

Economic perspectives

Problems with the valuation of Scotland's environment

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A paper by Williams *et al*, 'Exploring the value of Scotland's environment', in the March 2003 issue of this journal, estimated 'the annual value of the ecosystem services generated by Scotland's marine and terrestrial biomes' as £17.258 billion. This estimate was arrived at by adopting the methodology used by Costanza *et al* (1997a) to value ecosystem services for the globe as a whole. The first problem with this estimate is that it relates to a definition for which it makes no sense to produce an estimate. The second is that it is based on poor quality data.

What is Scotland's environment?

Williams *et al* define Scotland's environment to be its land surface plus the coastal waters out to 12 miles. In relation to ecosystem services to its economy and people, Scotland's environment is the global biosphere. For some particular services, a more restricted geographical scope may be appropriate. Each service needs to be considered in terms of the systems that deliver it. Such systems will not generally be confined within the boundaries of the Williams *et al* definition of 'Scotland's environment', which is a political one that has no relevance to the functioning of ecosystems and the services that they provide.

As an example of what is at issue here, consider the service which is Climate Regulation, in respect of which Williams *et al* come up with a number for the Forest biome in Scotland which is an estimate of the value of carbon sequestration in that biome. To a close approximation, CO₂ mixes uniformly in the atmosphere. What is relevant for Scotland's climate is the global CO₂ concentration. In regard to carbon sequestration by vegetation, the location of the vegetation is unimportant - it is the global amount of vegetation that affects global CO₂ concentrations. What is relevant to Scotland is the global amount of vegetation - the amount in Scotland is relevant only in so far as it contributes to the global total. Amazonian rain forest, for example, lies outwith 'Scotland's environment' as defined by Williams *et al*, but is as much involved in the Climate Regulation services enjoyed by the Scottish economy and people as are Forestry Commission plantations in Scotland (and England).

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Marine nutrient cycling

The methodology that Williams *et al* adopt from Costanza *et al* is intended to apply to evaluation at the global level. In the case of marine nutrient cycling, a lack of appreciation of this by Williams *et al* has, by virtue of their definition of 'Scotland's environment', substantial implications for the size of their estimate.

Costanza *et al* arrive at numbers for the value per ha of nutrient cycling for three marine biomes as follows (see Costanza *et al* 1997b). They estimate total global water runoff from the land into the oceans. They apply to this an estimate of the unit cost of removing nitrogen and phosphorous by the economy rather than by the ecosystem - this is known as the 'replacement cost' method of valuing ecosystem services. The total cost thus obtained is divided by 3 to give a cost for each of: the global Open Ocean biome, the global (continental) Shelf biome, the global Estuaries biome. For each of these biomes its total cost is divided by its area to give a figure for the service value per unit area.

Given the Williams *et al* definition of 'Scotland's environment' it contains only Shelf and Estuaries biome areas. They take the unit area values from Costanza *et al* for each of these biomes and apply them to the areas of each in 'Scotland's environment'. In effect, following the logic of the adopted methodology, that environment is cycling only two thirds of Scotland's nitrogen and phosphorous. If the Costanza *et al* methodology is to be consistently followed, the definition of Scotland's environment needs to be modified so that the services of the Open Ocean also get taken into account. One crude way to do this is simply to multiply the valuation based on just two national biomes by 1.5. In that case, the entry for Nutrient Cycling in Table 4 in Williams *et al* would go from £12.80 billions to £19.20 billions, the total for All Ecosystem Services would go from £17.03 billions to £23.43 billions (an increase of 38%), and the percentage contribution to the total of Nutrient Cycling would go from 75.19% to 81.97%.

This crude calculation is offered only to make the point that improperly applying a global methodology to a subset of the global environment can lead to non-trivial 'error' in the numbers obtained. If one thinks that it makes sense to put a money value on marine Nutrient Cycling to a nation using the replacement method, then to get a defensible number it would be necessary to apply replacement costing to the nutrient load generated by that nation.

Food production

Williams *et al* consider 10 biomes and 17 ecosystem services, generating a requirement for 170 unit area valuations. Following Costanza *et al*, Williams *et al* state that in 28 cases, the services 'do not occur or are known to be negligible' while in 88 cases (52%) no unit values can be used due to 'lack of available information'. Based on figures for the remaining 54 cases, Williams *et al* come up

with two numbers for the 'value of Scotland's environment'. Using exactly the same unit area values as in Costanza *et al* they get £17.027 billion. The figure cited above, £17.258 billion, arises when they use what they consider to be values more appropriate to Scotland in 8 cases. Clearly, the numbers that Williams *et al* produce for the 'value of Scotland's environment' are dominated by the unit values used by Costanza *et al* for the services of global ecosystems.

