Section 3

Discussion and Conclusion

"Non noli nocere" (first do no harm)

Hippocrates

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13.1 Introduction

Ecosystem goods and services formerly deemed to be free should be deemed so no longer. The costs of some alternate technological solutions to provision of equivalent goods and services are there in the marketplace for all to see (Costanza *et al.,* 1997b; McNeeley 1988; Cork and Shelton 2000; Wilson 2002). The costs are generally an order of magnitude or more larger than the values assigned to ecosystem services as a production function of land in this study (eg. water filtration plants; artificial pollination; insecticides). Wilson (2002:1) claims that:

"To supplant natural ecosystems entirely, even mostly, is an economic and even physical impossibility, and we would certainly die if we tried. The reason, ecological economists explain, is that the marginal value, defined as the rate of change in the value of ecosystems services relative to the rate of fall in the availability of these services, rises sharply with every increment in the fall. If taken too far, the rise will outpace human capacity to sustain the needed services by combined natural and artificial means. Hence, a much greater dependence on artificial means…in other words, environmental prostheses…puts at risk not just the biosphere but also humanity itself: ALREADY IN THE RED" (Wilson's emphasis).

This chapter was designed to provide a synthesis of the research results in the context of the chosen methodology, previous work and methods applied, the need for the study, and what the results mean and what the future holds in terms of the primary aim of the research. The chapter is organised around four main themes:

1. A discussion of the results in order to clarify the points of agreement and the points of difference emanating from the Delphi Inquiry.
2. Past deficiencies in economic valuation of the environment and difficulties in transferability that have led to the current lack of confidence in these procedures.
3. The advantages of the empirical method of environmental valuation including its already pivotal role in national administration and convergent validity.

4. What the values mean and what the future holds in terms of application of this methodology to conservation problems, some limitations, and applications for financing in the local and global context.

The primary aim of the project was to develop a new or modified approach to the economic conundrum of valuing non-market (unpriced) goods, typically environmental goods and services. Three proposed outcomes of the research were as follows:

- Improved understanding of the costs and benefits of ecological systems in the provision of a range of services, along with recognition of sound environmental practice appropriate to enhance services and minimise disservices.
- An appraisal technique developed to establish an opening price for ecosystem services in a future trading market.
- Acceptance of these techniques by mainstream practitioners, producers, consumers and financiers.

Some general conclusions will be made in regard to the primary aim and the proposed outcomes above which will be highlighted in the text, leading to more specific conclusions presented in the next chapter.

13.2 Points of Agreement and Points of Difference: the Delphi Inquiry

The statistical methods employed showed a significant level of agreement between the panellists in all but a few cases where N was small for the multiple criteria models, and in all cases for the questionnaires. The degree of agreement, represented by Kendall's *W*, was much higher (closer to one) for the questionnaires, which used data converted to a ratio scale (per cent of each discipline who answered 'true'), than for the multiple criteria models, which also employed ratio scale data. However, the individual panellist's set of weightings for each attribute in the models was analysed for concordance with every other panellists' set of weightings, resulting in lower levels of concordance, although still significantly different to 'no agreement'. Taking the mean of the panellists' weightings for the attributes in each model, and comparing the level of agreement between disciplines, resulted in levels of

concordance much closer to one. The effect of 'smoothing' the data by taking the mean reflects the group's collective weighting for the attribute, and not the individual's weighting, and the significance of the statistical comparison between disciplines of their mean weighting, reflects the group concordance, which was very high.

The main points of agreement and points of difference emanating from the weightings provided by the panellist's for the MCA were as follows:

- In model 1 the coefficient of variance was lowest for gas regulation, and highest for the three life-fulfilling attributes, recreation, aesthetics and other non-use values (bequest, existence, option).
- In model 2 the coefficient of variance was lowest for gas regulation and biodiversity, and highest for pollination, aesthetics and other non-use values.
- In model 3, which had some negative values and the coefficient of variance statistic did not apply; the range was smallest for erosion control, biological control and biodiversity, and largest for climate regulation, recreation and other non-uses values.

Clearly a higher degree of uncertainty existed with the panellists when it came to providing weightings, or ranking attributes, when they were most intangible such as the life-fulfilling services, although recreation is possibly the one ecosystem service that has been most valued. One could conclude from these results, one or all of three things:

1. In the absence of complete information (eg. for other non-use values), it is not possible to make a rational judgement;
2. That humans (or at least the panel) are more certain about the services that provide 'real' benefits, rather than those that provide 'psychological' benefits (eg. all life-fulfilling services); and,
3. That there is still a lack of confidence in past methods used to value the environment, with recreation being the most valued attribute using neo-classical methods such as TCM and CVM, yet the panellists showed a higher degree of uncertainty in weighting this attribute than most other attributes that have never been valued by any previous method.

A community workshop conducted by CSIRO's Ecosystem Services Project in the Gwydir catchment in Victoria was asked to rank a not dissimilar suite (more rural user friendly) of ecosystem services (CSIRO 2002). Not surprisingly they ascribed the highest rank to soil health, which would encompass all or part of the attributes in this study of gas regulation, climate regulation, disturbance regulation, water regulation, erosion control, biological control, soil formation, nutrient cycling and storage, biodiversity, water supply, food production, raw materials, genetic resources, and other non-use values: that is, fourteen of the suite of 20. Habitat was ranked next in order of importance, which would encompass directly only refugia, but take into account all other attributes in the suite. Waterways were next, which arguably encompass the whole 20 attributes in the suite. Ranked fourth was life-fulfilment, which in a broad sense should encompass everything, but in the narrow sense, only includes recreation, aesthetics and non-use (bequest, existence, option value). River flows and ground water levels followed in order of importance, which again can be directly or indirectly connected to many of the attributes presented here. The point to be made is that the interconnectivity of ecosystem services obfuscates modelling and confounds attempts to value them. This example goes a long way towards demonstrating why the MCA systematic approach was taken. MCA is unashamedly reductionist, positivist-rationalist, and anthropocentric, however it does have the merit of being able to produce usable results, rather than, simply, theory.

General Conclusion 1. Humans are more certain about the value of ecosystem services that provide real benefits than they are about those that provide psychological benefits.

13.3 Past Deficiencies in Environmental Valuation

Neoclassical economists developed most environmental valuation procedures in the period after the 1950s, when attempts were first being made to put a value on non-market effects in the CBA of a project or policy. The theory and application is presented in Chapter 2, along with some criticisms of the approaches taken. Researchers working in the field today are very diverse, with some still using these procedures, for example the travel cost method

(TCM), which really only values recreation values, and hedonic pricing (HP), which really only values amenity. The most common method used is the contingency valuation method (CVM), where the hypothetical market is described to a random selection of respondents and they are expected to have some knowledge of it, experience in trading in it, and respond as though it was real. However Hanley and Spash (1993), amongst others, have a few problems with CVM, due to it being based on peoples' preferences backed up by the ability to pay. As such it raises profound issues to do with anthropocentrism, as well as difficulties to do with information variability across groups, the effects of value aggregation across groups and the positivist-rationalist approach. A great deal of attention was focussed on CVM in the USA particularly subsequent to the *Exxon Valdez* disaster in Alaska. The Exxon corporation commissioned various studies of the reliability of CVM, as there is now legal precedent in the USA of CVM as a means of measuring the extent of damages under some legislation. The findings of these studies were highly critical of CVM, leading to the appointment of a panel of economists to the US government to advise on the status of CVM (Common 1996). Their findings were ‘cautiously favourable’, as they acknowledged the problems with the method and promoted careful survey design and improved WTP questioning (Arrow *et al.,* 1992; Common 1996), however, this did little to allay the concerns of Hanley and Spash (1993). One reason why these methods are being perpetuated is the intransigence of some economists who are entrenched within their own particular brand of economics. Other methods have more relevance, such as ‘avoided cost’ and ‘dose response’, as being able to be linked to markets, however these are also limited in application. Clearly also, a lot of modern researchers are moving forward with new methods such as choice modelling (CM), a variation on the CVM, which has been found to overcome bias and be ‘incentive compatible’ (Harrison *et al.,* 2002). The mainstream economics approach of measuring marginal utility (ie. value) as being one unit more or less of a good is not very useful for decision-making, as it leads to either very low prices due to excess supply and low demand, or very high prices due to high demand and low supply (scarcity). The latter situation must be the norm for some of the most important ecosystem services, eg. water supply, clean air, purification, assimilation of

waste etc. One of the major criticisms of Costanza *et al's.,* (1997a) approach in their seminal paper in Nature was their failure to assess value based upon the marginal utility approach, but instead aggregated a series of estimates of marginal value (Cork and Shelton 2000). However, Robert Costanza is an ecological economist, not a neoclassical economist.

The former leader of CSIRO's Ecosystem Services Project, Dr Steve Cork says that what is needed (amongst other things), is:

"imaginative use of coupled ecological and economic analyses that builds people's understanding of what is valuable and move beyond the neoclassical paradigm of individual preferences" (Cork 2001:6).

Daly (1999:*xii*) claims that standard neoclassical economics:

"…has become a brittle, desiccated and ossified discipline"; which: *"…under the tutelage of economists, has sacrificed purpose for a socially blind, short-run, mechanistic concept of efficiency."*

The economist's toolbox includes the most used method, CVM, which uses people's preferences for what they would be willing to pay for non-market ecosystem services. Yet these preferences are based upon one of the central assumptions in neo-classical economics, that people will make decisions as individuals based upon self-interest (Cork 2001). In other words, the preferences sought did not account for individual materialism, which by and large was responsible for the 'tragedy of the commons'. This is described in economic terms by Borcherding (1991) as a misallocation of resources. The objective of ascribing values to ecosystem services is clearly not just economic efficiency; it also includes social and ecological sustainability, for which people's individual preferences may be a poor measure in the absence of complete information. Cork (2001:3) also lays the blame for the current state of the world on ignorance, market failure and institutional failure, saying that humans:

"…have failed to give ecosystems and the services that come from them as much value as other activities and products that degrade ecosystems".

Ignorance: because people are generally unaware of the extent of the benefits provided by ecosystems and the potential to lose them due to population growth and development. Market failure: because of the lack of a properly

functioning price mechanism (Common 1996). And institutional failure: because taxes and subsidies are still generally weighted against conservation, particularly on private land (Cork 2001).

Very few attempts have been made to broadly value all ecosystem services in a bioregion or whole ecosystems due to the difficulty in valuing certain aspects of them (Cork and Shelton 2000). While the approaches used in neoclassical and environmental economics have been the subject of aggressive controversy for decades, due to continual refinement they still have some merit and application when it comes to placing value on certain attributes of the environment, such as recreation (Harrison *et al.,* 2002). A reference set of environmental values, the product of many years of past studies, may be able to be adapted to specific situations and the value estimates extrapolated to situations other than the one in which they were developed. This is known as 'benefit transfer' (Harrison *et al.,* 2002). Evidence of the continued development of non-market valuation techniques in Australia and further refinement of the existing methods was featured in Chapter 3 and taken from the 'special issue' of the Journal of the Economic Society of Australia (Queensland) in June 2002. Articles featured in the issue were based on research projects that took place over the last, say, 6 years, and used a variety of the techniques:

All of these studies were complex and apparently carried out in a rigorous and exemplary manner. Some were more academic in that they addressed implications of policy change (eg. Herbohn and Henderson 2002), and others produced practical results by way of dollar values for environmental goods and services which were within the accepted order of magnitude of the productive function of terrestrial ecosystems (see 13.5 this chapter), however, the researcher approached the problem (eg. Driml 2002; Duthy 2002). One could ask then, why is there still a fundamental lack of confidence in the outcomes of attempts to value the environment? The answer is that most methods lack empirical verification (the partial exception in this selection of studies is Pearson *et al.,* 2002). The studies complied with price theory, however, they did not produce an exchange value which is precisely what the

valuer or land economist is interested in. Chamberlin (1965) described economic theory as often remote and unreal due to the underlying assumptions not being entirely supported by fact. Non-market economic valuation methods have been grossly criticised ever since they were first introduced fifty years ago, and while the more rigorous studies have had some positive outcomes in conservation, they have never had the benefit of price-fixing by legal fiat, as has been the case for real property for centuries (Murray 1954). It should also be noted that all but one of the ten studies was exclusively from academia. One could ask why again? And the answer is twofold. Firstly, it is the penchant of professors of economics, and indeed all professors, to have students pursue their research interests. There is nothing wrong with this, insofar as it does not constrain the development of new paradigms. Secondly, the time frame for work of this nature using the economic valuation procedures is such that it is rarely undertaken by private firms. However, with the ever growing demand for competent and unbiased environmental impact assessments for projects and policies, most, if not all of which are carried out by private firms, it is vital that the private sector appreciates the need for efficient environmental valuation of impacts (rather than just saying there is one), and develops the skills to undertake the work within the requisite time-frame.

