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Water Footprint and Carbon Footprint – Disparate Relatives

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I. Of Backpacks and Footprints – the Basic Idea

Footprint concepts are special forms of environmental accounting¹. Based on the *ecological footprint* concept developed in the 1990s by *Wackernagel* and *Rees*², they have seen a meteoric rise in popularity ever since.³ Whilst the ecological footprint represents a cumulative parameter that regards the many diverse forms of human exploitation of nature and seeks to achieve comparability using the global land requirement in hectares as a measure, carbon and water footprints each regard only one specific resource and express its exploitation as a quantity of the resource itself.

The term *ecological footprint* is understood as a measure of the Earth's surface needed to enable the different lifestyles of people (under present-day conditions of production and consumption). This includes not only areas required for the production of supply goods or the supply of energy, but also e.g. for the disposal of waste or for the capture of CO₂ released as a

¹ For an overview see, e.g., *Environmental Protection Agency*, An introduction to environmental accounting as a business management tool: Key concepts and terms, 1995, with further references.

² *Rees*, *Environment and Urbanization* 1992, 121; *Rees/Wackernagel*, *Environmental Impact Assessment Review* 1996, 223; *Wackernagel/Yount*, *Environmental Monitoring and Assessment* 1998, 511.

³ For an overview of the vast number of publications that take the concept as a basis, develop it further and apply it empirically, see those listed under http://www.footprintnetwork.org/de/index.php/GFN/page/academic_references.

result of human activity.⁴ The values are given in “global hectares per person and year”. Hence the concept can be understood as a sustainability indicator.

Footprint concepts for carbon (*carbon footprint*) and water (*water footprint*), although still methodologically demanding,⁵ are far more modest by comparison. They each sum up the quantities of the resource in question (carbon emissions or water turnover) along value chains and assign them to specific causally related objects of consideration (products, individuals, organisations, countries or events, e.g. travel). Both values therefore convey a quantitative measure of the strain that human production and consumption activities place on resources at any chosen level of aggregation. In the case of the resource “water”, because water which does not physically go into a product, e.g. the water requirement of a tomato or coffee plant, is also “moved” along the value chain, this is referred to here as “*virtual water*”, a term that encompasses all life-cycle-related water requirements per cost object (product, individual, company, country etc.).

Both concepts – the *carbon footprint* and the *water footprint* – have attracted a great deal of attention in recent years and far outshine all other ecological accounting indicators in the public perception. *Footprint accounting* has become a popular topos that calls upon companies, consumers and policy makers to reflect upon their decisions. The scientific literature on the topic has literally exploded, and meanwhile an independent field of study has emerged. On internet portals, anyone can calculate their own “personal” footprint,⁶ and companies, government agencies and international organisations are adopting the concepts.⁷ Footprint accounting also has originated far-reaching implications for climate, environmental, economic and trade policy which, however, partly represent problematic over-interpretations (for more on this, see below).

All of the ecological accounting concepts mentioned share one common feature: they all aim to communicate, on the basis of scientific principles, comprehensible, quantitative insights into the strain that human activity places on the planet’s limited resources while seeking to draw maximum public attention to this fact. To a large extent this has proven very successful – albeit to varying degrees. Beyond the mere consideration of calculations (positive analysis) the concepts simultaneously seek relevance to natural resources policy (normative implications) (II.).

⁴ On the methodology, see in particular *Borucke et al.*, *Ecological Indicators* 2013, 518.

⁵ See, e.g., for carbon footprinting, *Williams et al.*, *A beginner’s guide to carbon footprinting*, *Carbon Management* 2012, 55-67; *Wright et al.*, ‘Carbon footprinting’: towards a universally accepted definition, *Carbon Management* 2011, 61-72.

⁶ See alone http://www.footprintnetwork.org/de/index.php/GFN/page/basics_introduction/ or <http://www.waterfootprint.org/?page=files/home>.

⁷ See, e.g., The Coca Cola Company, *The Nature Conservancy, Product water footprint assessments – Practical applications in corporate water stewardship*, 2010; BMU/UBA/Öko-Institut, *Memorandum Product Carbon Footprint, Position statement on measurement and communication of the product carbon footprint for international standardization and harmonization purposes*, 2009; *Chapagain/Hoekstra*, *Water footprints of nations*, UNESCO-IHE Value of Water Research Report Series No. 16, 2004.

