Briefing Paper: putting a price on eco-system services using flexible emission fees

The “invisible hand of the market” setting the price of goods has been praised for its efficiency since the term was coined by Adam Smith. The economist Friedrich Hayek wrote: “[t]he marvel is that in a case like that of a scarcity of one raw material, without an order being issued, without more than perhaps a handful of people knowing the cause, tens of thousands of people whose identity could not be ascertained by months of investigation, are made to use the material or its products more sparingly; i.e., they move in the right direction.”

Nonetheless, as Hayek himself noted, the price mechanism does not provide perfect information and does not necessarily lead to a perfectly efficient distribution of resources. The price mechanism falls short when a voluntary transaction between two parties affects a third party, producing some sort of harm to an innocent bystander. This is known as the problem of externality, and it is why pollution and environmental degradation pose a challenge to the free-market system.

From an ecological point of view, environmental degradation is a general term, and one that is difficult to connect to economic value. Eco system services were given prominence in the work done for the Millennium Assessment in their Guide to the Millennium Assessment Reports. What the report elegantly reminds us of is that for our life on Earth, nature does most of the work. As you can see from the diagram below, eco systems support, provide and regulate giving us what we need to eat, clothe, house and make ourselves secure. That is not forgetting the cultural and aesthetic experience.

Eco-system services is more useful as a starting point for pricing pollution, as any action that degrades eco-system services by definition also harms the economy. The diagram below illustrates how eco-system services, divided into supporting, regulating, provisioning and cultural provide the basis of our well-being.

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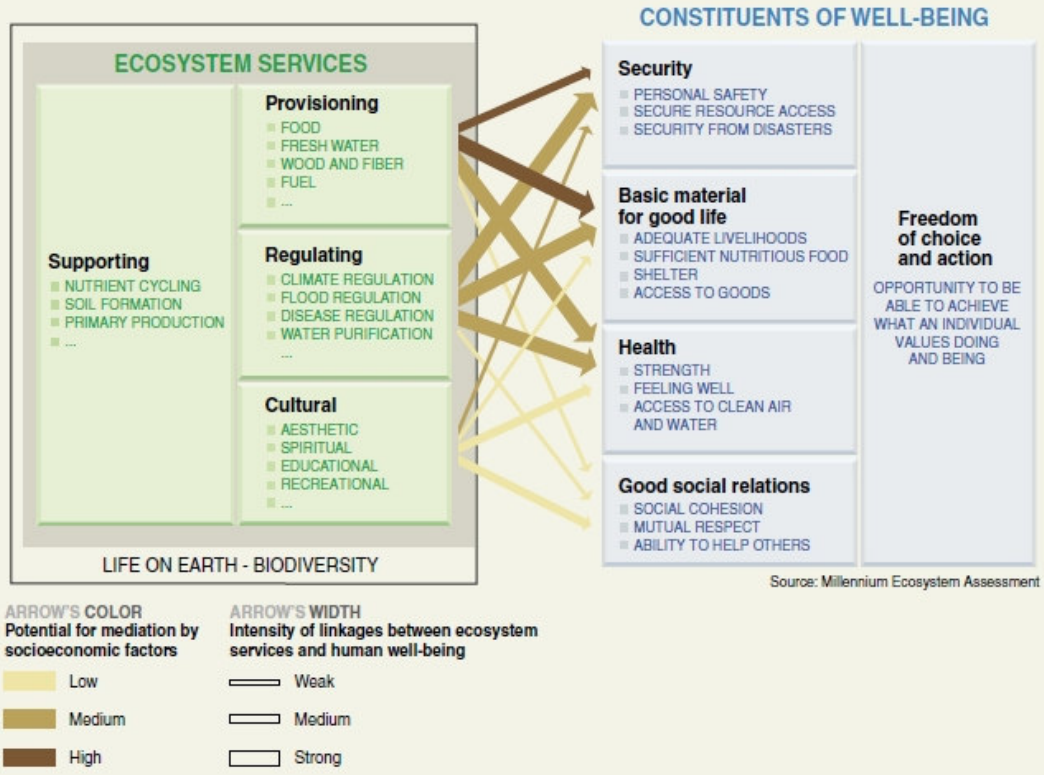
Figure A. Linkages between Ecosystem Services and Human Well-being