General Conclusion 2. There is still a general lack of confidence in past methods used to value the environment.

13.4 The Advantages of the Empirical Method of Valuation

The divorce or complete disassociation of academic economics from practical valuation theory and practice is and should be a cause of grief for both professions, and as a consequence both have been retarded (Murray 1954). The former deals with the abstract theory of value using the marginal utility approach and indifference curves developed by Hicks, while the latter with the measurement of value in the market. Valuation practice is the only branch of economic theory that relies on empirical verification of hypotheses. It has a very wide application to a diversity of subjects, including land utilisation,

agriculture, engineering, architecture and so forth, that are ancillary to it and require synthesis in order to determine value (Murray 1954).

The economic theory of value is the study of market phenomena, which attempts to analyse and explain price triggers ‘a priori’ under a variety of hypothetical market situations, and as such uses inductive reasoning. Conversely the theory of valuation is concerned ‘a posteriori’ with interplays in actual market situations (ie. deductive reasoning). The theory of valuation is a pragmatic extension of the theories of value and of price and was developed as a matter of practical, judicial and administrative necessity, by the judiciary, the chartered surveyor (UK) and the accountant. The efficient fiscal administration of a country is dependent on processes of valuation ‘which are accepted by the courts, the commercial world and the individual’ (Murray 1954). Murray (1954:77) deplored the situation where such potent factors ‘have been overlooked in all expositions of the theories of value and price’. Most of the sub-disciplines of economics including land economics have discovered that their methods and theories often have synergy, the difference however, being how they arrived at the result. Despite this there still remains no widely accepted method to value a specific aspect of the environment that remains unambiguous (Lally 1998). Valuation practice predates classical economics by centuries, although it is the modern refinements and legal precedent that has consolidated its pivotal role in national administration. Economists have in many cases merely enunciated in general form, ‘the theories upon which practising valuers worked’. Moreover many of these theories were at the centre of the foundations of economics and were interpreted and applied by the valuer in determination of the market value of real estate. Theories to do with rent, interest, capitalisation rate, profit, risk, uncertainty, costs, prices, etc., are the everyday tools of the valuer (Murray 1954). Murray (1954:79) elucidated on the task of a valuer, as:

“…to ascertain points of indifference and to solve valuation problems incidental to market relationships, which can be regarded as the focal point of exchange. And in which both competitive and monopolistic forces combine in the determination of price. His daily bread is indeed working at the centre of economic realities, by measuring the results of monopolistic

and imperfect competition, and by taking cognisance in his appraisals, of all the forces which determine the imputed price".

The philosopher-mathematician, Leontief (1948) postulated that complexity built upon complexity, and theoretical models tended to fail through inability to rely on inductive reasoning. Under these circumstances more reliance was needed on empirical evidence and controlled experiment. Murray (1954) stated that economic theory is generally in line with scientific procedure, but due to a complete rejection of the possibility of experiment or observation, it was not real. Again deploring this situation, Murray (1954:79) wrote:

"Economists have, because of the lack of a satisfactory basis for isolating and understanding the causes of economic phenomena, occurring in a world of infinite complexity, been compelled to develop their methodology within the framework of imaginary models and to show, by reasoning, how a given set of conditions is always and inevitably followed by particular effects. A phenomenon is then explained by showing that it is bound to occur by the operation of the set of conditions postulated by the hypothesis. The illustrations are, however, often vested with an air of unreality because, in the desire to achieve simplicity, the process of elimination is carried so far that the only factors remaining are more appropriate to the Garden of Eden, where the media of exchange were fruit until the serpent effected the translation into the real world".

The part of the methodology used in this research that was strictly empirical was the use of the median unimproved value (*MUV*) of land as a fixed reference point for a bioregion at a certain point in time. The multiple criteria analysis was a form of systematic analysis and the criteria that bound the weightings provided by the panellists were derived partly from the economic theory of environmental valuation, ecology and the biophysical environment. The Delphi Inquiry technique is a well-established method of social research in order to gain consensus or opinion about an environmental problem from an already informed group. However, without the fixed reference point as a surrogate (the *MUV*), results from the MCA and the Delphi would have been meaningless. And without the fixed reference point (in time) there would have been no capital dollar value for the land that hosts the services, and no *UFpa* for computation of the value of the flow of total and individual ecosystem goods and services. True, there would have been a result in that the non-pecuniary weights and sensitivities of the ecosystem services would have

been determined from the analysis and inquiry, however these would have fallen into the vast basket of theoretical studies gathering dust on the shelf of indifference, with no practical application in the real world.

One of the difficulties in environmental valuation is the decreasing tangibility from direct use, to say existence values, or use and non-use values, however there does not appear to be much difference between the economist's concept of total economic value (TEV) (Chapter 2), and the concept of market value, as the latter is simply made up of varying degrees of use and non-use values (Lally 1998; Sarpong-Oti 1998). Moreover, ecosystem goods and services can occur everywhere (CSIRO 2002), on private and public land, with the beneficiaries both the owners and society (Sarpong-Oti 1998). In some situations the market value concept would take precedence over the TEV concept, particularly when assessing natural resource values. The difficulties when trying to assess these values from the point of view of all members of society are formidable, however the United Nations (SNA93) recommended that for national balance sheet purposes, valuation of natural resources should be:

"…on the basis of current observable market prices as this is the basis on which decisions by producers, consumers, investors and other economic agents are made".

(p.xi cited in Sarpong-Oti 1998:338). This recognition of the role of market value in valuing natural resources, was then sanctioned by the publication of 'Experimental Estimates of Values of Natural Resources Covering Forests, Land and Subsoil', by the Australian Bureau of Statistics in 1995, which stated:

"…the values for both urban and rural lands were based on land values for rating and taxation purposes provided by state valuation agencies"

(ABS 1995; Sarpong-Oti 1998:339). Moreover, this application was transferred to land under public utilities, and by implication to public reserves by the introduction of Australian Accounting Standard AAS 27 (Rowles *et al.,* 1998). It would thus appear clear that there is not only wide acceptance and support for the empirical method of valuation, but that it is the preference of both national governments and supra-national agencies.

General Conclusion 3. The use of unimproved land values provided by state agencies as a baseline for estimating the value of natural resources has wide acceptance in Australia and overseas.

13.5 What the Values Mean and What the Future Holds

13.5.1 What the Values Mean

The main issue in rationalising a range of values for ecosystem goods and services is maintaining them within an order of magnitude of the values for all other uses to which land is put and other avenues of investment in the economic system. The values for the Wet Tropics Bioregion derived from the methodology and reflecting risk and uncertainty, level of protection and land use characteristic could be extrapolated for the whole of Australia (Table 13.1).

Table 13.1 Extrapolated values for the tenure categories for the whole of Australia using tenure categories and areas from Year Book Australia 2002 (ABS 2002).

Tenure Category	%	Sq Km	Sq Km rate	Total Value
Private Land	62.7	4819600	$18,231.00	$ 87,866,127,600
ATSI Land	14.3	1094800	$18,898.00	$ 20,689,530,400
Public Land				
Nature Reserve	6.81	524100	$23,651.00	$ 12,395,489,100
Aboriginal Freehold NP	0.14	10800	$23,651.00	$ 255,430,800
Vacant Crown Land	12.49	960700	$18,980.00	$ 18,234,086,000
Other Crown Land	1.06	80600	$14,916.00	$ 1,202,229,600
Forestry Reserve	1.93	148200	$21,431.00	$ 3,176,074,200
Water Reserve	0.14	11000	$20,717.00	$ 227,887,000
Defence Land	0.25	18600	$18,593.00	$ 345,829,800
Mining Reserve	0.07	5000	$18,593.00	$ 92,965,000
Mixed Category Land	0.12	8900	$14,916.00	$ 132,752,400
Total Value	100.01			**$ 144,618,401,900**

Note: National land tenure details are the latest available from AUSLIG (1993). Some changes have taken place since, particularly in the composition of public land tenures.

Although some bioregions will have substantially higher *UFpa* due to scarcity factors and elevated real property values, and others such as in inland Australia will be much lower. Thus 140 – 150 billion Australian dollars per annum could be a reasonable ballpark figure for ecosystem goods and services for the whole of terrestrial Australia, which is the equivalent of about

one quarter of the Australian Gross Domestic Product for the year 2000-2001 (ABS 2002).

By comparison Costanza *et al.,* (1997a) estimated about 12 trillion US dollars for the world's terrestrial ecosystems, or about two thirds of the then World's GDP. However, this study was widely criticised for a number of reasons, one being the magnitude of the figure (Cork and Shelton 2000). Some of the values ascribed by different researchers that were extrapolated for Costanza's study for particular ecosystems were well out of the ballpark. For example: wetlands US$14,785 $ha^{-1}yr^{-1}$, and Lakes/Rivers US$8,498 $ha^{-1}yr^{-1}$, and even tropical forests, US$2,007 $ha^{-1}yr^{-1}$. McNeeley (1988) reported similar values for studies of wetlands in the USA, of US$7,950 $ha^{-1}yr^{-1}$ (which the researcher incidentally capitalised at a rate of 5.375% to produce a capital value of $147,900 ha^{-1}), and coastal marshes, of US$4,938 $ha^{-1}yr^{-1}$. Closer to the mark were temperate forest US$307 $ha^{-1}yr^{-1}$ and grass/rangelands US$232 $ha^{-1}yr^{-1}$. Also closer to the mark were separate studies done by Adger *et al.,*(1995), de Groot (1994) and Castro (1994). Adgers *et al.,* (1995) valued a limited suite of ecosystem services in Mexico's forests at US$80 $ha^{-1}yr^{-1}$, de Groot (1994) came up with US$500 $ha^{-1}yr^{-1}$ for use and non-uses values in Panama's forests, and Castro (1994) in the most comprehensive study to date arrived at a figure of US$102 to US$214 $ha^{-1}yr^{-1}$ for the ecosystem services in the 13,000 km^2 of wildlands (mostly tropical rainforest) in Costa Rica. The Castro case study area is most similar to the WTWHA in both ecosystem type and areal extent. It is also most similar by way of values, with a range of about AUD$180 to $380 $ha^{-1}yr^{-1}$ or AUD$240 to $500 million $year^{-1}$ for 13,000 km^2, compared to the values derived for the WTWHA in this thesis of AUD$149 to $342 $ha^{-1}yr^{-1}$ within tenures ($210 to $236 across tenures) or AUD$188 to $211 million $year^{-1}$ for the 8,944 km^2. Moreover a summary review in 1996 by Pimentel *et al.,* of the sustainable use value of several dozen forests revealed a hypothetical overall value of about US$220 $ha^{-1}yr^{-1}$ (cited in Myers 1997), and Duthy's (2002) work on the non-consumptive use and non-use values in Whian Whian State Forest in northeastern NSW, reviewed in section 13.3 of this chapter, revealed a range of from AUD$214 to $404 $ha^{-1}yr^{-1}$. Although there were differences in what these and other studies purported to value

