

## ***Interactive comment on “Consumptive water use associated with food waste: case study of fresh mango in Australia” by B. G. Ridoutt et al.***

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The authors wish to thank the Reviewer for his contribution, although we feel that he has been preoccupied with issues which are not the direct concern of this paper.

### 1. Regarding the water footprint methodology

What seems to be the Reviewer’s major concern is that, “. . .the underlying tension between two water measurement communities will not be reconciled by this work.” (First paragraph of review) This concern appears to be at the core of many of the Reviewer’s subsequent remarks.

In reply, we would like to state that the purpose of the research reported in this paper

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was not to resolve apparent tension in the water measurement community. As stated on page 5089, lines 17-19:

“Our research concerns the mapping of food waste through the distribution and consumption stages of the product life cycle and the use of water footprinting to assess the impact on water resources.”

We express our findings in a variety of ways, including the virtual water content of the waste (VWC), and also the water footprint and Australian-equivalent water footprint using the method of Ridoutt and Pfister (Global Environmental Change, in press, DOI:10.1016/j.gloenvcha.2009.08.003). As such, we have calculated the water footprint using a recognised methodology which has been accepted for publication in an international peer-reviewed science journal of high ranking. This revised approach to water footprinting is also now being used in industry by some of the largest global food companies.

The reality is that the water footprint concept is in a state of evolution in order to meet the diversity of applications being proposed. Approaches to water footprinting that describe simple volumes may be useful for certain kinds of analyses; however, they have been found to be problematic when applied to products (Ridoutt et al. 2009). With a variety of international initiatives currently addressing water footprinting methodologies, including an ISO work programme, further refinement and redefinition of the concept is likely. We regard this activity as healthy and an example of the scientific process at work.

Indeed, there is variability in the water footprinting calculation methods that were used in the Reviewer’s own research on UK water footprints (Chapagain and Orr, 2009) and another recent report by WWF (Anon, 2009). The concept of “net” green water was used in the latter.

As such, we reject the Reviewer’s concerns about redefinition of the water footprint concept. The Reviewer’s criticism of the revised water footprint calculation method of

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Ridoutt and Pfister (2009) would be better directed toward that publication rather than the current case study of mango food chain waste.

What is important is that the method being used is clearly defined and appropriate to the research objectives, and this is certainly true in our case.

## 2. Regarding water management decision making

What appears to be the Reviewer's second major concern is that the results lack relevance to, "...water management decision making." (First paragraph of review)

Again, this appears to be unfair criticism of our research which is product-oriented rather than watershed-oriented, and therefore not primarily directed toward water resource managers.

One way of reducing pressure on freshwater systems is to create a link between the production and consumption of goods and services and the potential to contribute to water scarcity. The word potential is used intentionally because many real world products (as distinct from agricultural commodities) have diverse and variable supply chains that may be impacting local hydrological systems in many parts of the world, often far from where the final production and consumption takes place. It is not practical to measure the actual impacts of consumptive water use on a global basis and at high geographic resolution. Furthermore, the actual social and environmental impacts arising from consumptive water use vary according to location. For example, in the Murray Darling Basin the major impact arising from consumptive water use is damage to freshwater ecosystems. In contrast, in the western United States where water is abstracted from the Ogallala Aquifer for agricultural production, a major impact is freshwater resource depletion. As such, at the product level, the current focus is on quantifying the potential contribution to global water scarcity, taking into consideration the consumptive water use occurring across the entire product life cycle.

Therefore, water footprinting at the product level is intended to be a driver for sus-

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tainable production and consumption. However, it does not seek to address all issues pertaining to water resources management. As described in Ridoutt and Pfister (2009):

“Product water footprinting is not expected to effectively address local issues pertaining to watershed management. For a particular freshwater ecosystem, the natural variability in flows can be great and the relationship to ecosystem health extremely complex (Arthington et al., 2006; King and Brown, 2006; Richter et al., 2006; Acreman et al., 2008). As such, sourcing products from a region of greater water abundance does not ensure that the specific environmental flow requirements of river systems are necessarily being met. Environmental flow requirements encompass not only a volume, but also timing and duration (Smakhtin, 2008). Therefore, although product water footprinting promises to be a useful driver of sustainable consumption and production, with potential to encourage global-scale change with respect to freshwater resource consumption, other approaches to environmental protection and management will also be required.”

### 3. Other specific issues raised

P5087, 14. In the revised manuscript we will revise this sentence as follows – “That is, there is no verifiable return flow to the local source of origin”

P5087, 22. The definition of green water is consistent with Ridoutt and Pfister (2009).

P5089, 23. Our study is based on regional statistics combined with local climate data. We do not claim to be the only study that is regionally-oriented. The Reviewer’s concern will be addressed by adding an additional statement: “Only recently have water footprint studies specifically focussed at the regional scale (Chapagain and Orr, 2009; Aldaya and Hoekstra, 2009).”

P5092, 21. Any potential confusion can be overcome by removing reference to Chapagain and Orr (2009). It is not necessary to attribute the comment to these authors as the issue about overestimation of irrigation water use is probably common knowledge.

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P5092, 20-30. The problem is that water footprints have been reported as single numbers in scientific forums and the popular media. We would argue that insufficient care has been taken in the dissemination of the findings of water footprint studies to manage the potential for misunderstanding and confusion. Indeed, the line between science and advocacy is unclear.

P5095, 10. Here the average is derived from several regional scale assessments. This is very different from an average based on crude national scale statistics. Also, in the same sentence we note that the proportions, "...varied from one growing region to another."

P5099, 4. Mangoes are grown in Northern Australia in areas of comparatively low water stress, quite different from areas such as the Murray Darling Basin.

## References

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Ridoutt, B. G., Eady, S. J., Sellahewa, J., Simons, L., and Bektash, R. 2009. Water footprinting at the product brand level: case study and future challenges, J. Clean Prod., 17(13), 1228–1235.

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