This Figure depicts the strength of linkages between categories of ecosystem services and components of human well-being that are commonly encountered, and includes indications of the extent to which it is possible for socioeconomic factors to mediate the linkage. (For example, if it is possible to purchase a substitute for a degraded ecosystem service, then there is a high potential for mediation.) The strength of the linkages and the potential for mediation differ in different ecosystems and regions. In addition to the influence of ecosystem services on human well-being depicted here, other factors—including other environmental factors as well as economic, social, technological, and cultural factors—influence human well-being, and ecosystems are in turn affected by changes in human well-being. (See Figure B.)



Source: Millennium Ecosystem Assessment

Finding a clear mechanism by which to put a value on the services is still difficult. There are possibilities, however, but to understand these, it is necessary to explore what it is that nature does that provides these services.

Ecologists describe how all eco-systems strive to become mature. You probably have the idea somewhere in the back of your mind, how smaller animals give way to large predators, small plants become forests, rushing water becomes a swamp, etc.

Ecologists like Odum describe nature as tending towards maturity. As the table below explains, natural systems develop so that growth slows, but nutrient recycling maximizes.

Table 1. Major tendencies describing the development incurred during ecosystem development, based on a selection of Odum's (1969) 24 attributes of maturity. These ecosystem indices can all be quantified using the Ecopath model.

Ecosystem attributes	Developmental stages	Mature stages
Gross production/biomass	High	Low
Biomass supported / energy flow	Low	High
Total organic matter	Small	Large
Niche specialization	Broad	Narrow
Size of organism	Small	Large
Mineral cycles	Open	Closed
Nutrient exchange rate, between organisms and environment	Rapid	Slow
Role of detritus in nutrient cycling	Unimportant	Important
Nutrient conservation	Poor	Good

The various aspects of ecological maturity are explained below.

Gross production. This means the total amount of biomass that accumulates in the system. Note that as a system matures, the slower biomass increases. For example, young trees grow very fast, older trees grow much slower.

Biomass supported. As the system matures, more biomass is in the system – more trees grow, more animals and plants more in, and they are larger.

Total organic matter. As above, the more mature the system, the more in the eco-system.

Size of organism. In immature systems, the organisms are small. As the system matures, and there is more for predators to eat, for example, the more and larger the organisms become.

Niche specialism. As the system matures so does diversity. More specialized organisms move in.

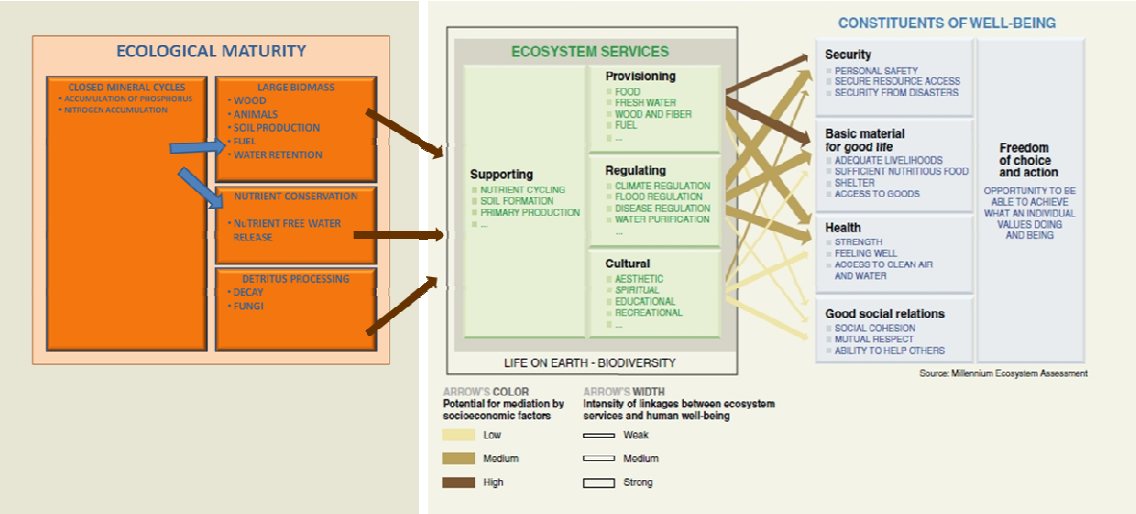
Mineral cycles. Eco systems need minerals to cycle in them in order to function, so to have more biomass they must retain nutrients.