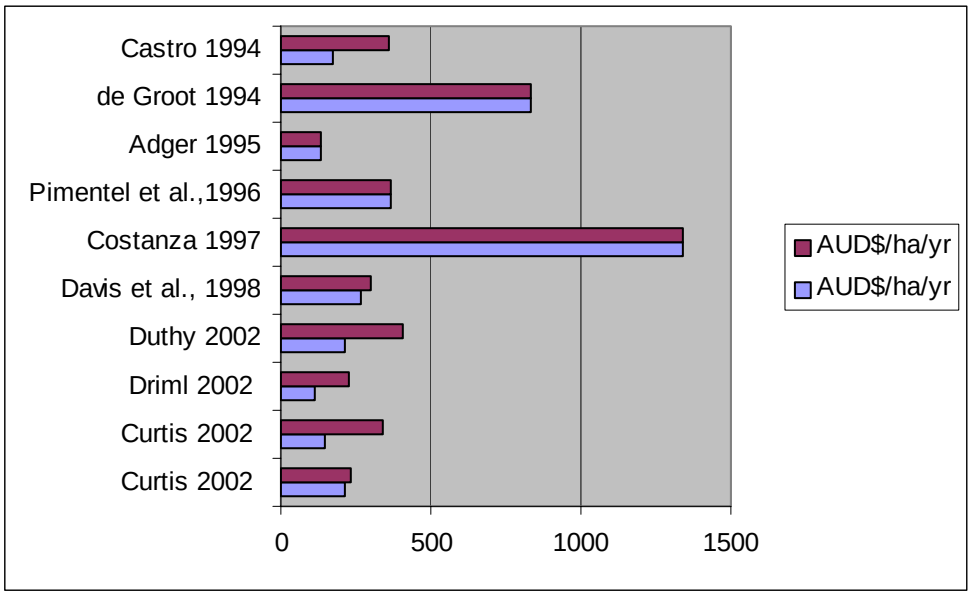
(Table 13.2), for example: all suite or limited suite of ecosystem goods and services; or just recreation; or consumptive use and non-use values, most of the values were of the same order of magnitude.

Table 13.2 Comparison of the subject (what) of a selection of studies of valuations of ecosystem services (Sources: Castro 1994; de Groot 1994; Adgers *et al.,* 1995; Myers 1997; Curtis 2002; Driml 2002; Duthy 2002).

Researcher	Locality	What	Value $ha^{-1}yr^{-1}$
Curtis 2002	WTWHA Queensland Australia	Full suite of ecosystem services. Linked to unimproved property values and human population density	AUD$ 210 - $236 across tenures, AUD$149 – $342 within tenures
Driml 1997 (updated 2002)	WTWHA Queensland Australia	Recreation	AUD$112 - $224
Duthy 2002	Whian Whian State Forest, NE NSW, Australia	Non-consumptive use and non-use values	AUD$214 - $404
Davis *et al.,* 1998	Gibraltar and Dorrigo National Parks, NE NSW, Australia	Recreation	AUD$264 - $ 298
Adgers *et al.,* 1995	Mexico's forests	Limited suite of ecosystem services	US$80
de Groot 1994	Panama's forests	Use and non-use values	US$500
Castro 1994	Costa Rica 'wildlands'	Ecosystem services	US$102 - $214-
Pimentel *et al., 1996*	Several dozen forests	Sustainable use value	US$220

The methods used to derive the values in this study are in accord with the principles of both the economic theory of value, which is based on price theory and human preferences (Frank 1991) and the theory of valuation (which is based on actual interplays in market situations), the combination of which provides the empirical justification for the research. Irrespective of whether the values of the individual ecosystem attributes are adopted, the philosophical link between the value of land and it's productive function (*UFpa*) as a supplier of planetary life support is without question, and ratified by, amongst others, the United Nations (Sarpong-Oti 1998), the Australian Government (ABS 1995) and the Australian Accounting Standards Board (Rowles *et al.,* 1998). What is questionable is whether the link between land values and the planetary life support value functions (*UFpa*) supports the values derived by the very many and diverse CVM and TCM studies, or if it is the other way around. None of the CVM and TCM studies have any fixed reference point or

longitudinal data set upon which to rely yet, with the possible exception of wetlands, they generally produce results in the same order of magnitude as the *UFpa* in this study (Figure 13.1). How is this?



Note: The two ranges of values ascribed to Curtis are for 'within tenures' and 'across tenures'.

Figure 13.1 Comparison of the values derived for various suites of ecosystem services by various researchers (Source: Castro 1994; de Groot 1994; Adgers *et al.,* 1995; Costanza 1997a; Myers 1997; Curtis 2002; Driml 2002; Duthy 2002).

The congruence of the values in most studies could mean that the preferences that people reveal to purchase property for a multitude of purposes are subconsciously expressed when asked to bid for environmental protection of their investment. Yet they are not to know, or be able to compute the end result from their own simple bid. It could be that the bid levels are preordained to elicit a median or expected response, which will result in a value to the order of the generally accepted magnitude. If this were the case it would imply that the methods are even more suspect than was previously thought. Some of the values of individual attributes of the environment revealed in this study can be compared with markets; for example, water, carbon (some trades have taken place), and they are again in the same order of magnitude. However, Driml's (1996) PhD valuation of recreation in the WTWHA at between AUD$100 and $200 million yr^{-1}, is an order of magnitude larger than the values for two of the pertinent life-fulfilling services (recreation and aesthetics) in this study, which totalled $15 to $17 million yr^{-1} for the WTWHA as part of the whole suite of services worth between $188 and $211

million year^{-1}. Likewise the benefit transfer of recreation values for the Dorrigo and Gibraltar National Parks in NSW to Whian Whian State Forest would have had the effect of doubling the total estimate for all of the other non-consumptive uses and non uses in this forest. Clearly, this one use, recreation, is not worth more or as much as all of the others. The Delphi panel were emphatic in this regard. Recreation was ranked 19th out of twenty in model one, 12th out of twenty in model two, and 17th out of twenty in model three, 17th overall. Aesthetics, cultural and spiritual values fared better, being ranked 18th in model one, 14th in model two and 6th in model three, 10th overall. The TCM uses travel cost to access a natural area as a surrogate for value. However this beggars the question: the value of what? The CVM describes a hypothetical market to respondents to elicit their response to a scenario that may impact on a natural area, but are they being asked to value a specific attribute of the environment that is being impacted or the whole basket of goods and services? Psychologically it is difficult for respondents to separate out the, say, recreational value and nominate a bid level, when in fact they have absolutely no idea what other attributes there are, what attributes are valuable and what values apply to them. As a result, the imputed price derived from studies of this kind is not just for say, recreation, but everything the respondent consciously or subconsciously perceives as being part of the natural environment in question, and as such it must include non-use values and option values and existence values. The same logic can be applied to the TCM. The economic values of the whole suite of ecosystem goods and services are constrained within measures that are consistent with all other uses to which land is put and other avenues of investment in the economic system. The values of individual ecosystem services are constrained within this overall basket of goods and services on a landscape or bioregional scale, however, in some ecosystems certain goods and services may be worth more than others based on scarcity or limiting factors.

General Conclusion 4. The value of a fully intact suite of ecosystem goods and services is 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.

Transferability of the methodology expounded in this thesis to other bioregions requires advice from the state agencies or LGs as to the rateable value (UV) of land in the LGAs, and the area of that land, as well as a landscape assessment for ecological integrity. A minimum level of development is required in a bioregion by way of infrastructure for the values to be comparable, and as the level of development increases so do the values for ecosystem services, which reflects the economic concept of scarcity. Dobson *et al.,* (2001:1019-1026) conducted research on 'underlying patterns of species diversity, the distribution of threats to diversity (such as relative rates of habitat loss)', human population density, and the value of land in different areas in five states in the USA. The relationship between human population densities and land values was exponential (R=0.99; *P*<.001), and there were similar strong relationships between human population densities and numbers of endangered species as well as numbers of alien species. Dobson *et al.,* (2001:1019) concluded that 'protecting wilderness is valuable and relatively easy', however, greater focus is required on areas that are of most value to humans. Scott *et al.,* (2001:999) found that nature reserves are most often dedicated at higher elevations with less productive soils, while an analysis of the distribution of plants and animals showed that the greatest number of species is found at lower elevations. Patterns of land ownership also indicated that land at lower elevations was more productive, and had been 'extensively converted to urban and agricultural uses'. The predominantly private ownership of land at lower elevations and coastal zones where human population densities are highest, land values are highest, and thus ecosystem services more scarce, requires that the private sector should be involved in innovative strategies to capture the full range of biodiversity. The population density of the Wet Tropics Bioregion in 2002 was 22 persons km^{-2}, (374,814 in 1996 plus 1.5% annual increase ~ area of the bioregion 18,497 km^2) (WTMA 2001). A highly significant relationship was also found to exist between the population of the eleven shires in the bioregion and the mean unimproved value of the land in each shire (R=0.929; *P*<.000) (Figure 13.2). The comparability of the values for ecosystem services between bioregions using the methodology expounded in this thesis is thus linked to the human population density in a bioregion.

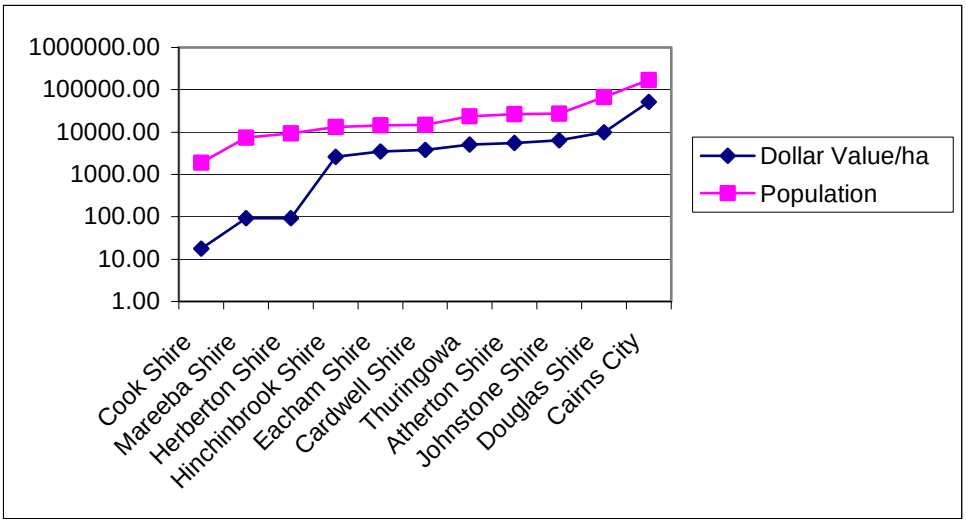


Figure 13.2 Log scale chart of the exponential relationship between human population density and land value in the Wet Tropics Bioregion.

General Conclusion 5. Values of ecosystem services in a bioregion will increase proportionate to the human population density.

