resources such as land). This in turn could help quantify the effect of virtual water trade on local water scarcity, and be useful in deriving careful local policy advice, for example on the appropriate pricing of irrigation water in order to prevent overexploitation of ground water, or to help farmers in water-scarce regions switch from low-value to high-value crops in order to use scarce water resources more economically.

The theory of virtual water is relatively young: Allan (1996) introduced the term "virtual water" in order to describe the water >

used to produce crops traded in international markets. Hoekstra and Hung extended the theory by estimating the "flows of virtual water" between countries and by developing the concept of the "water footprint" (Hoekstra and Hung 2002). A few years later the theory was again refined by distinguishing between the blue and the green components (Chapagain et al. 2006, Yang et al. 2006, Yang and Zehnder 2007), acknowledging that blue water used for irrigation is the part of the virtual water that is responsible for local water scarcity. Chapagain and Hoekstra then joined forces to improve the theory further by developing a water footprint which distinguishes between an internal water footprint (volume of water used from domestic water resources) and an external water footprint (volume of water used in other countries to produce goods and services), thus gaining the important information on how much water has been used in the production of a good. Recently, they combined the additional information on external and internal water footprints with the information on blue and green water for the production of rice and thus achieved an even more accurate indicator of the impact the production and trade of virtual water has on local water resources (Chapagain and Hoekstra 2011). Although this new water footprint is already a decisive step in the right direction, it still does not reveal whether the water used for producing export goods aggravates water scarcity problems locally. Two recent studies try to approach this problem by developing indexes which incorporate water scarcity locally: Ridoutt and Pfister (2010) developed a stress-weighted water footprint where they combine the volumetric impact on blue water availability with local water stress for two individual products; Biewald et al. (2011) use water shadow prices as water scarcity indicators and combine them with virtual blue water used for the production of export food crops to develop an indicator of the significance of water saving.

These examples show that latest research has made immense progress in improving the concept of virtual water trade as well as the concept of the water footprint. Although the new water footprints and indexes already deliver a lot of important information – blue or green water used, production in water scarce or water abundant regions –, information which could be very useful when trying to improve the concept concerning the sustainable use of the blue water has not yet been approached explicitly. Developing an index for virtual water trade that contains information on the sustainability of the blue water use is therefore an effort that has still to be made in the scientific community.

The theory of virtual water has been criticized for developing trading strategies which are not consistent with the concept of comparative advantages, the most prominent critic being Dennis Wichelns (Wichelns 2004, 2010). Trying to explain export and import of virtual water only on the basis of comparative advantages, or trying to build policy advice on these findings is bound to fail, since there is not only one scarce resource which is decisive for the production and trading decision. But taking the multitude of drivers of trade into account, one can still derive valuable information on how trade affects blue water used for production by using the virtual water trade and looking at the local conditions of resources. Since international flows of virtual water are likely to increase (Ramirez-Vallejo and Rogers 2004), and water availability in many regions is predicted to decrease as a consequence of global climate change (Bates et al. 2008), it seems important not to dismiss a tool which could be helpful in understanding and interpreting the flows of virtual water and the effects these flows have on local water conditions.

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