Nutrient exchange rate organisms <> environment . Immature systems "leak" both heat and nutrients to other eco-systems.

Role of detritus in nutrient cycling. As the system matures, detritus is more and more important as a source of minerals and energy for the organisms in it. Nutrient conservation. Mature systems conserve minerals and do not leak them to other systems.

Ecological maturity is quite easy to identify scientifically: for example by testing the water leaving the areas, and taking infra red pictures of the areas from the air to identify solar energy capture levels.

Because of its clarity and simplicity, the measure of maturity could be accepted as a sound basis for fee establishment. The diagram below explains the relationship of ecological maturity to eco-system services.



Two widely discussed approaches to pricing pollution have been cap and trade and a straight pollution tax. The idea of a pollution tax dates back even further than cap and trade — to the work of economist Arthur Cecil Pigou in the 1920s. Pigou believed that negative externalities caused by market interactions justified government intervention. And he showed that the way to reduce damaging externalities was for government to tax the activities leading to them, based on the amount of damage they caused — thereby giving offenders very real, material reasons to cut back on their harmful behavior.

Pollution tax has been further developed by Anders Höglund who proposes that:

1) A fee is set to be sufficiently high to encourage behaviour change in the market.
2) That it is changed regularly in response to how the market reacts. If reaction is too little, the fee is raised.
3) That fees collected are returned in sufficiently high degree to tax payers to motivate the decision and to encourage economic activity.
4) That the fee shall be set as high up in the supply chain as possible to stimulate all supply chain actors to innovation.

Höglund proposes that this flexible, floating fee mechanism works to discover the true price of pollution, by stimulating the market to find out what it costs to *not* pollute.

Work commissioned by the Nordic Council of Ministers investigated Höglund's mechanism in general and specifically looked at carbon dioxide emissions and those of phosphorous. The point highest up in the supply chain identified was where a nation extracted fossil fuel or imported it. For phosphorous it was the same.

Clearly, as it possible to measure the maturity of an eco-system, and it is possible to understand the supply chain from extraction /import to release, then it is possible to put fees in place that stimulate

market behaviour to be clean. Initially, the more the market ignores the signals from the fee mechanism, the more money flows into consumer's accounts and the higher the stimulus for alternatives.

Höglund's mechanism, then, combines the cutting edge of economic thinking using fast feedback of market data to adjust fees whilst leaving innovation to the market and the consumer, with the latest scientific analytical techniques that are able to value natural capital through its maturity.

More investigation is needed into putting a price on direct interventions into eco-systems, like clear-felling or burning to see how the Höglund's mechanism could be applied practically. However, the concept is clear enough, that the fee rises until the behaviour stops and eco-system services are left to increase to their maximum. This provides a much simpler, more practical approach to marrying the concept of economic and natural growth.

References:

Odum, E. P. 1969. The strategy of ecosystem development. Science, 104:262-270.

Enell, M. 2012. Flexible emission fees. An incentive for driving sustainable production and consumption. Nordic Council of Ministers ISBN 978-92-893-2335-2

The Millenium Assessment http://www.maweb.org/en/index.aspx