II. Footprints as a Concept for Action in Resources Policy

1. From Measured Value to Normative Concept for Action

Footprint analysis is not limited to calculating measured values, ensuring that they are methodologically robust, and then making them widely available to the public. The question naturally arises as to what exactly should be done with the information that is made available. Therefore, parts of the literature go one step further and use these measures as a basis for normative concepts for action in resources policy. They not only convey quantitative knowledge, they also state how resources-related production and consumption behaviour and global resources-related policy (climate, environmental, economic and trade policies) should be shaped so as to imply the “correct” footprint parameter values. In so doing, they rely on normative evaluations to determine which value ranges of the calculated key indicators should be regarded as “better” or “worse” and call for political measures or individual patterns of behaviour in order to achieve the desired key figures.

Thus, for example, the idea is propagated that achieving CO₂ neutrality and balancing footprint-derived climate impact estimations in an object-related manner is desirable, which is why, for instance, companies or organisations which are concerned about the environment or their public image seek to compensate their employees’ (air) travel (by investing in rainforest reforestation, renewable energies or other climate-friendly measures). It is also suggested that, when making decisions, those who know the CO₂ footprints for several different policy options can take these figures into account – if necessary, after weighing other relevant decision-making factors – for example, by choosing the option with the smaller footprint. In general, the aim is to implement “measures to reduce”⁸ the footprint values. Of course, like all informational instruments of environmental policy, the question who uses it where and to the best effect remains open. Here, the carbon footprint has the same effect as an eco-label that implicitly calls for reduced consumption.

Per-capita emissions of CO₂ are furthermore an element of the Human Sustainable Development Index (HSDI) as well as the United Nations Millennium Development Goal Indicators (MDG Indicators) and the new Sustainable Development Goals (SDG) formulated in 2015. Finally, normative concepts of *climate justice* partly demand that international climate policy be oriented towards an equal global greenhouse gas emissions budget per person.⁹

Even further, and at times contradictory, are the resources policy implications of the water footprint concept. Here, too, sometimes the idea of a “just” distribution of globally available water resources among all inhabitants of the earth (“virtual water for all”¹⁰) is a driving force:

⁸ See e.g. BMU/BDI, Product-related climate protection strategies. Understanding and using Product Carbon Footprints, 2010, p. 39, <http://www.proesler.com/wp-content/uploads/2009/11/Product-related-climate-protection-strategies.pdf>.

⁹ See, e.g., *Mohai et al.*, Environmental Justice, Annual Review of Environment and Resources 2009, 405-430; in the German-speaking world, e.g., *Meyer*, Klimagerechtigkeit, 2015; *Ekardt* (ed.), Klimagerechtigkeit. Ethische, rechtliche, ökonomische und transdisziplinäre Zugänge, 2012.

¹⁰ *Zehnder*, Water Food Nexus, Presentation at the First Water Research Horizon Conference, Berlin, 13 July 2010.

In the industrialised world one would acquire (virtual) water which, in a per capita comparison, is far higher than the annual “share” that would be available to an Indian or Zambian, for instance.¹¹ Other normative approaches aim to increase global “water efficiency” by arranging trade flows such that water savings can be made globally, for instance, in the supply of water-intensive agricultural products.¹²

Against this background, the global regulation of so-called virtual water flows is widely regarded as necessary.¹³ To support such views, some authors refer to “global justice” considerations and the potential geopolitical consequences of virtual water trade and/or the idea that trade flows must be geared towards the criterion of so-called “global water use efficiency”¹⁴; this is satisfied only by virtual water flows from water-rich to water-poor regions. Corresponding regulation proposals range from international agreements on cross-border water taxes, which are supposed to open the eyes of consumers in industrialised countries to the costs of their behaviour,¹⁵ to tradeable water-footprint certificates. Such licenses are supposed to be distributed to all countries according to their “rightful” share in the sustainable consumption of globally available water resources. This means that additional rights would have to be obtained for an “above-average” per capita water footprint, whereas people with below-average consumption would have to receive a compensation, whereby the tradability of the rights is by no means regarded as mandatory.¹⁶ The supposed task of virtual water taxes is therefore to bring the consumption of virtual water in industrialised nations to an appropriate level, in other words, to reduce the “flow” of virtual water into those countries. On top of that comes the proposal to introduce a “pollution tax” on products which, during the disposal phase, cause water contamination. In particular, this is intended to combat nutrient contamination in densely populated areas, which can be viewed in the same way as soil leaching in areas of intensive farming. This problem of the unclosed nutrient cycle, which arises especially with international trade in foodstuffs, would have to be regulated at the global level, if necessary, by shipping foodstuffs or manure back to the place of manufacture.¹⁷