13.5.2 What the Future Holds

Indicators help to shape public perception of the complex systems that are ecosystems, and play an important role in public policy, particularly when the effectiveness of alternative public decisions is warranted (Milon and Shogren 1995). Many important economic indicators have been developed which play a large part in public policy implementation (for eg. GNP, CPI), yet they ignore the fundamental contribution of the environment. Just as economic measures such as the GNP can be used to reflect performance of an economy, exchange values for ecosystem goods and services can be used to indicate the state of the environment, in terms that facilitate trading where necessary and compensation for loss. Biophysical indicators (say of water quality) are also social indicators as they are linked to social objectives (clean water), provided society supports the policy intent (Milon and Shogren 1995; Hamilton and Lutz 1996). The Gross National Product and its derivatives is the system of national accounts used in most countries. Based on the United Nations (1968; 1977) framework of 'balance sheet'; the stock of national assets and liabilities that indicate changes in national wealth due to accumulation,

depreciation and revaluation of assets; and 'profit and loss'; the flow of money received from goods and services produced, as well as other flow accounts to provide a measure of economic activity (cited in Milon 1995). It is only in the last decade that these measures have been strongly criticised for failing to account for the basic value, or of changes in the value of natural capital due to resource depletion (stock); for failing to depreciate environmental and natural resources due to over-consumption in the flow accounts; and, for including the cost of mitigation of the external effects due to economic activity in the flow accounts (Milon 1995; Young *et al.,* 1995; Daly 1999). This has come about due to natural resources being included principally in the form of privately owned land that is traded in markets. Publicly owned land and other finite natural and environmental assets, ie. ecosystem goods and services, are not traded in markets and hence, excluded. To reinforce this neoclassical paradigm, Daly (1999) refers to advanced texts on 'growth theory', where the neoclassical production function is concerned with production represented as a function of capital and labour only, with resources not included. This concept of nature's gifts being free due to them being non-market goods and services, or public or common property such as fisheries, has led to widespread resource depletion akin to 'the tragedy of the commons'. The more common the good or service is, apparently, the harder it is to ascribe ownership and hence value it. The more common the good or service is, apparently, the harder it is to provide a level of protection, and the more it is endangered. The table of descriptions of ecosystem services (Table 1.1) in the introductory chapter, shows 14 of the ecosystem attributes as being held exclusively in the public domain, with the remaining 6 being both public and private property. Moreover, 16 of the attributes benefit everyone, with only 4 having benefits shared between everyone and private interests. A basic, but poignant example of how national accounts create a false impression is that of two of the most pressing environmental problems in Australia today. Agricultural outputs rely heavily on soil and water resources, yet they are not included as a cost of production because they are regarded as free (non-market). Yet the cost of other inputs such as fertilisers and fuel (for pumps, bores etc.) is included, even to the extent of additional purchases to offset the degraded soil quality and depleted water supply brought about by poor farming practices

(Milon 1995). Biological resources including wildlife only feature to the extent of the inputs to the economy to enjoy them, such as the purchase of camping equipment for recreation. More important is the failure to account for the biospheric life-supporting services, without which the national accounts would be irrelevant.

A new system that would integrate environmental and economic accounts was developed by the United Nations and published as a System of National Accounts handbook in 1993 (Bartelmus 1995; Hamilton and Lutz 1996). Rather than modify the 'core' system, it was developed as a 'satellite' system for trial, as some of the methodological proposals lacked consensus. This applied particularly to those of the monetary valuation of non-marketed ecosystem goods and services. An Environmentally adjusted net Domestic Product, or 'Eco Domestic Product' (EDP) can be compiled, where the transition from conventional accounts to 'green' accounts first integrates the economic asset accounts with the supply/use accounts and then expands the asset accounts to include 'environmental' assets (Bartelmus 1995; Hamilton and Lutz 1996). EDP would then equal output less intermediate consumption (domestic) of goods and services, less depreciation (capital consumption) less environmental costs. This would be equivalent to final consumption (domestic and other) of goods and services, plus net capital accumulation (economic and environmental) plus net exports less net imports. Net capital accumulation would be composed of gross economic capital formation less depreciation plus gross environmental accumulation less environmental dis-accumulation. The whole system would be in the accounting framework of opening stocks of economic and environmental assets, plus flows and transfers, plus other volume changes, adjustments, revaluations, which would equal closing stocks of economic and environmental assets (Bartelmus 1995). However, patently without a method to readily place a value on the many non-market components of this system, it will never be complete enough or competent to fully reflect the economic and environmental state of a nation or of the world. The United Nations acknowledged this in the handbook for 'integrated economic and ecological accounting' by placing a 'zero' economic value on goods and services not currently traded in markets (Bartelmus 1995).

Moreover Young *et al.,* (1995) maintain that the empirical problems and the costs associated with determining values for all of the positive and negative aspects of environmental goods and services may be prohibitive. And further, that a system of integrated national accounts for Australia is unlikely to prove effective, as:

"…conditionally renewable resource depletion and environmental degradation is trivial in relation to the total economic activity in an industrialised nation such as Australia"

(Young *et al.,* 1995:170).

Instead Young *et al.,* (1995) argue for state of the environment reporting and the development of consistent economic (including resources) and ecological data sets arranged temporally and spatially to enable integration and modelling, and coordinated by the use of geographic information systems for resource and income accounting.

Bennett (1991) in discussing the paradox between economics and the environment, and the juxtaposition of the two disciplines, suggests that economics can provide a paradigm for environmentalism. Government failure to include environmental services in the market economy, or their interference by way of perverse subsidies and regulations is counterproductive to ensure proper 'stewardship of the environment'. The essence of Bennett's (1991) paradigm was that market forces could be harnessed to ensure 'stewardship of the environment'. Despite the many conceptual and logistic problems in achieving this, and the many schools of economic thought, by far the majority of all authorities agree that markets provide a powerful mechanism to achieve environmental goals. Assignment of property rights is seen by many to be critical to resolution of what environmental attributes or ecosystem goods and services can be traded in markets (Young *et al.,* 1996). Some economists say that markets may not form in the absence of a property right, or the transaction costs could be so high that a trade is not worthwhile (Bennett 1991, Chant *et al.,* 1991). Also high uncertainty about the attributes of a good or service, too few buyers and too few sellers and asymmetric information between buyers and sellers, can impact on the viability or existence of a market (Murtough *et al.,* 2002).

In reality, economic and ecological sustainable use of the environment requires that ecosystem goods and services be privately held, or that government exercises such rights on behalf of society (Chant *et al*., 1991). Borcherding (1991) discusses the heterodoxy of the economics of property rights and public choice, noting that neither government intervention, nor forms of private ownership allocates resources optimally over time. Borcherding (1991) puts this down to 'the upward bias of the private discount rate', that is, preferences for the present over the future; 'perversities in the tax system', which could distort values as they lower the present value of exploitation today; and expensive private legal costs to enforce private property rights which may be compromised by excessive depletion/consumption of resources on adjoining common property holdings. These are rational arguments, but complicate the issue of valuing the environment; firstly by the assumption that a valuation must be discounted into the future; secondly, that taxation is relevant to the assessment of environmental values except insofar as it may impact on the capitalisation rate used to derive a net yield or value for the flow of benefits; and thirdly, use of the benefits of common property holdings could and should be regulated to avoid excess depletion and cross border effects. The use of a capitalisation rate converts a capital value to an annual value at a certain point in time, as opposed to a discount rate which attempts to predict interest rates into the future and discounts them to reflect people's preferences for 'a dollar today over one tomorrow'. Daly (1999) treats discounting nature's gifts with 'moral outrage', saying that routinely discounting costs and benefits of ecological support services at 10%, means that in fifty years each dollar of costs and benefits is worth a 'mere penny' today. To discount the yield (*UFpa*) as a product of the capitalisation procedure would presuppose that it was possible to not only predict ecosystem performance into the future, but also the cost of money, and the effect of discounting is in essence to devalue them irrespective of this uncertainty. That is not the intention in this thesis.

General Conclusion 6. Applying a discount rate to the current value of ecosystem services is counter-intuitive to the concept of intergenerational equity.

In this research project, for the first time, a method has been formulated that allows valuation of individual ecosystem goods and services constrained within an overall valuation of the whole suite of ecosystem goods and services in the ecosystem in question, including transgenerational equity, at a certain point in time. Using a panel of experts (Delphi Inquiry) to assign weightings, the values of individual attributes were determined by anthropocentric, economic and ecological criteria (multiple criteria analysis). The overall value of the whole suite of ecosystem goods and services extant in the ecosystem in question was determined by its productivity function (*UFpa*), which was empirically linked to the properties hosting the services (in terrestrial ecosystems) and all other avenues of investment in the economic system. The property right is thus assigned.

The property right for all of the individual ecosystem goods and services in an ecosystem is assigned to the proprietor of the estate in fee simple in possession of any particular property holding, including government, whether public land, private or leasehold, although in the case of some leasehold land there are reversionary interests to be considered. A proprietor may assign some rights to individual attributes to another party, which could be an absolute transfer, or a policy instrument such as a conservation covenant. As a case in point, most states in Australia now leading up to the first commitment period under the Kyoto protocol have legislation in place so that land, trees, and the carbon stored in the trees, can vest in different owners. Contrary to what Bennett (1991) and the various schools of economic thought have seen as a major hindrance to trading of ecosystem goods and services, if the valuation method is directly linked to the ownership of real property, property rights are well-defined, and depending on scale, transaction costs should be minimal. The ecosystem approach is of course not a total solution, however it is one over which humans have some measure of control. For example, assigning property rights to common services such as gas regulation (atmospheric composition) and climate regulation (the threat of global warming) is only possible from the scale of ecosystems or terrestrial bioregions, where the damage is either done or undone. More difficult to assess are the world's oceans, where property rights exist only over the

coastal zones provided governments act to enforce them on behalf of the whole of society.

General Conclusion 7. Linking ecosystem services to the estate in fee simple of the land that hosts them assures that property rights are assigned.

The 'Blueprint for a Living Continent' drawn up by the Wentworth Group of Concerned Scientists in 2002, with Australia in the grip of the worst drought for a 100 years, attempted to lay many myths to rest (WWF Australia 2002). In essence, the tectonic, geological and geomorphological history of Australia is unique, such that it is currently the driest and most ancient inhabited continent on earth, it has the 'most variable climate', the land is old and weathered with no recent glaciation or regional volcanism to recycle parent material, and 'with a salt inheritance' due to regular incursions by epeiric seas. Under this scenario, farming practices since colonisation have been the root cause of all land degradation, but not drought. Drought is a legacy that 'comes with the turf', and nothing can be done about the effect until the continent of Australia rafts up against Asia and is out of the influence of the Antarctic circum-polar currents. The Wentworth Group propose that the blueprint would include some fundamental changes, such as:

- clarifying water property rights;
- clarifying obligations associated with those rights;
- restoring environmental flows;
- ending broadscale clearing of remnant native vegetation;
- paying farmers for providing environmental services;
- assisting farmers to farm sustainably and profitably by transferring the cost of environmental subsidies to the price structure of farm produce in order that they are borne by all.

The Wentworth Group sum up by saying:

"By giving power back to our communities, valuing the ecosystem services provided by native vegetation, recognising the importance of environmental flows in our rivers, and rewarding people for environmental stewardship, our generation can leave a legacy of living rivers and healthy landscapes, not drains and dustbowls" (WWF Australia 2002:4).

Markets that value the role of natural ecosystems and the ecological life support processes operating in natural landscapes must be created in order to conserve native vegetation, and at the same time make farm forestry pay (Binning and Young 1999c; Binning *et al.,* 2000). Research by the Productivity Commission (PC) in Australia has shown that an important role exists for both the public and private sectors in conserving biodiversity *in situ,* although the private sector is constrained by a variety of problems, including wildlife legislation, some elements of land tenures, the inability in the most part to recoup the cost of conservation, and the possibility of competition from public reserves (Byron *et al.,* 2001). According to WWF Australia (2002) the conservation of biodiversity is the foundation stone for sustainable futures in Australia and elsewhere.

The essential ecosystem services that underpin Australia's agricultural resource base, and by extension and implication urban life in Australia, now require significant investment in landscape and regional scale recovery plans, converting over-cleared farmland back to bushland, 'stitching' back patches of remnant bush and replanting riparian zones and corridors. Clearly it is an economic solution that is required, as 63% of land in Australia is privately owned, and 75% of forested land is publicly owned (NIEIR 1996) thus requiring government to exercise the existing property rights in favour of conservation. WWF Australia (2002) report that two-thirds of landholders expect their property values to decline by up to 25% over the next three to five years as a result of land degradation, which is not surprising because the land *is* degraded. What is surprising however, is the further inclusion in the Wentworth Group Blueprint (WWF Australia 2002), of some tax signals which may have perverse implications on the value of conservation that have been sought from the Commonwealth, for example: allowing a tax deduction for a reduction in land value when a landholder places a conservation covenant on their land; and, allowing deductions for the discounted sale of a property for conservation purposes. The implication is dangerous; as it implies that land that is not degraded and worthy of conservation for the provision of life-supporting services is worth less than land that is used, say for agriculture. Similar implications have been made by, for example Binning and Young

(1999a), Binning and Young (1999b) and Binning and Feilman (2000). Clearly this message is not consistent with all of the other messages about the value of biodiversity, life-support functions etc. Clearly also, incentives are needed, particularly for the philanthropic contribution to conservation, but not at the expense of a perpetuating conception that conservation of remnant vegetation is detrimental to the productive function of land and therefore land values diminish. Lally (1998) maintains that the valuation of a property subject to a private conservation agreement is generally no different from the valuation of one that is not, however in the light of the new environmental awareness, and prevailing market considerations, the new status of the property as a conservation reserve may confer a 'special' value over and above market value.

