WATER: AN 'ECO-CURRENCY'

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Abstract

There is evidence of long-term community scepticism regarding the ability of environmental policies to decrease social inequities or to increase ecosystem wealth. This paper posits that the community is seeking new forms of accountability that credibly and transparently describe the consequences of activities by both government and business. This paper also proposes that 'water', once considered by economists as a Free Good, should be the basic valuation criterion for the eco-system as it is the basis of life. The fundament of this position paper is the creation of water, an objective environmental valuation criterion by which generally accepted scientifically sustainability methods can be measured and replicated. This proposal is made possible through modern technology through which it is that unprecedented opportunities are created for corporate and social governance, with scientifically based practices that can be monitored.

Keywords

free good, economics, money, triple bottom line, value water, wetlands.

1. Introduction

Triple Bottom Line [TBL - a term used synonymously with GRI, citizenship reporting, social reporting, reporting and other terms that encompass the economic, environmental, and social aspects of an organisation's performance] is a burgeoning method of comparing social, economic and environmental impacts [costs and benefits] associated with the spectrum of human activities ranging from development proposals through to day-to-day activities [Global Reporting, 1999]. Over the past two decades authors [e.g. Hamilton 1994 and Lomborg 2001] have raised concerns regarding the application of environmental values to the decision making process and associated interpretations. Because of the lack of an accepted relationship between economic, environmental and community values, TBL's acceptance has been hindered by inconsistent and non-scientific environmental reporting. Of these three parameters economic assessment is the most advanced and accepted, benefiting from more than a hundred years of theoretical development in the form of 'Monetary Economics'. Similarly, sociological evaluation has a developing theoretical model for the past half century, albeit still coming to terms with changing 'held' values [Brown, 1966], ethics and 'green morality'. Weakest within the TBL equation is the assessment and continued monitoring of environmental values. During the 1960s the concept of energy was posited as a consistent and meaningful measure, but with the advent of the conflict in assessing nuclear *vs* solar power this method of measure lost favour by the 1990s [e.g. Tiezzi *et al*, 1991].

For more than a century economists have asserted that water had zero 'economic' value [e.g. Adam Smith, 1776] classifying it as a 'free good' albeit 'Water', in its variety of forms, is a critical element of life (all life forms would not have been on Earth without it) and it also has an essential use value critical to human endeavours. Further, water has a distinct 'held' value by providing aesthetics within the global landscape covering more than 75% of the planet's surface. Even though 97% of planet earth is covered by water, 71% Oceans and 26% in wetlands, rivers and lakes [http://www.tesag.jcu.edu.au/] these resources are finite.

Recognition that non-oceanic water has real economic value is reinforced by governments legislating to control this resource where an economic good is dichotomous to the notion of a Free Good. An extension of these government actions is that water does have value in its own right, as well as providing value to other natural elements [e.g. Brennan and Watson, 2000].

Unmined or un-won alluvial gold is void of value, but once processed it enters the sphere of production it assumes value both as a good and as a currency for exchange purposes. Similarly, atmospheric moisture is not attributed value until it precipitates and enters the earth's ecosystem where upon water is assigned an economic value when the supply is utilised in production, whether for domestic, irrigation or processing purposes. Accordingly water can be employed as a currency in the same manner as gold, paper, or plastic transactions. Moreover, water can be utilised as a measure of environmental change – spatial or locational – allowing the development of an ecosystem index, in a similar manner as different money values are used as an international exchange rate index.

Water has the necessary attributes to provide a means of exchange, a measure of value and an index of change. Succinctly, it is asserted that the quality and quantity attributes of water can be use as a currency for facilitating Triple Bottom Line [TBL] environmental assessment, – i.e. provision of a 'common denominator' for valuation assessment whether at micro or macro levels. From these propositions, this position paper presents an alternative perspective to the long held notion that water is a free good, i.e, that it is valueless; it puts the position that environmental value determination should be able to parallel the basic theories developed for the money economy.

2. A Comprehension of 'Water'

Governments are regulating the collection of precipitation/rain run-off into dams, extraction from rivers, application rates for specific uses such as irrigation, putting monetary values on water licences and how water can be returned to the broader environment. However, within current legislative frameworks there is no direct reference to the scientific composition of this product i.e. chemical composition such as dihydrogen monoxide, 'distilled water', or H_2O. Either by implication or ignorance, legislative process adopts the term 'water' to mean a generally accepted, albeit an undefined mix of substances contained in solution suitable for human consumption. Adding to the confusion is the array of nomenclatures such as 'rainwater' and 'seawater', yet neither of the classifications are homogeneous products in its own right. To illustrate, 'rainwater' may contain various levels of acidity ['acid rain'] while seawater varies in salt concentrations from one part of the planet to the other [e.g. Pacific Ocean *vs* Dead Sea].

