Valuing Ecosystem Services in a Green Economy

Thesis submitted by

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What is aught but as 'tis valued?
But value dwells not in particular will;
It holds its estimate and dignity
As well wherein 'tis precious of itself
As in the priser; 'tis mad idolatry
To make the service greater than the God;

Troilus And Cressida, Act II., Sc. II.

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Foreword: A Green Economy

In a green economy corporations will behave differently. They will have a different philosophy. Sustainable principles will be paramount in their operational decisions, with minimal use of non-renewable resources and multiple recycling. A large part of their overall investment will be ethical. In a green economy, maintenance of ecosystem services such as clean air, unpolluted water and biodiversity, would be the responsibility of global business. The environment will be on the balance sheet of the multi-national corporations of the world.

Under such a scenario, a market for the formerly "free" goods and services provided by the environment could be readily envisaged, thus removing the last stumbling-block to our placing a value on these goods and services. Just as a carbon credit has a monetary value in an enhanced greenhouse context, perhaps equated to the ability of a hectare of forest to sequester carbon, so also biodiversity credits, for all the intrinsic reasons as well as a gene pool for medical research. Clean air and water can be evaluated on the basis of the cost to society to provide it otherwise.

So nature's storehouse becomes big business. The stability and growth of the corporate investment becomes a function of ecosystem condition. Inventories of ecosystem goods and services form part of the annual accounts for corporations as well as countries. However, the input for these inventories comes from zoologists, botanists, ecologists and environmental scientists, rather than from economists and accountants.

Abstract

Scope

Ecosystems are being degraded and destroyed worldwide at a rate unprecedented in human history. Accordingly a great deal of interest is currently being focussed on ecosystems, the role they play in planetary life support, and the need for a market mechanism to conserve these formerly regarded 'free' goods and services. This research project is concerned with the various divisions or branches within economics dealing with environmental valuation, including applied economics in the form of valuation practice, environmental science, and ecology. It is thus both multi-disciplinary and interdisciplinary and has as its central theme the use of a surrogate market to establish shadow prices for ecosystem services.

Methodology

Twenty ecosystem attributes were identified as being common to all ecosystems depending on the level of integrity, and ranked in order of importance on the basis of a range of criteria. This was achieved by a systematic analysis, namely a multiple criteria analysis, and a social study, in the form of a Delphi philosophical inquiry. These two methods incorporated many different perspectives: namely anthropocentric, utilitarian (economic), ecological, aesthetics, equity, risk and uncertainty. The weightings provided by the panellists were non-pecuniary, and as such were not subject to any bias or odium that may have been associated with putting monetary values on nature's gifts. The non-pecuniary weightings assigned by the panellists were converted to dollar values by empirically linking them to the surrogate market, namely the property market in the region, and calculating the value of a flow of benefits emanating from them (the economic rent). A valuation table was devised to assess the ecosystem integrity of individual ecosystems on private or public land and a conceptual model devised for landscapes. The case study area was the Wet Tropics World Heritage Area of northeast Queensland.

Results

The Delphi panel reached consensus in all three rounds of questionnaires, and the weights provided for the twenty attributes for all three models in the multiple criteria analysis showed a significant level of agreement between the disciplines represented on the panel. The ten ecosystem services ranked most important were: biodiversity; refugia; erosion control/soil and sediment retention; genetic resources; gas regulation; climate regulation; biological control; purification (clean air, water); disturbance regulation; and aesthetics, in that order. The total value of ecosystem goods and services in all the tenure categories in the Wet Tropics World Heritage Area (8,944 km^2) was determined to be in the range AUD$188 to $211 million $year^{-1}$, or AUD$210 to $236 $ha^{-1}yr^{-1}$ across tenure categories. The individual ecosystem services mentioned above ranged from AUD$18.6 to $20.9 million $year^{-1}$ for biodiversity down to AUD$10.2 to $11.4 million $year^{-1}$ for aesthetics. The value of individual ecosystem services constrained within a fully intact suite of ecosystem goods and services was found to be consistent with the value of all other uses to which land is put in a bioregion and with other avenues of investment in the economic system, and will increase proportionate to the human population density, and hence scarcity of ecosystem services.

Conclusion

The combination of revealed preferences in a surrogate market as the empirical baseline for the whole suite of ecosystem services in a bioregion or Local Government Area, along with the expressed preferences of a group of experts as to the importance of each individual good or service, provides the theoretical and practical justification for the acceptance of the technique as a means of establishing opening prices in a future trading market. Being linked to the value of real property and hence population density in a region, it provides a key insight into the status and thus value of ecosystems services provided by public and private land, including scarcity. The most critical recommendation to policy and decision-makers emanating from this research is the requirement that environmental impacts arising from development projects, policies or proposals be properly identified, the magnitude of the impact properly assessed, and mitigation of the impacts strictly enforced. The

same applies for environmental pollution, damage and degradation with legal liability apparent. Legislation is required to be enacted which will lead to the need for rigorous environmental valuation procedures that have empirical verification and will stand scrutiny in a court of law. The technique expounded in this thesis is such a procedure.