Land identified as being of high conservation value may be acquired by conservation agencies, and often these acquisitions do not satisfy the willing buyer/willing seller criteria of market value (Lally 1998). However, Vaughan (1999) claims it is still uncertain how the value of land included in a conservation zone is affected, as there are still too few comparable sales. A complete rethink is needed here. In addition to consensus amongst practitioners in the field that conservation of remnant vegetation or conservation generally does not diminish the value of land owing to the value of the flow of environmental benefits (*UFpa*) emanating from it, a concerted effort must be made to educate landholders of the real benefits that could accrue to them. The latter is a mechanism of ANZECC's National Framework for Management and Monitoring of Australia's Native Vegetation (Environment Australia 2001), however more needs to be done as was reported in the Cairns Post (AAP Brisbane 2000):

"Queenslands rural lobby group Agforce, which represents about 8600 primary producers in the state presented its submission on Monday to the Federal Government's House of Representatives Environment and Heritage Committee's Inquiry into Public Good Conservation. Agforce said…land conservation measures which benefited the public…caused a loss of production and market value in their properties. Agforce called on the Federal Government to make a commitment to providing compensation for the loss of market value as a result of measures which were of benefit to the wider community but not the property owner".

And, on ABC's Landline program on December 7, 2002:

"NSW farmers say tough land-clearing restrictions have caused land values to fall and thrown future business plans into disarray. Defiant and angry, they've banned government staff from their properties, resigned from local vegetation committees and most worryingly admit illegal clearing is rife" (Australian Broadcasting Commission 2002).

In addition, 'the Federal Cabinet Subcommittee on Environmental Sustainability has agreed to a plan to compensate farmers for the costs of protecting native species and reducing their water use'. 'The Deputy Prime Minister, John Anderson, presented an interdepartmental paper outlining proposed compensation for farmers where property values are reduced by application of the *Environmental Protection and Biodiversity Act* and by reduction in water entitlements'. 'Further progress will depend on the states agreeing to the principal of compensation for reduction of property rights to achieve environmental outcomes' (Enviroinfo 2002:3).

More recently the Wentworth Group of Concerned Scientists proposed a radical new way of managing native vegetation in New South Wales in a report to Premier Carr (Wentworth Group of Concerned Scientists 2003). In a scenario of growing awareness amongst farmers of the merit of conservation of native vegetation and tough new land clearing laws, the Wentworth Group proposed a model that will replace perverse incentives, simplify native vegetation regulations, set environmental standards, and end broadscale clearing by providing substantial financial incentives and investment security for farmers to enter into property management plans aimed at on-ground conservation. The benefits expected to flow from this model are healthy rivers and landscapes that will conserve biodiversity and provide refugia, as well as permitting as functional a suite of ecosystem services as is possible to co-exist on land with human activities.

General Conclusion 8. Capitalisation of the *Usus Fructus per annum* of the land component managed for remnant vegetation at an appropriate rate will ensure that land values do not fall.

Particular advances have come about in the United States of America to appreciate and measure the value of ecosystem services due to certain legislation being enacted. *The Comprehensive Environmental Response, Compensation and Liability Act of 1980,* CERCLA or the Superfund Law, established the National Resources Damage Assessment (NRDA) program, which apart from administration costs are funded entirely by potentially responsible parties (Renner 1998; Lally 1999). Formerly adversarial with industry disputing the scientific and economic basis of assessments, NRDA is gradually changing its focus from estimating the value of lost resources to quick and efficient restoration programs. The three principal activities of NRDA were assessing injury, planning restoration and determining damages, which evolved as scientific and economic understanding increased. 'Injuries' were expanded to include the impairing of services that a habitat might provide and the growth of organisms. Consideration has also been given to baseline ecosystem conditions, the variability of natural systems, and community compensation for loss of individual organisms that may negate any lasting effect. Scientists look for a common metric of a habitat that can be tied to all the services, such as say the stem density and height of marsh grass in a coastal setting, and compare it to other habitats (Renner 1998). This legislation has led to an exponential growth in research into links between economics and ecology and environmental valuation.

Although Australia has begun to recognise and trial the merit of some market-based instruments (MBIs) for natural resource and environmental management, it is yet to fully implement any such scheme for ecosystem services. In the USA conservation and mitigation banking programs have gone a long way towards mitigating against negative impacts of development proposals or policies. Sheahan (2001:5) identifies ten 'essential elements, of the banking schemes:

1. Legislation and regulation
2. Data inventory, habitat classification, and planning
3. Permitting, and the requirement for mitigation
4. Valuing debits at the impact site
5. Valuing credits at the bank site

6. Long term land management at the bank site
7. Securing the status of the conservation bank
8. Developing an agreement between all parties
9. Establishing systems for credit sale
10. Monitoring and compliance

Where impacts are identified, the bank provides off-site mitigation by way of a land management plan for the bank site to ensure the credits are delivered in perpetuity. The banking schemes include conservation covenants, and an endowment fund for on-going management costs and ecological monitoring programs. As the banking agreement involves transfer of the legal responsibility for mitigation to the bank, it is first necessary that mitigation of the negative impacts be enforced through legislation, and hence demand is created for the bank product. Purchase of a credit by a developer thus finances conservation (Sheahan 2001). Four of the recommendations in Sheahan's (2001:6) report on conservation and mitigation banking and its applicability to NSW are as follows:

- The requirement for mitigation of environmental impacts to be scientifically valid, consistently applied and rigorously enforced in all development consents;
- Growing the market by broadening the requirements for mitigation to a range of Acts and jurisdictions. Whilst keeping one marketplace and one credit type to enhance trading;
- Development of credit and debit valuation methods which recognise the complexity of biodiversity yet enable relatively rapid assessment and classification;
- The ability of the scheme to protect the greatest area of habitat, and to share the economic benefits to the greatest number of landholders.

The concept and implications of conservation and mitigation banking are far too complex to attempt to summarise further in this discussion, suffice to say that it appears to be working in the USA, and it also appears to have considerable potential in Australia to facilitate a 'no net loss' scenario for

native vegetation, and by implication, ecosystem services (Commonwealth of Australia 1997).

In Australia, a range of MBIs are either being trialed or operating. Among them, the Department of Land and Water Conservation in NSW have selected 20 rural properties in areas known to contribute to salinity problems to take part in a scheme where the landholders will sell salinity services to the NSW government in return for their regenerating parts of their land. To quote the NSW Minister for Land and Water Conservation, Mr Amery:

"In a fully functioning environmental services market, landholders can earn credits by undertaking works which will provide benefits beyond their own properties. On the other side of the market, other farmers may want to clear their land for cropping purposes or carry out some other activity, which, say, would adversely affect the water table or other environmental factors. The farmer would subsequently be in debit, and may choose to buy some credits from his or her neighbour. It may be more cost effective to buy credits from a neighbour than to regenerate his or her property. This will all vary according to the quality of the land involved. Landholders can make money from this scheme, and they can make a profit on the credits, depending on market demand" (Parliament of New South Wales 2001:46-47).

All Australian governments joined together by funding a total of $5 million to the National Market-based Instruments Pilots Program under The National Action Plan for Salinity and Water Quality (NAPSWQ) in 2002 (Commonwealth of Australia 2002). This program was developed as evidence from overseas has shown that the use of MBIs markedly increased the potential for achieving environmental goals, and government were interested because they were more affordable to the community (Environment Australia 1997). The Productivity Commission noted that MBIs played an important role in managing environmental problems, but considered there was scope to improve the availability of information needed for a lot of environmental problems. Traditional policy approaches, for example: command and control, suasion and education, had failed to achieve desired natural resource outcomes. Current interest in MBIs can be put down to a shift in attitudes. Where some once saw the market as a powerful adversary, now it could be seen as a useful ally. Although there were still many unresolved problems to establishment of viable markets, economists and environmental scientists and engineers are more likely able to provide information to make the markets

viable. Well-designed MBIs could be more effective for this reason (Commonwealth of Australia 2002).

The Commonwealth Working Group on Market Based Instruments (CWGMBI) (Commonwealth of Australia 2002) saw three areas for improved policy design:

- cap and trade schemes;
- auctions (purchase of environmental services);
- strategic information disclosure, and

their survey of a range of MBIs in Australia focused on trading, and addressed a range of natural resource issues, including:

- conserving biodiversity;
- reducing salinity;
- rehabilitating wetlands;
- water allocation; and
- reducing nutrient inputs/levels.

Much of the lead-up work in MBIs can involve creating new markets. As most ecosystem goods and services are currently unpriced, the creation of a market mechanism may yield a price for a good or a service, thus creating an incentive to produce or conserve. One of the key challenges is to create property rights that will capture actual scarcity values that will be reflected in price signals. Scarcity can be created by imposition of limits on, say, clearing, water extraction, emissions; or by specifying biophysical standards to be achieved (nitrogen or salinity levels in waterways; vegetation retention, extent, quality, etc.) (Clairs and Young 1995; Commonwealth of Australia 1997). The CWGMBI (Commonwealth of Australia 2002:viii) stressed that ‘all offset and trading schemes are underpinned by the creation of scarcity’.

The proposed pilots include:

- auctions that examine multiple outcomes (eg. biodiversity);
- water trading for environmental outcomes in non-irrigation areas;
- point source and diffuse source permit trading;
- development of exchange rates for trading between market boundaries;

- expansion of point source emissions trading to other areas, (eg. pathogens);
- modification of trading for industries that have varying costs of pollution reduction; and
- eco-labelling markets

(Commonwealth of Australia 2002:viii). Some of these pilots address the 'polluter pays' principal with 'cap and trade' or 'bubble' schemes (cap on emissions at point source, or total pollutant load in the bubble). Many others are addressing various aspects of trading, including recognition, mechanisms and suitability to the environmental problem or asset of concern. Investment seeking strategies and equity raising for environmental outcomes feature in several trials and rely on both or a combination of philanthropy and the need for credits. Most of the trials are government programs and funded for only a few years, by which time they will have had to show at least a potential for self-funding or private sector funding for them to continue (Sheahan 2001). Some of the programs also involve a degree of complication in interpretation despite their apparent success, as say in the Bush Tender trials in Victoria, where a Biodiversity Benefits Index (BBI) was determined by dividing the product of the Biodiversity Significance Score (BSS) and the Habitat Services Score (HSS) by the landholder's bid (Stoneham *et al.,* 2002). Over complication and the need for complex calculations tend to obfuscate widespread acceptance by the community and mainstream practitioners, the latter due to time constraints. From the available budget and the areal extent of the habitat over which agreements were reached, the results appeared to indicate a once-only payment of \$123 ha^{-1}, which is not much different to the average cost of fencing off remnant vegetation, estimated at \$140 ha^{-1} by Driver (2002). For a system of environmental services payments to work, payments must be ongoing, as experience has shown after payments stop any leverage over landholder's behaviour also ceases (World Bank 2001).

Whilst all these initiatives are admirable they provide a level of complication to natural resource management and protection of the environment typical of the machinations of nations with several levels of government. Add to this the

contributions of NGOs, conservation bodies, private enterprise and philanthropists, and the result is a vast hotchpotch of innovative schemes all trying to achieve the same goal with limited and finite funding. To achieve a 'no net loss' scenario, it is important to not just legislate for strict enforcement of full mitigation in environmental impact assessment procedures, but to create new protected areas (PAs) or create new habitat to offset what is being lost. To hark back to one of Sheahan's (2001:6) key recommendations in his report to the Churchill Memorial Foundation on conservation banking and mitigation banking in the USA.