In this way, massive interventions in global trade flows are propagated solely from a “virtual water” perspective and, what’s more, in widely varying directions, depending on which normative concept is taken as a basis. In the process, practically everything – the import of virtu-

¹¹ Hoekstra, *The Global Dimension of Water Governance: Nine Reasons for Global Arrangements in Order to Cope With Local Water Problems*, UNESCO-IHE Value of Water Research Report Series, 2006, pp. 17 ff.

¹² Allen, *Groundwater* 1998, 545.

¹³ See e.g. *Daly/Cobb*, *For the Common Good: Redirecting the Economy Toward Community, the Environment and a Sustainable Future*, 1994. For a critical view of the concept of *global water governance* see: *Gawel/Bernsen*, *Nature and Culture* 2011, 205.

¹⁴ *Hoekstra/Hung*, *Virtual Water Trade: A Quantification of Virtual Water Flows Between Nations in Relation to International Crop Trade*, in: *Hoekstra*, *Virtual Water Trade – Proceedings of the International Expert Meeting on Virtual Water Trade*, UNESCO IHE Delft Value of Water Research Report Series No. 12, 2003, p. 26.

¹⁵ *Hoff*, *Current Opinion in Environmental Sustainability* 2009, 144.

¹⁶ *Hoekstra*, *Water* 2011, 33, 37 f.

¹⁷ *Ibid.*, p. 34 f.

al water, its export, and even internal consumption – could ever be characterised as morally questionable (Tab. 1).¹⁸

Table 1: Normative Valuations of Indicators of Virtual Water and Associated Problem Areas¹⁹

Indicator is defined as problematic if ...	Dimension of the problem		
		Trade regime	Consumption pattern	Local effects in the exporting country
Water footprint of a product	- “high“		X	X
Water footprint of an individual	- “high“ - above the global average		X	X
Trade balance of a country in relation to virtual water	- positive - negative - balanced in the case of unequal distribution of global water resources	X	X	X
Inter-regional trade flows in relation to virtual water	- from north to south - from south to north - not correlated with relative water availability	X	X	

These few comments may be enough to illustrate that, far beyond their genuine (and limited) informational content and the awareness-creating functions so often ascribed to them, footprint concepts are meant to legitimise far-reaching resources policy implications that have very significant economic, ecological and social effects. It is all the more crucial to clarify precisely what concrete, methodologically determined informational content these key parameters do actually have (quite apart from the data problems), whether any action based on this information can address the identified problem at all (effectiveness), and whether a euro deployed to reduce these key parameters can have the greatest possible effect in relation to the problem in question (efficiency).

¹⁸ On the arbitrary nature of normatively turned water footprint implications see *Gawel/Bernsen*, Environment and Planning C (Government and Policy) 2013, 168.

¹⁹ Source: Simplified after *Gawel*, Virtual Water and Trade: A Critical Economic Review, in: Bhaduri et al. (eds.): The Global Water System in the Anthropocene, 2015, 31 ff.

2. Normative Basis and Informational Requirements for Footprint-Based Sustainable Action

If footprint figures are to be used responsibly as a basis for action in the area of resources policy, it is important to first expose and reach an understanding about the respective normative concepts underlying policy recommendations concerning the “right” handling of resources. Otherwise the policy recommendations are wrongly lent the authority of spuriously accurate calculations, which cannot correspond with specific policy implications to begin with. So, for instance, it is necessary to clarify whether recommendations for reducing key figures of virtual water follow considerations of global “water use efficiency”, or rather, fairness-based valuations, which would still have to be specified in detail.