Acknowledgements

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The contributions and perseverance of family and friends are paramount in extended self-funded research projects such as this, and the understanding and contributions from my mother, brothers and children were greatly appreciated, particularly from the youngest who had to suffer my late scholarship from the age of 10 to 17, and who may have been a little short-changed. However, like me, I hope she found the experience character building. I would also like to thank my colleagues at James Cook University for patient listening, even though they did not have a clue what I was talking about most of the time. Cheryl Roberts again took valuable 'time out' from her own PhD research to patiently and expeditiously proof read my thesis more than once, and I love her for it.

Most of all, I would like to express my appreciation and utmost admiration for those that took part in the Delphi Inquiry. This was no easy task. The Delphi technique depends to a large degree on the group understanding of their role in the inquiry. Most Delphi inquiries involve one, or at most two rounds where contribution of the panellists is required. The Delphi Inquiry conducted as an integral part of this research had four rounds where contribution was required, feedback from each round, and involved six components: three questionnaires with a total of 60 questions, and three matrices each of 120 cells to weight the ecosystem services. I repeat, this was no easy task. The names of those who took part in the Delphi inquiry appear in Appendix C.

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List of Acronyms

A	Area
AAV	Assessed Annual Value
AHP	Analytical Heirarchy Process
ATSI	Aboriginal and Torres Straight Islanders
B	Benefit
BBI	Biodiversity Benefits Index
BBS	Biodiversity Significance Score
CBA	Cost Benefit Analysis
CBD	Convention on Biological Diversity
CCC	Cairns City Council
CDM	Clean Development Mechanism (Kyoto Protocol)
CERCLA	*The Comprehensive Environmental Response, Compensation and Liability Act 1980 (USA)*
CM	Choice Modelling
CPI	Consumer Price Index
cr	capitalisation rate
CSIRO	Commonwealth Scientific Industrial and Research Organisation
CVM	Contingency Valuation Method
CWGMBI	Commonwealth Working Group on Market Based Instruments
DPI	Department of Primary Industries
Ecol	Ecologist
EcolEcon	Ecological Economist
EDP	Environmentally adjusted net Domestic Product
EnvEcon	Environmental Economist
EnvSci	Environmental Scientist
EPA	Environment Protection Authority
ESD	Ecologically Sustainable Development
esi	extent of provision of ecosystem services
GBR	Great Barrier Reef
GDP	Gross Domestic Product
Geog	Geographer
GNP	Gross National Product
GPP	Gross Primary Production
ha	hectare
HP	Hedonic Pricing
HSS	Habitat Services Score
IBRA	Interim Biogeographic Regionalisation of Australia
IS	Inquiry System
IUCN	International Union for the Conservation of Nature
JI	Joint Implementation (Kyoto Protocol)
LGA	Local Government Authority
LGs	Local Governments
LOP	Level of Protection (model)
LUC	Land Use Characteristic (model)
MA	Millenium Ecosystem Assessment
MADM	Multiple Attribute Decision Method
MBIs	Market Based Instruments
MCA	Multiple Criteria Analysis
MUV	Median Unimproved Value
N	Number
NAPSWQ	National Action Plan for Water Qualityand Salinity
NatRM	Natural Resource Manager

NIEIR	National Institute of Economics and Industry Research
NRDA	National Resources Damage Assessment
NRDA	Natural Resources Damage Assessment
NSB	Net Social Benefit
OECD	Organisation for Economic Cooperation and Development
PAGE	Pilot Analysis of Global Ecosystems
PAs	Protected Areas
PC	Productivity Commission
REs	Regional Ecosystems
S	Species Richness
SCEP	Study of Critical Environmental Problems
TCM	Travel Cost Method
TEV	Total Economic Value
TV	Total Value
TVi	Total value individual attribute
TVw	Total value whole ecosystem
UFpa	*Usus Fructus per annum*
UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational Scientific and Cultural Organisation
UV	Unimproved Value
W	Kendall's Coefficient of Concordance
WCED	World Commission on Economic Development
WHA	World Heritage Area
WRI	World Resources Institute
wt	weight of ecosystem attribute
WTA	Willingness to Accept
WTMA	Wet Tropics Management Authority
WTP	Willingness to Pay
WTWHA	Wet Tropics World Heritage Area
WWF	World Wide Fund (for nature)

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Signature **Date**