"Growing the market by broadening the requirements for mitigation to a range of Acts and jurisdictions, whilst keeping one marketplace and one credit type to enhance trading".

Keeping one marketplace and one credit type requires all credits to be equal, while clearly all ecological benefits are not equal. This was clearly identified in the results of the Delphi panel's responses to the three multiple criteria models, and CSIRO's community workshop at Gwydir (CSIRO 2002). Sheahan (2001) proposed that credits be linked to land area and quite rightly notes that trading credits associated with existing PAs does not achieve a net ecological gain. Considering the time lag in creating or restoring habitat, or legislating for new PAs, it will most definitely result in a net ecological loss. Linking credits to land area would be unlikely to conform to the 'one credit type' recommendation, as the credit could be for any number of hectares depending on ecological integrity, ecosystem type and level of protection. Using currency as the common denominator satisfies the recommendation for one credit type and it can be applied to both whole ecosystems and individual attributes. Thus if a whole ecosystem is to be degraded, the proponent would be required to purchase credits to offset the creation or restoration of equivalent habitat, with the payment to include an additional sum discounted into the future to allow for the time lag in the realisation of compensatory ecological benefits. Thus conservation is financed. If a single or a few individual ecosystem services rather than the whole ecosystem are to be impacted by a proposal, similar financial sensitivities can be undertaken using the methodology presented in this thesis to ensure that there is 'no net loss'.

13.5.3 Transferability and Limitations of the Method

The values of ecosystem services using the methodology presented in this thesis were derived from the median unimproved value of land in the bioregion, meaning that they are applicable on a landscape scale. But what of say, a hypothetical intensive resort development proposed within the LGA with the highest mean capital unimproved value, in this case Cairns City Council, at \$51,340 ha^{-1}. The land may be freehold and at risk of loss of some or all ecosystem services, so a capitalisation rate of say, 8.25% would apply. The *UFpa* is thus \$4,236 $ha^{-1}yr^{-1}$ or 13.5 times the *UFpa* for the whole bioregion. This is understandable because ecosystem services are most valuable where they are most scarce and at risk, ie. lower elevations, coastal zones, higher population densities, etc., (Dobson *et al.,* 2001; Scott *et al.,* 2001). The environmental impact study for the hypothetical resort development identified the impacts of the proposal, and legislation is in place (also hypothetical) to enforce mitigation. The proponent may have a number of alternate courses of action, including:

- Not proceed.
- Mitigate within the same LGA. Mitigation would involve creating equivalent protected habitat on a hectare for hectare basis in perpetuity plus a factor to allow for the time lag. It is not sufficient just to place a level of protection over a land holding from say, freehold land to conservation covenant, as the land was providing ecosystem services anyway and it does not satisfy the 'no net loss' criterion.
- Mitigate elsewhere in the bioregion, either at the *UFpa* for that LGA and applying the appropriate multiplier, or at the least the *UFpa* for the bioregion. The latter option would require habitat creation of 13.5 hectares plus, for every 1 hectare of the site impacted (Figure 13.3).
- Mitigate elsewhere in the bioregion by placing existing habitat under protection using the capitalisation rate and the increased level of provision of ecosystem services, by virtue of the new protection status, to determine the multiplier. For example, by purchasing freehold land and protecting it by way of a conservation covenant the capitalisation rate would drop from 8.25% to 7% and the level of ecosystem services

provision could potentially increase by 18%. This may result in the multiplier being 20 (hectares) rather than 13.5, which may be a better financial proposition than creating new habitat.

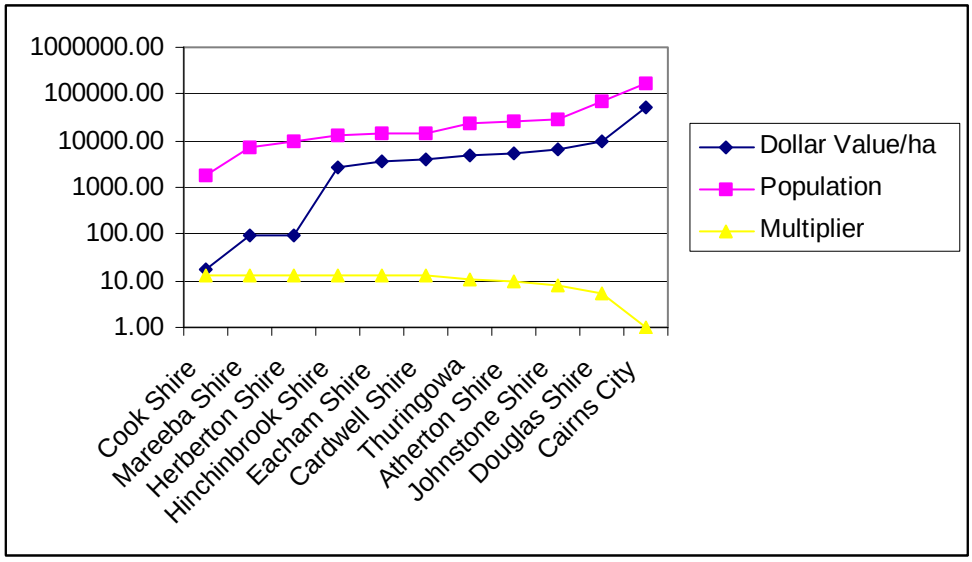


Figure 13.3 Log scale chart showing the exponential relationship between human population density and land values and the multiplier for mitigation of an impact in Cairns City Council (CCC) in other shires in the bioregion. In all shires to the left and including the median, Cardwell Shire, the multiplier is 13.5:1. For Thuringowa it is 10.2:1; in Atherton, 9.8:1; in Johnstone, 8.1:1; in Douglas, 5.2:1 and in CCC 1:1

To look at this from another perspective, the lowest mean UV per hectare in the bioregion was for Cook Shire, which has a very small representation in the Wet Tropics Bioregion, with by far the majority in the Cape York Peninsula Bioregion. Iron Range National Park is comprised of mostly tropical rainforest situated on the east coast of Cape York Peninsula about 550 kilometres north of Cairns. Yet due to the very sparse population, remoteness and lack of infrastructure in the whole of the shire, the 'stand alone' *UFpa* for a National Park in this LGA is just over one dollar (Figure 13.4). Accordingly the methodology requires that irrespective of the individual mean UVs per hectare in the LGAs in a bioregion, the median UV for the whole bioregion in which it has representation should be adopted as the least measure in assessing the value of ecosystem services. To take this line of reasoning a step further, for bioregions which do not have any major population centres, or do not have a representation in an adjoining bioregion which does have a major population centre, or are so vast that the population density and hence property values

are very low, an ad hoc approach may be required using the nearest market comparables for *UFpa.*

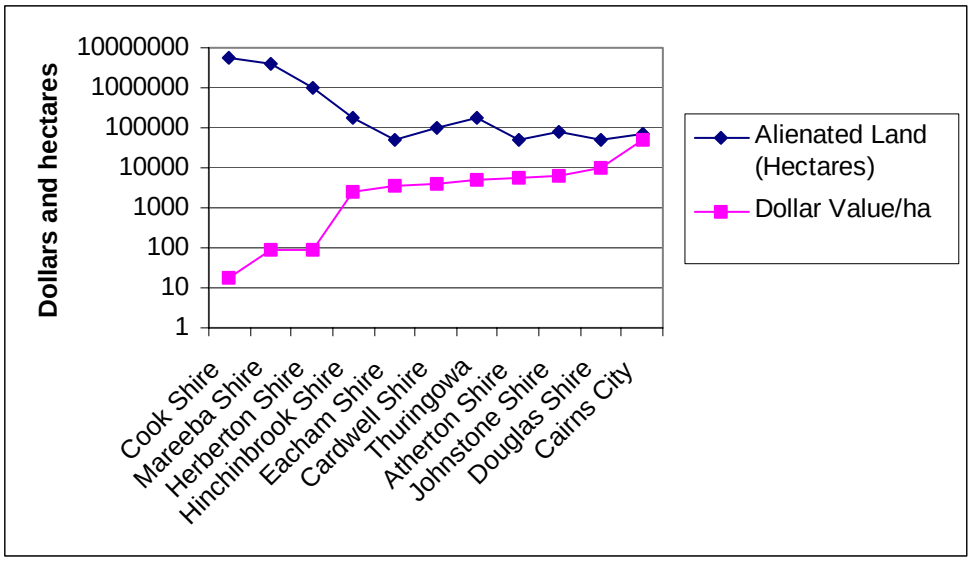


Figure 13.4 Log scale chart showing lowest land values for the shires with the largest overall land area and component of alienated (rateable) land.

Transferability to remote bioregions is thus the major limitation of this study. While the methodology applies very well in populated areas in Australia, mainly coastal regions, but extending well inland in the more populated states, the vastness of inland Australia defies measurement except on a 'whole of Australia' approach. However, it is inconceivable that the level of development in Australia will reach a point where even the most remote regions (Central Australia) will need to be individually valued to provide ecosystem service credits for impact mitigation. Protected areas away from population centres, eg. Uluru, Kakadu and the Kimberleys, can be assessed using a combination of individual assessment using the valuation table, the conceptual models for LOP and LUC, and benefit transfer. These methods will have to be put to the test when the occasion warrants.

In assessing an individual landholding as being worthy of consideration for impact mitigation offset, consideration must be given to its size, shape and the nature of it's boundaries with other landholdings, ie. what is the extent and type of edge effects? (Meffe and Carroll 1997; Turton and Freiburger 1997). Also to be assessed are the vegetation types, the current and past history of

disturbance, and if a conservation covenant is to be entered into with the proprietors, for how much of the land and to what extent will the human activities on the land be modified. A case study of a relatively large private landholding comprising about 90% tropical rainforest in the Bloomfield valley (Cook Shire) is provided in Box 13.1.

General Conclusion 9. Using currency as the measure of value for a credit or debit in ecosystem services in a bioregion or LGA will ensure that trades are comparable and target the specific impact or loss.

13.5.4 The Global Context

On a global scale Bhoutros Bhoutros-Ghali (1995) claims that the challenge is to link the culture of development with effective methods of financing as no ineffective use of resources can be sustained, nor should it create a burden for future generations. Scarce resources need to be leveraged through partnerships. The private sector needs the right incentive frameworks, 'market-based instruments not just regulations', which also require contributions from society. New partnerships need to be forged between national and state/local governments; national and international private sectors; civil society, and international financiers. Sustainable development can no longer depend on Governments alone or on resources from 'traditional donors' (Mathews 1995; Mazula 1995; Serageldin and Sfeir-Younis 1995). Serageldin (1995:11) proposed three elements to successful financing of environmentally sustainable development:

1. increase the level of finance to move to more sustainable patterns of development by mobilising domestic savings; better macro-economic management; less distorted markets; more efficient domestic financial markets, and foreign assistance where appropriate;
2. changing patterns of existing finance, eg. taxation. The purpose to change behaviour, not just to raise more revenue. Individuals and enterprises should be encouraged to act more responsibly towards the environment through clear tax signals; and,

Box 13.1. Case study of Wyalla Plains for impact mitigation offset assessment.

Description
Wyalla Plains is located at the foot of Mount McMillan in the Finlayson Range. The holding extends from sea-level mangrove communities, through some naturally regenerated rainforest, crossing the Bloomfield/Rossville Road adjacent to the airstrip, and then to an elevation of about 600 metes, where it borders Timber Reserve R165, which also approximates the boundary of the WTWHA. The land comprises approximately 1020 hectares, 900 of which are tropical rainforest. There is a cleared level grassed plain of 100 hectares (for about 100 years), and 20 hectares is devoted to tropical fruit orchards, botanical gardens and house sites. The boundaries of the land are in the most part natural forest, with the exception of the boundary with the airstrip, and internal boundaries with the road that passes through the landholding and with the grassed plain.

