

## ***Interactive comment on “Review article: Quantifying the human impact on water resources: a critical review of the water footprint concept” by J. Chenoweth et al.***

**Anonymous Referee #3**

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This review aims to provide an up-to-date assessment of the water footprint concept, aiming to stimulate a constructive debate with respect to the concept and its wider significance. However the claim is not fully met in the paper. The paper is unnecessary lengthy. It merely lists a number of scientific peer reviewed articles and numerous grey literatures, but fails to critically examine their content. The authors cite numerous critical examinations by other authors already published and well cited in the field. In a nut-shell I'm afraid I've concluded that "this article is a Dictionary, not a poem", and I have question on the way the argument is presented as well.

A similar paper has recently been published by Chapagain and Orr (2012) on the same

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topic "Water footprint: Help or Hindrance?]. I see a great overlap in these two papers. I'd appreciate if the authors could show how different it is from the published paper and if they differ, it would be useful to support where they differ with a proper analysis, and critically examine the differences. In the goals of the paper it is aimed that it would help future researchers, policy-makers, corporations and consumers interested in this field. I very much doubt given a very weak discussion and conclusion section.

I see that it is a great compilation of literature in this field, but lack a coherent thread and is shallow in understanding of the existing literatures, a point supported in my detailed review of the article underneath.

In section 2: Water footprinting methodologies – still a work in progress:

R: The heading section 2 is misleading. There is never an end point in the progression of science, hence there will be eventually refinements in the methodologies as science advances. For example, the water footprint of a nation as defined by Hoekstra and Hung (2002) has been greatly refined with subsequent publications in the field in the last decade, a point also noted by the authors in this paper. There is ISO14046 being developed in this field. However, WFN has summarised all the recent developments which have been peer reviewed and published in scientific journals in the form of a manual (WFN manual by Hoekstra et al] in 2011. So, the title “still a work in progress” only shows that the authors anticipate new progression and criticise the established method being under developed already without proper scrutiny.

R: “The method of assessing the water footprint of primary product and then attributing it to its secondary product based on value fraction and product fraction” is first published by Hoekstra and Chapagain 2007, and subsequently used in most of the many future publications. Hence the reference is wrong in lines 15-20, page 9394. This is one example which shows shallow literature review by the authors in preparing the paper.

R: In the following page (end p9394- beginning p9395), the authors cite (Mekonnen

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and Hoekstra, 2011a) to explain the green, blue and grey water footprint. Whereas the definitions of blue, green and grey water footprint originates from much earlier work by Chapagain et al (cotton), Hoekstra and Chapagain (2007). Though there is nothing wrong to cite the latest publication to define a concept, but in a peer-reviewed publication such as this, we must give proper credits to the original articles while at the same time give the most recent publication on the subject matter. In this case, the most comprehensive document would be the Hoekstra et al (Manual).

R: Page 9394-9395, the cited papers also explain the reasons for such a huge variations in the outcomes from different approaches. Failing to cite them in critically examining the approaches is not scientifically rigour exercise.

P9397: the sentence "The consideration of grey water is relatively new in water footprinting and was not included in earlier water footprinting studies, such as Chapagain et al. (2006) or Chapagain and Hoekstra (2004)."

R: Agree that the grey water footprint is not explicitly included in Chapagain and Hoekstra (2004), but I'm sorry to say that the authors again failed to notice that it is in fact "Chapagain et al 2006, which introduced the concept of grey water footprint. In my view, the authors were overwhelmed by the width of publications they needed to examine. This again shows how shallow the current paper is in terms of scientific rigour needed in critically examining the existing literatures.

P9433: Figure 2.

R: Which country is this data representing?

P9398, line "Furthermore, the inclusion of green water creates inconsistencies between water content figures for agricultural products compared to non-agricultural products (Zhang et al., 2011)."

R: It is important to say why it creates this inconsistencies? As clearly Zhang et presents that logic in their paper, but reading this in isolation here, it is difficult to guess

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what creates this inconsistency? Is it because we want to compare total water footprint sizes? Then, the authors have limited understanding of the power of Water Footprint Assessment which doesn't stop at accounting phase only. The end result of such exercise it to come up with a suitable strategic action that can address issues related to water use and its availability. In that mode, one can even argue that even blue water in one place and time is different than the same in another time or in place? So, the whole argument presented here is very weak.

P9398, line 13: "However, these nutrients are not usually considered in water footprint assessments".

R: This is not a correct statement, and even more there is no reference associated with such a strong statement. I'd rather say that the existing literatures have not taken into account the effect of other pollutants [not limited to nutrients!] so far. However, the WFN manual clearly states how the grey water footprint should be calculated, and it covers all the pollutants. After estimating the volume for each pollutant, the maximum volume of freshwater would be the total grey water footprint of the process or the product.

P9398, line 15-18. The sentence has two references in it, "In the absence of a standardized method for the quantification of dilution volumes required for assimilation (Thaler et al., 2012), grey water becomes a largely subjective estimate (Jeswani and Azapagic, 2011)."