If efforts towards reducing the utilisation of resources indicated by the measured values are to be *effective*, the environmental problem expressed through the key figure must be addressed directly. This means that the consumption of the resource measured by the key parameter must have a clear and stable functional relationship to the environmental problem itself. This is the case for the carbon footprint, because each unit of emission of a CO₂ equivalent is relevant to climate in the same way globally, but not for the water footprint, which, in its simple form, adds up quantities of water across the entire globe which were deployed under the widely varying conditions depending on the respective regional water balance and its utilisation. Whether rain-fed agriculture or irrigation farming, whether the region is humid or arid, whether water is used sustainably or mismanaged – here, a litre is above all a litre.²⁰

Ultimately, in order for such a recommended reduction of footprint values to be economically *efficient* as well, measures must be taken precisely where they will have the greatest effect per euro spent. It would not make any sense to haphazardly implement just any reductions; rather, each measure should be coordinated so that it has the greatest possible environmental effect for the limited economic resources used to reduce them or, in the reverse, that to achieve a certain environmental effect the lowest possible value consumption occurs. In short: the so-called economic principle should be observed (best possible target achievement for the given resources deployed or minimisation of the resources needed to achieve a given target). But footprint indicators *alone are quite fundamentally not* in a position to do so. This is because the respective opportunity costs must be known in order to decide where reductions can reasonably be made. Only then can the total value of the cuts that have to be made in order to limit the consumption of resources to a certain degree be minimised.

In that sense, neither the CO₂ neutralisation of business travel nor the decision in favour of a policy alternative with the lower CO₂ footprint is economically efficient. In all probability, the euro amounts that are respectively deployed here to reduce greenhouse gas emissions might have a far greater effect if deployed elsewhere. But for the decision maker, who sees only the footprint calculations, this remains unclear. Although the footprint-based setting of standards (building standards, energy efficiency standards) constituted a contribution to climate protection, such standards typically all remain economically inefficient due to the lack of infor-

²⁰ On refinements of the concept, which however do not solve the problem, see *Gawel/Bernsen*, *GAIa* 2011, 224; *Gawel*, in: *Bhaduri et al. (eds.), The Global Water System in the Anthropocene*, 2014, pp. 48 ff.

mation and consideration of opportunity costs for which there is only decentralized knowledge.

So, a mechanism that coordinates reduction efforts efficiently is still lacking. For this purpose, a comparison of the individual marginal costs of abatement with the benefits of lower utilisation of resources is required. A CO₂ tax or trade in CO₂ emissions are examples of such instruments. They create public scarcity signals about the use of resources which allow individuals to make efficient reduction decisions using only the individual opportunity costs known to them and the comparison with the scarcity signal. If such a coordination mechanism is lacking and individuals have to decide on the basis of the quantity information of the footprint alone, inefficient decisions will result because the condition for economic freedom from waste, technically speaking, the balancing of the marginal costs of abatement to the conservation of resources over different individuals, is bound to be missed.

Whilst it is possible to use information on the *carbon footprint*, at least for such complementary coordination instruments, it is not at all possible for the *water footprint* because of the lack of homogeneity of the measured and purely quantitatively aggregated environmental effects (III.): So, while knowledge about the carbon footprint is “merely” not yet sufficient to make reasonable decisions about the conservation of resources, the *water footprint* is a priori entirely unsuitable for the task.

III. Carbon Footprint and Water Footprint: Incomplete Information Problems – Differences and Commonalities

As illustrated under point I. above, both footprint concepts attempt to describe the strain on global resources in concrete quantitative terms through the specific unit responsible for the resource consumption (product, person, country etc.). Both are pure measures of quantity which aggregate the global use of the resource for a certain balance group (product, person, country etc.) and are not able to make any value statements about the costs or benefits of a reduction of the values. Therefore neither of these concepts *alone* can guide economically meaningful action on the basis of mere knowledge of the footprint data, because for this purpose value information is always required (see point II. above). The German Federal Environment Agency is therefore justifiably cautious in its position on the *carbon footprint*: it points out that the purely numerical value of the CO₂ footprint is of little use to the consumer since a standard of comparison is lacking, the values fail to lead to policy recommendations for optimal utilization from the climate perspective, because other environmental aspects are ignored and ultimately it has been more a source of confusion than orientation for consumers.²¹

In addition, the water footprint also has more serious methodological weaknesses which distinguish it from the carbon footprint and at the same time *fundamentally* call into question its

²¹ BMU/UBA/Öko-Institut, Memorandum Product Carbon Footprint. Position statement on measurement and communication of the product carbon footprint for international standardization and harmonization purposes, 2009.