History
The now grassed plain has been used variously over the last 100 years for cattle grazing and some farming of sugar cane, corn and tobacco. The forested areas were selectively logged for most of the period, the most intensive being about 30 to 40 years ago. The current proprietors continue to selectively log for their own use and mill the timber on site. The tropical fruit orchards are commercial in scope with most fruits exotic, eg. purple mangosteen. A minor mining operation occupies a small area supplying decomposed granite for internal roads and the adjacent airstrip. The current proprietors bought the land in 1973 and since then there has been no Aboriginal burning. In many areas evidence of rainforest regeneration can be seen, with advanced rainforest species (dbh > 0.5m) alongside sclerophyll emergents. Apart from using parts of the property for their own housing and income earning purposes, the proprietors are conservationists, using solar and micro-hydro energy generation sources for domestic lighting and appliances.

Human Impacts
Apart from the past clearing, burning, and land uses, continued impacts on the land are limited to small scale selective logging, exotic trees and shrubs, although these are limited to controlled areas, and domestic animals. Feral pigs are trapped and hunted using dogs. One permanent stream and several ephemeral creeks run through the property and these are unaltered. Some ecosystem goods and services may have been impacted by human activities eg. biodiversity, while others continue to function normally.

Property Management Plan
In order for the landholding to be considered for impact mitigation assessment, either the whole landholding or the 900 hectares of tropical rainforest would need to be placed under a conservation covenant that would prohibit selective logging and any further incursion or planting of exotics. Capitalisation rates that apply to that level of protection would be used to calculate the *UFpa.*

Valuation Table
A valuation table was completed (Table 13.3). The value of ecosystem services provision on the most disturbed 120ha of the holding was calculated to be \$73.72 $ha^{-1}yr^{-1}$, and for the 900 hectares of forest, \$189.26 $ha^{-1}yr^{-1}$. For the purpose of impact mitigation assessment, Wyalla Plains placed under a conservation covenant would have a net annual value of, say, \$179,000, or \$170,000 for the 900 hectares of forested areas alone. This annual income would provide a reasonable return for the proprietors as compensation for the lost opportunity of logging the land, clearing and increasing agricultural production, or subdividing the land and selling rural housing sites or hobby farms, as has occurred all over Australia, including the Daintree.

Table 13.3 ValuationTable for Wyalla Plains, Bloomfield

TENURE CATEGORY OR PROPERTY DESCRIPTION: ~ Freehold Property with Conservation Covenant

The median unimproved value in the Wet Tropics Bioregion: $3,810.02 per hectare **Date of valuation: 30/6/02**

Group and Type of	Not Present		Type of	Present	*UFpa*	% Intact	% Intact	Weighting	Value per ha	Value per ha	TOTAL VALUE	TOTAL VALUE
Ecosystem Service	Temporary	Permanent	Disturbance		7.50%	120 ha	900 ha		120ha	900ha	120ha	900ha
Stabilisation Services												
Gas regulation				Yes	$ 285.75	40	68	0.069	$ 7.89	$ 13.41	**$ 946.41**	**$ 12,066.71**
Climate regulation				Yes	$ 285.75	40	68	0.068	$ 7.77	$ 13.21	**$ 932.69**	**$ 11,891.83**
Disturbance regulation				Yes	$ 285.75	40	68	0.055	$ 6.29	$ 10.69	**$ 754.38**	**$ 9,618.40**
Water regulation				Yes	$ 285.75	40	68	0.011	$ 1.26	$ 2.14	**$ 150.88**	**$ 1,923.68**
Erosion control				Yes	$ 285.75	40	68	0.073	$ 8.34	$ 14.18	**$ 1,001.27**	**$ 12,766.23**
Biological control				Yes	$ 285.75	10	68	0.063	$ 1.80	$ 12.24	**$ 216.03**	**$ 11,017.43**
Refugia		Yes	Clearing	Yes	$ 285.75	0	68	0.086	$ -	$ 16.71	**$ -**	**$ 15,039.67**
Regeneration Services												
Soil formation				Yes	$ 285.75	40	68	0.010	$ 1.14	$ 1.94	**$ 137.16**	**$ 1,748.80**
Nutrient cycling and storage				Yes	$ 285.75	40	68	0.039	$ 4.46	$ 7.58	**$ 534.93**	**$ 6,820.32**
Assimilation of waste				Yes	$ 285.75	40	68	0.051	$ 5.83	$ 9.91	**$ 699.52**	**$ 8,918.88**
Purification				Yes	$ 285.75	40	68	0.058	$ 6.63	$ 11.27	**$ 795.53**	**$ 10,143.04**
Pollination				Yes	$ 285.75	10	68	0.036	$ 1.03	$ 7.00	**$ 123.44**	**$ 6,295.68**
Biodiversity				Yes	$ 285.75	10	68	0.099	$ 2.83	$ 19.24	**$ 339.47**	**$ 17,313.11**
Production of Goods												
Water supply (catchment)				Yes	$ 285.75	40	68	0.043	$ 4.91	$ 8.36	**$ 589.79**	**$ 7,519.84**
Food production				Yes	$ 285.75	10	68	0.024	$ 0.69	$ 4.66	**$ 82.30**	**$ 4,197.12**
Raw materials				Yes	$ 285.75	10	68	0.029	$ 0.83	$ 5.64	**$ 99.44**	**$ 5,071.52**
Genetic resources				Yes	$ 285.75	10	68	0.073	$ 2.09	$ 14.18	**$ 250.32**	**$ 12,766.23**
Life Fulfilling Services												
Recreation opportunities		Yes	Freehold	Yes	$ 285.75	0	0	0.025	$ -	$ -	**$ -**	**$ -**
Aesthetic, cultural and spiritual				Yes	$ 285.75	40	68	0.054	$ 6.17	$ 10.49	**$ 740.67**	**$ 9,443.52**
Other non-use values				Yes	$ 285.75	40	68	0.033	$ 3.77	$ 6.41	**$ 452.63**	**$ 5,771.04**
									$ 73.72	**$ 189.26**	**$ 8,846.87**	**$ 170,333.04**

Note: Provision of ecosystem services for the most disturbed portion of the holding (120 hectares) is the same as the conceptual model for grasslands.
The forested area (900 ha) has been calculated on the basis of 180 ha (20%) at 40% provision (due to edge effects), and 720 ha at 75% provision
(the mean of the upper and lower limits for timber reserves), ie. 68% overall.

3. reduce the need for additional finance through cost effectiveness. Involve the private sector, households, farmers, corporations to decide how best to reduce environmental damage. Have lots of market-based instruments, tradable permits; deposit refund schemes; performance bonds; effluent charges, etc.

Yet Al Gore's (1995:30) statement that was presented to the Delphi panellists for a true or false response in round 3, namely:

"…the single best opportunity to make sustainable development happen is to make investments in sustainable practices and technologies attractive to private business and private investment",

elicited only a 68% true response, with environmental and ecological economists the lowest, and possibly the most conservative of the group of disciplines, the geographers voting 100% for true. This was a truly surprising result. Thinking laterally, could this result be due to environmental and ecological economists being more disposed to government now in their ascendency amongst disciplines, while geographers languish bereft of funding? Whatever the reason, it flies in the face of current thinking around the world with private sector money flows to developing countries some three times official aid (El-Ashry 1995; Serageldin and Sfeir-Younis 1995). Willis (1995:54) argues that:

"…good economics can help achieve ecologically sustainable outcomes by promoting more efficient use of resources". And "…state-owned monopolies traditionally have little incentive to use resources efficiently, hence establishment of competitive markets for utilities should better match prices to cost, reduce prices overall, and improve overall efficiency".

The following statement by Willis (1995:54) was also put to the Delphi panel for a true/false response:

"…rational pricing structures can be far more effective tools to help the environment than subsidies and regulations",

and the response was not really surprising with a group response of 68% true with all disciplines above 60% for true. This type of unconvincing response harks back to the problems of Adam Smith's 'invisible hand' proposition wherein he claimed markets would guide individual behaviour to the common good, yet one of the central assumptions in neo-classical economics is that people will make decisions as individuals based upon self-interest.

Dowdeswell (1995:67) says that ESD is fundamentally about changing our behaviour and like Serageldin (1995), proposed three things to do:

1. re-deploy and make more efficient use of existing resources by eliminating wasteful activities and encouraging more environmentally sound behaviour;
2. secure additional revenues using existing mechanisms (pricing utilities and public services; increased taxation of resource exploitation; reform of property taxes; removal of perverse subsidies); and
3. forge innovative partnerships with private sector (carbon offsets; tradeable emission permits; biodiversity prospecting; taxes on non-renewables, on speculative currency transactions, on conventional arms transfers, on international lotteries; etc.).

The World Conservation Union publish guidelines for financing protected areas (IUCN 2000), which explore the possibilities exhaustively, including international sources of funding, national level mechanisms and site level mechanisms. However, very few if any of these can be adapted to conservation on private land, other than the broad spectrum of philanthropy.

Perhaps the best recent example of financing environmental services on both public and private land is the Costa Rican experience. Costa Rica's forest cover decreased from more than 50% in 1950 to 29% in 1986, and thence reduced overall by 1.1% per year, with a much lower rate for the areas under protection by 1997. Secondary forest including plantation forest covers about three quarters of the deforested area (Chomitz *et al.,* 1998). Economic values were estimated by Kishor and Constantino in 1993 for some use and non-use services at US$162 to US$214 $ha^{-1}yr^{-1}$, the majority ascribed to carbon sequestration (US$120) (Chomitz *et al.,* 1998). In 1996, Costa Rica passed a new forestry law that permitted landholders to be compensated for providing some environmental services. The law (no. 7575) 'explicitly recognised four environmental services of forests', carbon fixation, hydrological services, biodiversity protection, and provision of scenic beauty. Implementing rules for the new law were adopted in 1997. A unique set of institutional arrangements was being put in place contemporaneously to enable the creation of markets for the forest's environmental services. Some of these novel arrangements

revolved around the joint implementation (JI) and clean development mechanism (CDM) provisions under the Kyoto Protocol (Chomitz *et al.,* 1998). There is no link between the provision of services and financing as the government acts as an intermediary to sell the services, and the funds realised are used to finance the services, including those provided by national parks and other public land. Payments to landholders under the program currently reimburse them for four types of actions over a 5 year period, after which time they are free to renegotiate or deal direct, however they commit to manage or protect the forest for 20 years, which is recorded on the public land register (Table 13.4).

Table 13.4 Payment schedule to landholders for conservation contracts in Costa Rica (Source: Modified after Chomitz *et al.,* 1998).

Activity	Min Area (ha)	Max Area (ha)	Total Payment US$ ha^{-1} over 5 years	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
Reforestation	1	any	$480	$240	$96	$72	$48	$24
Natural forest Management	2	300	$321	$161	$64	$32	$32	$32
Regeneration	2	300	$200	$40	$40	$40	$40	$40
Protection	2	300	$200	$40	$40	$40	$40	$40

Notes: Reforestation by organisations of small producers is limited to a maximum area of 10 hectares. Exchange rate approx $250 colones/US$1, March 1998.

Chomitz *et al.,* (1998:7) comment on the pricing structure as follows:

- 'reforestation' incentives appear generous as 'reforestation' appears to be more financially viable than pastures. High discount rates and risk aversion among small landholders may discourage plantation forestry;
- 'natural forest management' incentives appear too low to discourage clear felling, yet the new foresty law prohibits forest conversion and requires all production forests to be placed under a management plan. Yet 'natural forest management' is higher than 'protection' as the up-front cost of preparation of a management plan is higher than for 'protection'; and 'natural forest management' offers higher revenue but probably less benefits;
- 'protection' may appeal to landholders whose forested land is unsuited for conversion or management;
- the incentive price for 'regeneration' is about the same order of magnitude as the rental price for pasture.

At the start of the program earlier incentive programs already covered 145,000 hectares. In 1997, a further 79,000 ha were placed under forest protection, 10,000 ha under forest management, and 6,500 ha was destined for reforestation, for a gross payment to landholders of US$14 million. In 1998, the waiting list, or excess demand was estimated to be to the order of 70,000 ha (Chomitz *et al.,* 1998).