An exhaustive examination of the status of all of the values used in Costanza *et al* and in Williams *et al* would take up a lot of space. Some of the issues arising are discussed in contributions to a special issue of *Ecological Economics*, Volume 25, No 1 published in April 1998. To illustrate here the problems that attend these values I will consider the service Food Production across the biomes considered in Williams *et al*: the discussion is based on data and commentary in Costanza *et al* (1997b). The unit values in question are given in Table 1 here, using the original 1994 \$ figures from Table 2 in Costanza *et al* (1997a).

Table 1 Food production values per unit area

Biome	1994US\$ha ⁻¹ yr ⁻¹
Estuaries	521
Shelf	68
Boreal Forest	50
Grass Rangeland	67
Tidal Marsh	466
Swamps and Floodplains	47
Lakes and Rivers	41
Cropland	54

The figure for Estuaries is based on 4 studies with the simple average of \$521. One study is of commercial fishing in Italy (\$1331.17), one is of unspecified in Netherlands (\$490.45), one is of mussel culture in Netherlands (\$30.00), and one is of commercial fishing for the world as a whole (\$233.00). The Italian study result is described as 'regional income', unexplained, while the others are 'market price'. Note that valuing the ecosystem service at market price means that no value is attributed to labour and capital services, or to intermediate inputs to fishing activity. The figure for Shelf is based on one study, is 'market value', and refers to the world as a whole.

The forest figure is based on one study, which came up with a range of figures for which \$50 is apparently the simple average. The figures are for willingness to pay as revealed by contingent valuation, and appear to include figures obtained in tropical forests.

The Grass Rangeland figure is taken from one study, is for 'Net rent' and refers to 'US grassland and shrubland states'.

The Tidal Marsh figure is based on 13 studies, all of the USA, and is the simple average of 13 figures ranging from \$0.72 to \$1426.22. Eight of the figures are stated to be market price or dockside price. One, for commercial fishing, is said to be willingness to pay. One is 'marginal value', unexplained.

The Swamps and Floodplains figure is an average across 3 studies, one for Malaysia, one for the Danube in Austria, and one for Africa. The figures are market prices or surrogate market prices.

The Lakes and Rivers figure comes from one study, is said to be for the world, and based on market prices.

The basis for the figure of \$54 per ha per year for Cropland is not given in either of Costanza *et al* (1997a) or Costanza *et al* (1997b). Note that it is lower than the figure for Grass Rangeland, and only a little greater than that for Forest, or that for Swamps and Floodplains. While these relativities may make sense in some parts of the world, it is obvious that they do not for 'Scotland's environment' - what food gets produced in Scottish forests?

The figures used in the Costanza *et al* study were not an adequate basis for their attempt to value global ecosystem services. Their relevance to Scotland is, at best, remote.

What do Williams *et al*'s estimates mean?

According to Williams *et al*, their work generates 'annual values that are conservative and broadly defensible in relation to both their probable order-of-magnitude and to the relative contribution of different types of biome and ecosystem service'. There are two reasons for not accepting this assessment. First, the annual values are supposed to be of the services provided by Scotland's environment. These are not sensible things to try to estimate if by 'Scotland's environment' is meant the land within its borders and the surrounding sea to the 12 mile limit. Nature does not work that way. Important environmental services to the inhabitants and economy of Scotland originate outside Scotland. The distinction here is similar, but of a different order of magnitude, to that between domestic and national product/income. It might make sense to try to estimate the value of the environmental services enjoyed by a nation state.

The second reason for rejecting the Williams *et al* evaluation of their work is that it uses, mainly, valuations which had little value at the global level and have none in relation to the Scottish economy. Essentially, the figures that they produce are meaningless.

Why value environmental services?

According to Williams *et al*, the purpose of their work was to raise 'public awareness of Scotland's living environment', and to contribute to the 'growing policy debate about national economic, environmental and social sustainability'. Such work may serve the first purpose, notwithstanding that the numbers that it produces mean little. The Costanza *et al* exercise did receive a lot of publicity, and has resulted in a number of studies like that of Williams *et al*. Whether this kind of work is necessary to raise public awareness is an open question. As is the question of how long lasting any such effect is. One suspects that a few good TV shows about wildlife represent a better prospect. Many economists interested in the environment argue that it is necessary to put things in monetary terms to capture public attention. But then they would say that wouldn't they?

How this work can inform policy debate about sustainability is totally unclear. It has no direct relevance to any policy issue confronting the Scottish Executive or the UK government. Even if it did, its empirical base is so weak that there could be no justification for using any of its estimates.

References

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