suitability as a basis for decision making. While the *carbon footprint* indicates the aggregated global per-unit burden of greenhouse gases that lead to the same climate effects and which to that extent are comparable with one another, the water footprint combines completely disparate water uses and their ecological impacts in one figure.²² As has been shown, even the *carbon footprint* still cannot deliver any direct information about the desirability of an activity or its abatement, because additional information about the abatement costs and benefits of a product or activity are required for this. However, this missing information can be provided efficiently by complementary coordination mechanisms (CO₂ tax, equilibrium price generated by CO₂ emissions trading). However, in the case of the water footprint, even the most basic requirement, the homogeneity of the measured resource implications, is lacking.

From an ecological as well as from an economic standpoint, the consumption of one cubic metre of water clearly does not have the same environmental effects (environmental costs) everywhere. First and foremost, local conditions such as water availability and cultivation conditions play a crucial role: One cubic metre of water from Egypt is therefore not comparable with one cubic metre of water from Germany; the same water use can, in the one case, cause serious environmental damage or involve social waste, and in the other case be completely sustainable. Therefore, it is impossible to make general statements about the desirability of a certain level of a water footprint, because they contain neither information about the sustainability of water use in the exporting country nor about the value placed on the good in question in the importing country. In the end, whether local water resources should be used in the production of export goods or whether more valuable alternative uses exist can only be decided locally according to the opportunity costs of production: Thus, for example, the deployment of scarce water to produce a very highly valued good can make good economic sense.²³ What is important is that each factor of production is deployed according to its actual scarcity, that these scarcities are accurately reflected in consumer prices²⁴ and that the requirements of sustainability and *good governance* are complied with when using water. In any event, whether this is case or not cannot be inferred from a water footprint.

Also, regarding a concept of “water neutrality”²⁵, it is by no means irrelevant where the consumption of a certain quantity of water is compensated, because the environmental effects of water use are a local or regional problem. That the idea of saving water in one part of the world in order to “free it up”²⁶ for other regions does not seem very helpful is also reflected in the sharp critique of the European Commission’s deliberations on introducing uniform Eu-

²² *Ridoutt/Pfister*, Global Environmental Change 2010, 113.

²³ *Wichelns*, International Journal of Water Resources Development 2010, 647 f.

²⁴ A “correct” price in this sense also comprises potential environmental costs (such as pollution caused by fertilisers, pesticides and salinisation) that arise in the producing country.

²⁵ *Hoekstra*, Water Neutral: Reducing and Offsetting the Impacts of Water Footprints, UNESCO-IHE Value of Water Research Report Series Nr. 28, 2008. Dazu zu Recht sehr kritisch *O’Neill*, There’s another word for ‘water neutrality’: death, <http://www.spiked-online.com/newsite/article/5603>.

²⁶ *Hoekstra/Chapagain/Aldaya/Mekonnen*, Water Footprint Manual, State of the Art 2009, Water Footprint Report, 2009, p. 68.

rope-wide building standards in relation to water efficiency²⁷, because, ultimately, water saved in Germany is not going to tackle a drought in Spain.²⁸

The water footprint's inherent violation of the homogeneity requirement means that the parameter is rendered on the whole useless due to the lack of exploitable information, and that the economic decisions of businesses and consumers, but also national and international environment, water and trade policies, cannot be properly guided by it (IV.).

IV. The Limitations and Problems of Footprints – Based on the Example of Virtual Water Trading

Global analyses of the water footprint swiftly focus attention on international trade with agricultural products.²⁹ This is because 70% of all water withdrawals are used for agricultural purposes, with low and frequently subsidised water prices contributing to wasteful handling of the scarce resource.³⁰ The connections between international trade, food security and the local use of water resources have recently been attracting greater attention; *water footprints* play a major role here in that they are supposed to say something about what global trade should look like from a water resources standpoint.

