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Commentary

Response to commentary on the paper "forests and water: The value of native temperate forests in supplying water for human consumption"

In Núñez et al. (2006) we estimated the economic value of water supply as an ecosystem service of Chilean temperate forests in the production of drinkable water. We used the change in productivity method (production function approach or also referred as to valuing the environment as an input) to derive benefit estimates per cubic meter of stream water, per household, and per hectare. Because the benefits of an ecosystem service can enhance an economic activity (i.e. drinkable water production), willingness to pay (WTP) for such service can be measured by estimating its value as an input factor in a productive activity (Freeman, 2003; Barbier, 2007). This represents the essence of the change in productivity method (Barbier, 2007).

In their comment, Figueroa and Pasten (henceforth FP) indicate that we incurred in miscalculations when estimating economic values per household and per hectare. We claim that there are not such miscalculations but instead differences in approach, which we now proceed to clarify.

The first difference between our study and FP's commentary lies on the definition of ecosystem service. In our paper we follow the concept provided by De Groot et al. (2002) while FP adopt the definition by Boyd and Banzhaf (2006) where ecosystem services are defined as the "end products of nature or components of nature directly enjoyed, consumed or used to yield human well-being". As Boyd and Banzhaf (2006) point out "this deceptively innocuous verbal definition is in fact quite constraining and has important properties from the standpoint of welfare measurement".

The use of Boyd and Banzhaf's definition is not a trivial issue, since it provides FP with an argument to measure the effect on welfare of discrete (non-marginal) rather than marginal changes (which is the approach we followed). As stated by Boyd and Banzhaf (2006 p. 11) "defining ecosystem services as end products of nature requires us to shift production function analysis to the analysis of the shadow value of the non-marketed input (the ecosystem service)". It is to be expected then that our results differ from those presented by FP; yet, none of the approaches is to be ruled out as incorrect.

We estimated a production function of the form $Qi = Qi(X\,i, S)$, where Q is the firm's measurable output of drinkable water, X is a vector of inputs, and S is the environmental service with no market price (Mäler, 1992), which is measured by the stream water from Llancahue watershed. Our analysis intends to capture the effect on society's welfare from a change in the environmental service originated by a change in forest cover. As pointed out by Mäler (1992), the welfare changes measured by the production function method represent the economic value of a small variation in the resource supply holding all other prices constant. In other words, if a change in an environmental service affects a market activity, the impact of such change will be transmitted to individuals through variations in costs and prices of final goods and services and in input prices and incomes (Mäler 1992) leading to increases in consumer and perhaps in producer surplus (Freeman, 2003). In turn, the sum of these surpluses provides a measure of the willingness to pay for the improved ecosystem service (Barbier, 2007).

The primary estimate of WTP we obtained was the economic value of a cubic meter of stream water. This is obtained by multiplying the marginal product of stream water by the price of drinkable water. Figueroa and Pasten make no observations to this primary estimate.

To express the economic value of water supply in a different form, we also calculated the economic value per household. To do so, we multiplied the primary value estimate by the average annual stream flow that is actually used in the production of drinkable water (7 618 078 m^3) and then divided this result by the total number of relevant households. Instead, FP multiplied our primary value estimate by the total annual stream flow (15 873 408 m^3). It is worth noting that in summer time these two volumes nearly coincide. In consequence, the estimate per household obtained by FP is proportionally larger than ours. But again, none of the results should be ruled out as incorrect.

Since we were interested in the impact on welfare of marginal changes on the ecosystem services as a result from changes in native forest cover to other land uses, we estimated the value of forests on a per hectare basis using the expression

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replicated by FP in equation 7 of their comment. We calculated the loss in water supply arising from a change in forest cover ($\partial S/\partial H$) from the data provided by Oyarzún et al. (2005). The result obtained is consistent with our primary estimate (value per cubic meter) and also consistent with a marginal change approach.

Figueroa and Pasten argue that we strongly underestimated this value based on the mathematical expression given in equation 8 of their comment, which they present as a "procedure that allows estimating gross benefits per hectare". Equation 8 replaces $\partial S/\partial H$ with $\Delta S/\Delta H$, which FP obtain dividing the total stream flow by the total area of Llancahue watershed. As a result of their approach, they obtain a larger value estimate per hectare. Again, neither our result nor theirs should be ruled out as incorrect.

Both approaches are sustained by a significant amount of recent literature on economic valuation and green accounting.

The paragraphs above support with simple arguments that we have not incurred in miscalculations when estimating the economic value of temperate forests. Figueroa and Pasten obviously obtained larger values as their definitions and methods diverge from ours.

Finally, we want to point out the care that researches need to take when using specific value estimates in benefit transfer exercises. As pointed out by Boyd and Banzhaf (2006), the social value of ecosystem services is spatially explicit. So are their scarcity, substitutes and complements, and therefore their economic benefits. Our primary estimate per cubic meter, which is the base for the calculations of FP, depends critically on the physical and social landscape of our selected study area (i.e. climate, soil, forest type and cover, watershed hydrological conditions, population, and market conditions) and their supposedly corrected estimates can not reverse this fact.

We thank the comments of FP as they provide us with an opportunity to clarify any doubt about our research approach and enrich the scientific discussion regarding economic valuation of ecosystem services.

REFERENCES

Barbier, E., 2007. Valuing ecosystem services as productive inputs. Economic Policy 22 (49), 177–229.

Boyd, J., Banzhaf, S., 2006. What are ecosystem services? The need for standardized environmental accounting units. Resources for the Future. RFF DP 06-02, 26 pp.

De Groot, R., Wilson, M., Boumans, R., 2002. A typology for the classification, descriptions and valuation of ecosystem functions, goods and services. Ecol. Econ. 41, 393–408.

Freeman III, A.M., 2003. The measurement of environmental and resource values: theory and methods, Second edition. Resources for the Future, Washington. 491 pp.

Mäller, K.-G., 1992. The production function approach in developing countries. In: Vincent, J., Crawford, E., Hoehn, J. (Eds.), Valuing Environmental Benefits in Developing Economies. Seminar Proceedings, Michigan State University Graduate Specialization in Resource Economics, East Lansing, Michigan, U.S.A.

Núñez, D., Nahuelhual, L., Oyarzún, C., 2006. Forests and water: the value of native temperate forests in supplying water for human consumption. Ecol. Econ. 58, 606–616.

Oyarzún, C., Nahuelhual, L., Núñez, D., 2005. Los servicios ecosistémicos del bosque templado lluvioso: producción de agua y su valoración económica. Ambiente y Desarrollo 20, 88–95.

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