Similarly, the 'clean' water delivered by government controlled reticulation schemes is a mixture of substances that may include fluoride, chlorine and micro-organisms – attributes considered superior in quality to an alternative mix that is collected into a domestic water tank connected to household roof collecting natural precipitation ['tank-water']. In terms of 'positive economic' values each of these potable water mixtures are considered superior to the mixtures discharged from non-potable 'grey' and 'black' water-sources. From the foregoing it is deduced that water:

- is a scarce resource requiring government intervention – it can no longer be considered a free good in the neo-classical economic meaning;
- can be value-ranked based on solids and living matter held in solution; and
- has direct economic value as regulatory authorities utilise these differentiation of values for monetary purposes whether it be cost recovery or imposition of penalties [e.g. NSW Load Based Licensing].

Generalising each of the above instances, direct or indirect monetary values can be placed on these various water mixes, this value being dependent on a function of human use, which is a function of the environmental import and export points.

3. Water Homogeneity

Science confirms that the composition of substances contained in 'water' at a specific location varies with water depth, exposure to sunlight, temperature, the influence of surrounding vegetation, impacts of adjacent land use, season, and a vast array of other physical factors. Regrettably, governments regulate on an underlying assumption that water is a universally homogeneous substance that notionally approaches unspecified qualities in order to be deemed as having positive economic and/or environmental values.

Ignorance of or evasion for ecological requirements for water to assume a variety of attributes distorts the underpinning philosophy to government policy and its implementation of environmental policy. Anecdotal observations suggest serious distortion of value allocation - with highest values being attributed to so-called pristine water [specific mixes] while water with high substance concentrations [e.g. grey and black water] have low or negative value. These value allocations are human-use based and are contradictory ecosystem functionality where a range of water mixes [qualities] are required to support a vast array of life forms. To illustrate work by Burgin shows that some species of eels require turbid slow-moving water while other fish species require clear fast-running water

Accordingly it is incorrect for water values to be assessed exclusively on human requirement criteria. To illustrate – New South Wales [NSW] government policy requires that only 'clean' water from urban developments can enter a wetland. This policy results in wetlands being subjected to a disproportionate amount of nutrient deficient water, causing long-term changes to vegetation types, invertebrate colonies and macro-fauna compositions. Further, Brennan and Dingsdag [1999] report that State Environmental Planning Policy No 14 [SEPP14], designed to protect the State's coastal wetlands has caused artificial changes and diminution of natural values. In other instances the inappropriate creation of recreational aquatic features can be responsible salination of contiguous lands [*pers. com.* R. A. Patterson, 2003]. In more recent times the subject of water has become so politicised that community distortion and disinformation is being generated. To illustrate, a recent television documentary showed images of Dr Tim Flannery in a helicopter over the mouth of the Murray River advocating the need for a constant outflow, albeit this situation never occurred in the natural state is contrary to the recommendations of scientists who forecast deleterious impacts if this aspect of the Living Murray Program proceeds [ABC, July 2003].

Collectively the above overview illustrates that water has economic and environmental values, as well as influencing values of other natural resources, although these values may be either positive or negative. Accordingly, there are immediate incentives to abandon politically motivated 'populist environmentalism' decision-making processes to adoption of holistic and scientifically methods which objectively assess [a] resources to be developed, [b] intensity development, [c] cumulative impacts to be addressed and [d] interpretation of ongoing monitoring. The scientific analysis and statistical assessment of water fulfils each of these criteria. Water accommodates scientific requirements in terms of measurement, experimentation and replication and can be conducted in a manner that parallels the criteria of monetary economics. For these reasons water provides the means of facilitating the scientific examination in place of current unsubstantiated and at times emotive statements that presently dominate much political and community discussion.

4. Conformity of Water Valuation to Classical Monetary Theory

Historically, monetary value and exchange relied on coins being made from gold or alloys (as well as debased metals) and legal tender paper money being guaranteed by gold and for some period in the 20th Century by the 'Gold Standard'. However with sophistication this requirement progressively gave way to no money exchange but relying on magnetic strips on plastic cards and more recently, 'Smart Cards' and other forms of electronic exchange. Monetary theory has also progressively developed over two centuries to include futures exchanges, stocks and shares, appreciation/depreciation, superannuation, etc none of which require legal tender for exchange purposes. Money exists because it contains transactionary confidence as a medium of exchange and value. One of the attributes of currency is to represent a notional value, which itself changes even daily in level (for example the Australian dollar is traded as a commodity in money markets in which it is bought and sold at varying prices). Within this framework of theory and practice, the attributes of money are expressed in a variety of ways including, capital, income, interest and expenditure; suggesting that any medium used for environmental valuation could also contain a variety of interpretation of value.

5. Eco-Currency

Conceptually, the notion of an eco-currency is neither unrealistic nor fanciful. Table 1 contains a basic comparison of traditional monetary theory with the proposed Eco-currency, indicating that the established monetary theories can be adopted to fulfil a new need, albeit becoming irrelevant in the modern paperless economy.