International trade is ultimately based on a country's comparative cost advantages in the production of a specific good, which can be attributed, among other things, to the abundance of certain natural resources. If a country is particularly rich in one factor (e.g. water), that factor is relatively cheap in comparison to other factors of production, giving the country a cost advantage for goods that use that factor particularly intensively in production (e.g. rice). Hence, free trade essentially serves to increase welfare on all sides by giving rise to an efficient international division of labour based on specialization and exchange, which increases prosperity for all participating countries. Moreover, water can be used precisely where it is most abundantly available and where its use causes the least opportunity and environmental cost. In addition, through trade, countries with fewer natural resources are able to enjoy essential commodities: For Israel, the importing of virtual water is just as essential to survival as the supply of imported raw materials is for Germany. Also, for many countries, the virtual "water losses" incurred through the export of agricultural products represent an important source of revenue for exchanging other goods against them on the global market.

Even so, for good economic reasons, the resulting trade flows by no means accurately reflect the trading partners' water scarcity because besides water, the availability of land, manpower and cultivation techniques also play a role in agricultural production:³¹ The Netherlands has an abundant supply of water, but arable land is scarce and therefore it is an "importer" of vir-

²⁷ European Commission, *Water Scarcity and Droughts – 2012 Policy Review – Building Blocks*, 2010.

²⁸ *Kleinhubbert*, Schwacher Strahl, Spiegel-Online, 27/09/2010, www.spiegel.de/spiegel/0,1518,719873,00.html.

²⁹ For an overview see *Gawel/Bernsen*, *Environment and Planning C (Government and Policy)* 2013, 168.

³⁰ OECD, *Managing Water for All – An OECD Perspective on Pricing and Financing*, 2009, p. 32.

³¹ *Wichelns*, *Agricultural Water Management* 2004, 49 ff.

tual water – in contrast to Kazakhstan, which for the same reason in reverse order appears as an “exporter”. For this reason, ideas about organising trade flows on the basis of “global water use efficiency”³² also are also economically misguided. But at the same time, and partly by the same authors, the organisation of virtual water trade along “fairness gradients”³³ is propagated, which can only inadvertently coincide with the outcome using the criterion of “global water use efficiency”.

From an economic perspective, the consumption of water does not result in the same environmental effects and opportunity costs everywhere, but rather regional conditions such as water availability, alternative water uses, cultivation conditions and preferences play a decisive role. It should be left to each country itself to decide whether it will use its national water supplies to grow agricultural products for export and thus get access to, for instance, power plants or other high-tech products on the world market.

These deliberations show that an indicator such as the water footprint, which is based purely on volume, is hardly suitable for exposing water-related issues, let alone for helping to solve them³⁴ regardless of how detailed water footprint analysis might become in the future. At any rate, which would be the “right” direction for virtual water flows does not emerge from the normative critique of trade in virtual water: is it north-south trade that should be prevented on the grounds of the dependencies that result, or south-north trade on the grounds of our “exploitative” consumption patterns, or possibly even water-based trading as a whole? The water footprint offers no specific value information based on which economically and ecologically “right” trading decisions could be made; in addition, the normative “thinking framework” behind the concept of the water footprint is in itself contradictory and would only allow one to conclude that each country should budget with the resources it can find on its own territory. But the idea of throwing every economy back to relying on their own regionally available natural resources and denying them the opportunity to trade that potential on the world market in order to increase welfare is downright grotesque. If the idea of resource autonomy emerges behind the concept in order to ward off trade “injustices” and degradation of the environment through agriculture, under the banner of water protection, a programme of global impoverishment threatens.³⁵

Comparisons between country and per-capita consumptions are also, in principle, of little relevance, because a person living in a water-rich country will naturally consume different water-intensive goods than a person living in a water-poor country, and will possibly have other preferences and habits too. Different water footprints are not just simply attributable to differences in living standards and these, in turn, are not directly related to sustainability in the management of water resources. Comparisons between different degrees of “externalization” of water consumption (transferring the use of water to other countries) or dependencies on

³² *Hoekstra/Hung* (fn. 14), p. 26.

³³ *Verkerk/Hoekstra/Gerbens-Leenes*, *Global Water Governance: Conceptual Design of Global Institutional Arrangements*, UNESCO-IHE Value of Water Research Report Series No. 26, 2008, p. 31 ff.

³⁴ See also *Wichelns*, *Water productivity and water footprints are not helpful in determining optimal water allocations or efficient management strategies*, *Water International* 2015, 1059.