Leveraging private investment through partnerships based on commercial criteria that are founded on increased ecological sustainability can bring about a rural and regional renewal in Australia. Government policies will need to be adopted that address significant market and institutional failure, along with strong leadership to mobilise nation-wide action to stimulate investment in more sustainable practices. The Allen Consulting Group (2001) estimate that with strong leadership and supporting expenditure of about AUD$3.6 billion over ten years from the Australian government, the private sector could be encouraged to invest more than AUD$12.7 billion in the same period (a multiplier of 3.48). Henry and Olson reviewed grants to voluntary conservation organisations in 1992 and reported that the multiplier of 3.22 attributed to the Australian Commonwealth Government grants to the program, was ‘possibly’ an underestimate due to the spin-off benefits of raised community awareness and understanding of environmental and heritage issues (Young *et al.,* 1996).

General Conclusion 10. Government has to be a leader in order to maximise private sector involvement and leverage investment in best practice environmental management.

Chapter 14

Conclusion

14.1 Introduction

This chapter will present the general conclusions and more specific conclusions reached in the course of the research and discussion. Limitations of the research will be discussed, along with recommendations for further work in order to make the approach more widely acceptable to community, mainstream practitioners and government. Recommendations will also be made to policy and decision-makers for inclusion of environmental valuation as a prerequisite in any project, proposal or policy that may impact on the environment and society.

The Elsevier Science Journal 'Ecological Economics' describes the integration of economics and ecology as necessary due to 'conceptual and professional isolation' which has 'led to economic and environmental policies which are mutually destructive rather than reinforcing in the long term.' The journal describes itself as 'transdisciplinary in spirit and methodologically open', and invites contributions for research into, 'natural resource valuation, critical assessments of the basic assumptions underlying current economic and ecological paradigms and the implications of alternative assumptions, and alternative principles for valuing natural wealth' (Chapter 3). It is in the spirit of this invitation that the author embarked on a journey of discovery of the empirical value of ecosystem goods and services. This thesis challenges many established paradigms in economics, yet conforms to others and to the theory of valuation. It uses established procedures in systems analysis and social research and applies them to a problem in a way that has not been done before. In these ways, the thesis is both multidisciplinary and interdisciplinary. There are four original contributions to knowledge in this thesis, namely:

1. The use of the property market in a bioregion to establish median unimproved values and acceptance of the provision of ecosystem

services as being the 'highest and best use' of land (the *Usus Fructus per annum);*

2. The combination of a multiple criteria analysis and a Delphi Inquiry to gain consensus as to the relative non-pecuniary weightings of individual ecosystem goods and services;
3. The development of a conceptual model for the level of provision of ecosystem services using species richness, vegetation cover, and either the level of protection or land use characteristic;
4. The development of a valuation table to assess the natural production function of the land in dollar terms.

Included in the extended definition of *usufruct* attributed to Simpson and Weiner (Oxford Dictionary 1989) in Chapter 4 was a reference to Marsh (1864:35) 'Man in Nature', wherein he stated:

"Man has too long forgotten that the earth was given to him for usufruct alone, not for consumption".

Usufruct is a fine word and a fine definition of economic, environmental and ecological sustainability, yet it has all but disappeared from the literature. Most people have also never heard of ESD, and if they had they would probably curse the proliferation of acronyms in society rather than wonder what it meant. In truth ESD has had a revival in the last 15 years with industry finally getting on the bandwagon and mouthing empty platitudes in the interest of their corporate image, thinking all the time that the E in ESD stood for economic. If it were not so serious it would be laughable. In the English-speaking world the term *usufruct* was in common use for centuries with tenants holding *usufructuary* rights over land that provided them with life-support. Since colonialism, the term was used to describe certain rights of indigenous people to the land they occupied. *Usufruct* is used in this thesis in the context of its original meaning, 'use of the fruit of the land', but conceptually extended to include all of the goods and services, and in this sense the *usufruct* is the production function of the land. As the planetary life-support functions provided by ecosystems are the 'highest and best use' of land, land in its natural state or land conserved for this use must be worth as least as much as the median value for all other uses to which the land could

be put. Hence the unimproved capital value of land in a bioregion or an LGA is a logical surrogate for the capital value of land that hosts ecosystem services. The *usus fructus per annum* is the capitalised annual value of these services.

14.2 General Conclusions

The general conclusions presented in Chapter 13 were as follows:

1. Humans are more certain about the value of ecosystem services that provide real benefits than they are about those that provide psychological benefits.
2. There is still a lack of confidence in past methods used to value the environment.
3. The use of unimproved land values provided by state agencies as a baseline for estimating the value of natural resources has wide acceptance in Australia and overseas.
4. The value of a fully intact suite of ecosystem goods and services is 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.
5. Values of ecosystem services in a bioregion will increase proportionate to the human population density.
6. Applying a discount rate to the current value of ecosystem services is counter-intuitive to the concept of intergenerational equity.
7. Linking ecosystem services to the estate in fee simple of the land that hosts them assures that property rights are assigned.
8. Capitalisation of the *Usus Fructus* of the land component managed for remnant vegetation at an appropriate rate will ensure that land values do not fall.
9. Using currency as the measure of value for a credit or debit in ecosystem services in a bioregion or LGA will ensure that trades are comparable and target the specific impact or loss.
10. Government has to be a leader in order to maximise private sector involvement and leverage investment in best practice environmental management.

14.3 Specific Conclusions

The primary aim of the project was to develop a new or modified approach to the economic conundrum of valuing non-market (unpriced) goods. This has been achieved by the use of the broader property market as a surrogate market, and in the process the first proposed outcome was also realised, namely: *"Improved understanding of the costs and benefits of ecological systems in the provision of a range of services, along with recognition of the need for sound environmental practice appropriate to enhance services and minimise disservices".*

The specific conclusions emanating from this research are as follows:

Specific Conclusion 1. The median unimproved capital value of all rateable land in a bioregion or LGA is an appropriate surrogate for the capital value of other non-rateable land in the bioregion or LGA.

Specific Conclusion 2. The *usus fructus per annum* or natural production function of land (ie. ecosystem services) can be derived by capitalisation of the median unimproved capital value in a bioregion or LGA.

Specific Conclusion 3. By virtue of the process of exploring the potential for, and act of valuing ecosystem services, societal understanding of the costs and benefits of ecological systems in the provision of a range of services has increased.

Specific Conclusion 4. The combination of revealed preferences in a surrogate market as the empirical baseline for the whole suite of ecosystem services in a bioregion or LGA, and the expressed preferences of a group of experts as to the importance of each individual good or service (as well as the values being within the accepted order of magnitude for ecosystem services), provides the theoretical and practical justification for the technique to be acceptable as a means of establishing opening prices in a future trading market.

The second proposed outcome, namely: *"An appraisal technique developed to establish an opening price for ecosystem services in a future trading market",* was realised by way of the combination of a Delphi Inquiry with a multiple criteria analysis to arrive at the non-pecuniary weightings of individual ecosystem goods and services, which along with the conceptual models and the valuation table were able to be converted to dollar values for the individual ecosystem goods and services constrained within the overall value for the whole suite of ecosystem goods and services.

The final proposed outcome, viz: "*acceptance of these techniques by mainstream practitioners, producers, consumers and financiers"*, cannot be determined at the time of writing this thesis. Although the information has been disseminated to a degree by a number of conference presentations and a dedicated web-site, it has still to be formally published. Possible barriers to wide acceptance are discussed further in the 14.4 (Limitations of the Research) and 14.5 (Recommendations for Further Work) below. Avenues for Future Research are proposed in 14.6.

14.4 Limitations of the Research

The main limitation of the research is the lack of practical application as yet under a variety of different scenarios. This is only to be expected as the technique is new. Two examples of application are discussed in Chapter 13, however there are many others, and as a valuer does, each individual situation must to be approached according to the peculiar circumstances surrounding it, and every investigation must be made of all matters pertinent. The empirical foundation for the technique is beyond challenge, although the figures change, as population density increases so do property values. The cost of money varies, sometimes being so high in times of inflation that it may hinder conservation. Right now conservation is affordable. In the example given in Chapter 13 of an hypothetical resort development in Cairns City LGA, the impost of mitigation of the impacts may result in the project not being financially viable and not proceeding, and this is as it should be. The costs to society of the loss of planetary support functions cannot go uncompensated. Unfortunately at the time of this writing they still are. The second example of a

privately held freehold property located adjacent to the WTWHA and within the bioregion, satisfies all of the criteria of a property at risk and worthy of conservation, as do many others in the bioregion. However, the extent of public land under protection in the WTWHA that could be structured as conservation or mitigation banks, thus resolving ongoing funding uncertainties of the management authority, is likely to preclude the private sector from capitalising on this opportunity in the short term. Of course a more liberal view would have management of existing protected areas fully funded from economic activity associated with tourism, leaving impact mitigation solely relying on bringing more 'at risk' ecosystems under protection.

A second limitation of the research may be the currency of the weightings ascribed by the Delphi panel to the ecosystem attributes. A different group of experts at a different time may rank them differently, although there is quite considerable logic behind the final weights. Suffice to say these are the most recent findings as to how a group of experts from overlapping disciplines view the importance of the suite of 20 ecosystem attributes. The relevance of this Delphi panel's findings as to the weightings for individual ecosystem services cannot be overstated, particularly when the rigour with which the true/false responses and text answers to the questions and statements in the Delphi rounds were addressed is considered, and the many insights that emanated from them (Chapter 8 and Appendices E, F, G and H).

14.5 Recommendations

The technique should be applied to other bioregions or LGAs including major cities such as Brisbane and Sydney, and many more scenarios such as public works, ie. dams, transmission corridors etc., and a range of private developments in urban and rural Australia. Only in this way will knowledge grow of the merit, comparability and transferability of the method. 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 goods and 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. This was a key prerequisite in Sheahan's (2001) report on conservation banking and mitigation banking in the USA and its applicability to NSW. The same applies for environmental pollution, damage and degradation with legal liability apparent. Legislation is required to be enacted in a similar vein as CERCLA in the USA (Chapter 13), 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.

14.6 Avenues for Future Research

The political reality in Australia is that more attention is still paid to economic and social benefits emanating from development and intensive land uses, than to managing the landscape for long-term sustainability. The community needs to be engaged to capitalise on existing knowledge of ecological constraints on development. Information such as how much, what types, and the size, shape and linkages between landscapes is needed to ensure ongoing ecosystem health and maintenance of natural capital. This information can best be assessed and utilised on a bioregional basis, with due consideration given to the population density of the bioregion and the supply of and demand for ecosystem goods and services. A plausible future can only be envisaged for Australia if a scientifically rational mix of landscapes is spread across the entire continent, with locally essential or desirable ecosystem goods and services available locally, including in cities. Less essential ecosystem goods and services can be provided on a 'whole of Australia' basis, provided that the ecological budget for Australia is in balance. A community perspective of what an ecologically sustainable landscape should look like in 10 to 100 years is required to mobilise incentives for future change.

The primary aim of any future research proposals would be to refine and extend work done so far in this PhD thesis, and incorporate other work on the biophysical processes operating on a range of scales, such that economic incentives can be accommodated to achieve a 'no net loss' scenario.

Some appropriate aims and outcomes would be:

- To determine the relative juxtaposition of ecological, social, cultural and economic values in the Australian landscape and the concurrent importance weighting of these typologies, such that argument may be developed to overcome current political will.
- To finesse currently developed land economic tools in order to assess the value of ecosystem goods and services provided by public land (parks, reserves, waterways, and land under public utilities) in each bioregion on the east coast of Australia.
- To extend these values to determine the contribution of ecosystem goods and services by other tenures in each bioregion (case studies focussed on the most common land uses, eg. urban precincts, cropping etc.).
- To link values of ecosystem goods and services across local government and bioregional borders by the use of multipliers based on the population density of the region, the median unimproved land value and the *Usus Fructus per annum.*
- To attempt to determine the extent to which ecological services provided in each bioregion on the east coast of Australia are satisfying local demand, as a subset of the ecological budget for the whole of Australia, yet to be determined.