R: Which one refers to what part of the statement? I find the practice of jam-packing a single statement with two references at two different parts of the sentence a poor practice in drawing conclusion from their study. In this particular sentence, does the later also say that there is absence of standard method? Or, is the former also agree with the later conclusion? Or, are both of them are in agreement? Then, what about others saying that there is a clear peer reviewed method to account the grey water footprint? In my view, the assessment by the authors in this paper is clearly biased by selecting only that suits their argument without any cross reference to counter argument.

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P9399, line 25:

R: The difference is not only because of green water volumes. Actually, one cannot compare these two results because one is absolute volume of water consumed (Hoekstra's (2012b) study), and the other is only a proxy of water consumed calculated using different weights to different kinds of water use. Now, since in Ridoutt's (2012a) study gives a weight of zero to grey and green, they effectively become zero in the score, and also because they weight the blue water footprint based on water scarcity, the final score is not a blue water volume actually associated to that specific use. It is rather an equivalent volume of water that would help compare products from different characters such as potato versus a computer. Hence, these two accounting serve two different purposes and are not comparable. The attempt to put them together by the authors here only gives wrong impression that one can compare these two results and conclude that they vary so much that such assessments are not trustworthy, or to say, are questionable. This is a poor comprehension of the strengths of these two different variants of the concept of water footprint.

P9400, line 12-13: The sentence "Using a similar logic, it is debatable, however, whether green and grey water can, in fact, be viewed as real volumes."

R: This is yet another statement without a clear argument. Is it a conclusion of the authors of the current paper [where is the argument and how it support this statement?], or is it argued by someone else [where is the reference]?

P9400, Line 21-22.

R: The sentence says that there are larger variations in numbers, but lacks references. Then, it suddenly jumps into another new definition "net green" concept. I find the flow of paper rather jerky and inconsistent. The flow could be improved if the concept is introduced first and then the inconsistencies presented with the help of references.

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R: The conclusion by author that businesses should work with the detailed data collection and do such a comprehensive analysis to be able to do "product labelling" is a poor understanding of the huge interest that the corporate sector is showing to the "water". They mainly do this to minimise their business risk to water, which is informed by water availability, water footprint, sustainability of their footprint both at operation and along their supply chain, and other legal and societal context. Product labelling is not the sole driver why the list of businesses mentioned in the previous paragraph are working on water footprint.

P9407, Line 8-9. R: The sentence. . ." with only a handful of papers questioning its purpose "would benefit if the authors would list these handful publications. I've recently seen a very strong paper by Chapagain and Dave (2012) which critically examines whether water footprint is a help or a hindrance to further the debate on sustainable water management.

P9410, Line 10-14: The further water footprints move in this direction, the further they get from their starting point of quantifying the volumes of "virtual water" being traded between countries and their role as a consumer indicator, thus becoming simply another form of local hydrological assessment.

R: The authors clearly miss the boat by not understanding what a water footprint assessment brings on the table. It connects the supply chain, it allows complex business to see their footprints distributed in different hydrological regions, thus it is more than a simple "location specific" and "in the box " disjointed hydrological assessments. Hence, the authors clearly don't see the thread that the WFA brings these different isolated hydrological assessments into a meaningful policy dialogue with relevant stakeholders along the complete value chain of the process, or a product.

p9410, Line 25: A water footprint alone only indicates the volume of water required to produce a product not the impact of that water use on the local environment, the opportunity costs of the water used, nor the degree of water scarcity in the producing

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regions]

R: I don't see how the authors could conclude this given that they have devoted a single section to describe the weighted water footprint approach in this paper to get a single number within the LCA approach earlier?

p9411, line 7-16: R: The whole argument why labelling may not be the first direct output of a water footprint analysis, I'd suggest the authors to reflect on the piece by Martina Di Fonzo (Martina de Fonzo 2011).

p9418, line 17-24:

R: The conclusion that the corporates should use water footprint within LCA framework is not based on the real world. In reality, corporates are cautiously working on water footprint to understand their business risk associated with water use within their operations and in their supply chains. Most of the corporate examples cited in this paper are the first steps for the businesses where they start with the volumetric assessment and go for the sustainability assessment, then target to develop strategic policy options to mitigate the issue. This is actually a Water footprint Assessment (WFA) framework which allows businesses or users to define the scope of their assessment, do the water footprint accounting, carry a full sustainability assessment [here LCA approaches could also fit] and finally prioritise locations where they need to act along the full value chain of their operations.

Finally, they conclude with the water footprint labelling and associated problems.

R: A well discussed issue elsewhere, please see Chapagain and Dave (2012) and (Martina de Fonzo 2011).

References:

Martina de Fonzo (2011) Water in Production and Products. PostNote 385. House of Parliament, Parliament Office of Science and technology. [www.parliament.uk/briefing-papers/POST-PN-385.pdf](http://www.parliament.uk/briefing-papers/POST-PN-385.pdf)

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