³⁵ *Gawel/Bernsen*, *Wirtschaftsdienst* 2011, 558, 563.

imports are also of little informative value, because, here, countries with a large surface area like Argentina are compared with small, densely populated countries like the Netherlands which are naturally more dependent on food imports, which similarly is not a problem in itself. What we should be concerned about is the sustainability of agricultural cultivation processes, the legitimization of regional process of making decisions about scarce water resources and the fairness of the global trade regime, not cross-border trade in water-intensive goods.

General trade-restrictive measures, such as a tax on traded virtual water, should thus be rejected from an economic perspective because they limit voluntary and mutually beneficial trading and distort the prices of products, that is, they limit their ability to accurately reflect costs and scarcity. Welfare losses would result. In addition, they make no contribution to improving the global sustainability of regional water balances, because all water-intensive products would be subject to across-the-board price increases. A differentiation according to place of production and water source would be practically impossible to implement³⁶ and would probably be difficult to convey to the affected countries as well. Moreover, as mentioned above, a specific water use can be wasteful in one country and make complete sense in another. For a start, such a tax would worsen the revenue situation of local producers, while the sustainability or non-sustainability of the local water management would remain the same; whether the desired environmental improvement would kick in is unclear.

The fact that trade barriers are not specific enough to combat local environmental problems has been discussed often enough.³⁷ Thus, increased demand through the liberalisation of trade can also raise the price of goods produced using a particular resource, which would increase the value of the resource and the incentive to conserve it and manage it sustainably, while trade barriers would have the opposite effect. By the same token, a deterioration in the income situation of local producers does not contribute to raising appreciation and awareness for a sustainable management of resources.³⁸ The most efficient solution would therefore be to remove the distortion which represents the root of the problem, in this case, too low, subsidised water prices in the agricultural sector as well as removing regional structures of *bad governance*. Because the problem of undemocratic, corrupt structures which facilitate excessive exploitation of resources would clearly not be solved with blanket trade barriers.³⁹

Similarly, a system of (tradeable) water footprints can only lead to distortions, because it ignores people's preferences. In addition, water-rich countries would be denied the "right" to use domestic water resources as they see fit: For instance, if a water-rich country could already reach an "above-average" level of consumption through its own resources: Should the acquisition/buying of additional footprint licenses or even forced deliveries of virtual water then be the consequence? Then there is the other question of whether poor, but water-rich

³⁶ *LeVernoy*, Water and the WTO: Don't Kill the Messenger, paper presented at the workshop "Accounting for Water Scarcity and Pollution in the Rules of International Trade", 25-26 November 2010, p. 10 f.

³⁷ See alone *Bhagwati*, *Scientific American* 1993, 18; *Siebert*, Trade policy and environmental protection, Working Paper 730, Kiel Institute of World Economics, 1996.

³⁸ See *Schulz*, *Environmental and Resource Economics* 1996, 20 ff.

³⁹ *Damanian*, Trade and the Political Economy of Renewable Resource Management, CIES Discussion Paper No. 0046, 2000.

countries, like for instance Bangladesh, should “share” their water resources. Sustainable water use in production would hardly be served by this because, in the case of water as a local resource, a national or global “cap” is not very helpful if water is not used efficiently at the local level. Then, if water - for instance as an input in agricultural production - were to be remunerated in accordance with its scarcity, the purchasing of additional certificates would no longer be required for “above-average” levels of consumption. How such an instrument could lead to a “fair distribution” of water resources is also not clear since the water footprint certificates would ultimately be traded according to a country’s ability to pay, while the problem of differences in development and income would hardly be solved. Instead, both instruments – virtual water taxes and certificates – display characteristics of paternalism and patronization by forcing people (especially in developing countries) to choose the “right” level of consumption, production or exports. The concept that certain countries are not capable of determining the water and trade strategy that is best for themselves, but rather are dependent on corrective measures in the context of a global water management system at the same time reveals a questionable affinity to forms of “eco-imperialism”.⁴⁰

V. Conclusion: On the Significance of Footprints for Resources Policy

Footprint concepts have managed to attract a great deal of scientific and public attention in a short space of time. Beyond the mere production of “figures”, these concepts are increasingly being used as a scientific basis for normatively guided policy recommendations on the management of resources. So, might the various ecological accounting concepts which have been developed and continuously perfected over the past few years at the same time provide suitable starting points for legislation on the protection of natural resources? Their suitability can be confirmed only very partially. Footprint concepts, *taken in isolation*, do not provide enough information for consumers, companies, government agencies or policy makers to make economically “right” decisions. They suffer from a lack of complementary value information about the utility of natural resources conservation. However, this value information could by all means be provided by complementary instruments such as a CO₂ tax or a CO₂ emissions trading system. For the water footprint, this is not possible either, because the concept fails to meet the basic requirement of homogeneity of the effects of the summed up water quantities.

In the context of this certainly critical⁴¹ debate, footprint concepts are often adjudged particularly suitable for exposing the implications of global consumption and for raising awareness

⁴⁰ Siebert, Trade Policy and Environmental Protection, Kieler Arbeitspapiere No. 730, 1996, p. 3.

⁴¹ For more on this, see for instance the massive criticism of *water footprints* from the environmental and agri-economics as well as hydrological perspective in *Wichelns*, Agricultural Water Management 2004, 49; *idem*, Water Resources Management 2010, 2203; *idem*, International Journal of Water Resources Development, 2010, 639; *idem*, GAiA 2011, 171; *idem*, Water International 2015, 1059; *Meran*, The unimportance of “virtual water” for environmental policy, http://www.infraday.tu-berlin.de/fileadmin/fg280/veranstaltungen/infraday/conference_2011/papers_presentations/presentation---meran.pdf; *Perry*, Agricultural Water Management 2014, 119; *Gawel/Bernsen*, Environment and Planning C (Government and Policy) 2013, 168; *dies.*, GAiA 2011, 162; *Gawel*, in: Bhaduri et al. (eds.), The Global Water System in the Anthropocene, 2014, 48.

in this regard.⁴² However, the question is, what concrete benefit can such information and the new awareness based on that information provide if the key indicators supplied cannot guide concrete individual action in any meaningful way and even lead to serious decision-making mistakes (pointless avoidance of certain products such as coffee from rain-fed crops, misallocation of resource conservation funds)? This doesn't affect the fact that aligning one's behaviour towards a low-carbon society may be rational at the individual level, for instance as a marketing tool to demonstrate orientation to climate and environmental concerns outwardly and to benefit from this commercially or in some other way⁴³ (e.g. German Rail highlights its eco-friendliness).

However, if you ask whether the water footprint reveals any important information about the use of scarce water resources and whether it can guide water-related economic and political decisions in any useful way, the answer in each case is clearly no.⁴⁴ The concept of virtual water, in particular, is likely to remain an academic Glass Bead Game; at any rate it does not qualify as a guideline for global water governance or for individual action and can – like all purely quantity-based concepts in environmental policy⁴⁵ – contribute to quite alarming disorientation. Normative interpretations of the concept are contradictory; in some circumstances it makes no contribution at all to meeting the self-defined water conservation and sustainability targets, but in other circumstances it implies massive inefficiencies and distortions in world trade and appears in essence paternalistic. International environmental and trade policy should not internalise the supposed policy implications of “virtual water calculations”. Above all, there must be no unseen transfer from the *carbon footprint* to the *water footprint*. The methodological differences between the two concepts are too great for this.

So, footprint calculations alone cannot provide a reliable foundation for resource protection policy. In the future, they must continue to obtain their objective legitimacy in the conventional manner, for example through politically defined climate protection or water protection targets. In particular, for economic reasons, there should be no implementation of mandatory product standards merely based on footprints.⁴⁶

⁴² See for instance *Biewald*, GAiA 2011, 168; *Biewald/Rolinski*, GAiA 2012, 88.

⁴³ For a recent competition law perspective on this, see *Roller*, ZUR 2014, 211.

⁴⁴ See also references mentioned in fn. 41.

⁴⁵ These include the Wuppertal Institute's so-called dematerialisation approach – see on this *Gawel*, Applied Economics Quarterly 1998, 173.

⁴⁶ This ultimately also includes the EU-wide light bulb ban, although the use of *carbon footprints* for the purpose of argument in the area of energy efficiency is unusual. Quite rightly critical of a standards-oriented energy efficiency policy in the interests of climate protection are *Mennel/Sturm*, Zeitschrift für Wirtschaftspolitik 2009, 3. For a legal analysis of the topic see *Jesse*, in: Reimer (ed.), Ressourceneffizienz – Leitbild für das Umweltrecht?, 2016, p. 165 ff.