Table 1: A Simple Comparison of the Monetary System and Eco-Currency

Criteria	Money	Eco-Currency
Legal Tender	Gold standard – based on weight Gold Index – based on weight Gold measured in carats	Water – based on volume, weight, mass Water measured in living support systems
Interest	Return to capital – usually in terms of % return Normally related to risk regarding the return of capital and interest payments – low risk low return	% Change in quantity or variety of living organisms supported and how these relate to risk and health Improved environmental outcomes, including the reduction of risk to flora, fauna and micro-organisms
Capital	Monies used in store for the purpose of security or investment potential	Storage in soils and other natural environments Risk management – drought proofing Potential resource for return – ie water consumption
Trading	Stock Market Futures Market	Water licence trading Carbon Credit type scheme Transfer of Development Rights – move demand from Sydney to other less risk prone areas
Taxation	Direct Indirect	Licences to use, reuse or dispose of water within the ecosystem Monitoring activities and correction requirements

Underpinning Table 1 is the application of traditional monetary theory including that, in the short-term, the supply of money was fixed, with variations to availability being determined by a number of human controlled factors. Similarly, water supply is fixed (all natural resources are finite - as illustrated by the water cycle), but, has the capacity to measure changes in the supply at a particular time and space – i.e. dams relocate water from one use to another, with associated opportunity costs [loss of free flowing rivers], returns to capital [drought proofing] and depreciation [alteration to adjoining land uses].

As noted above, water is not a homogeneous product, but neither is money, there being a real and well defined hierarchy of national currencies – the international exchange rate; there are strong currencies [e.g. US dollar, English Sterling, and Euro] and weak currencies [e.g. various South American countries, Bangladesh, and Fiji], each functioning within its own environment fulfilling the critical role of facilitating exchange of value. What money is to the economy, water is to the environment each being a common dominator that becomes 'stronger' with good eco-systems and 'weaker' in degraded eco-systems.

Figure 1 below illustrates the sources, use and outsource of water within a terrestrial catchment area. In each instance the quantity, quality and changes of water quality can be scientifically measured and the relationships expressed as mathematical functions. From these measurements and application of mathematic formulae, estimates of eco-values can be calculated. Furthermore, each of the functions can be presented as totals or measurement of change, which together can be used to derive sensitivity analysis. In a similar manner the analysis can be extended to include areas contiguous to or required to support the area under investigation.

Figure 1 depictions are represented below by a selection of mathematical functions to illustrate the basis for calculating the statistical and mathematical models. These equations are based on a litre of water as Eco-currency [i.e. the gold standard principle of a constant value]. Variation of the value arises from the impact of the use on the quality of the water as well as the addition or removal of water from the ecosystem – Table 2.

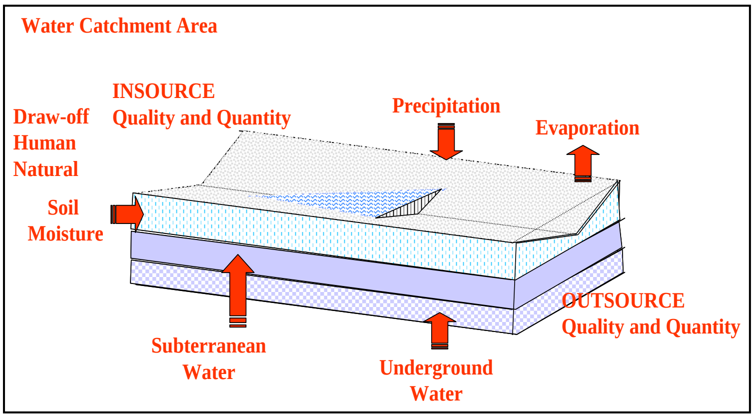

Figure 1: A simple illustration of diversity of water measurement within the natural environment

A. Example of Total Valuation Analysis [illustrative only]

Natural Capital = f {(ΣInsource $_{\text{Quantity, Quality}}$)-(ΣOutsource $_{\text{Quantity, Quality}}$)} ....(1)

Where

Quantity = f (Precipitation, Surface supply, Ground Water, artificial supply)....................(1a)

Quality = f (nutrients, salinity, turbidity, taste, micro-organisms, smell)............................(1b)

B. Example of Marginal Valuation Analysis [illustrative only - this function can also be modified to offer seasonally adjusted analysis]

Outsource cost = f {(δInsource $_{\text{Quantity, Quality}}$) - (δOutsource $_{\text{Quantity, Quality}}$)} ....(2)

Where

Quantity = f (precipitation, δsurface supply, δGround Water, artificial supply)..................(2a)

Quality = f (δnutrients, δsalinity, δturbidity, δmicro-organisms, δusability).......................(2b)

C. Example of Multidimensional [Matrix] Valuation Analysis [illustrative only]

Value $_{\text{Ground Water}}$ = $f(\Sigma)$ ....(3)

	nutrients	salinity	Availability	Potable	Reliability
Soil Moisture					
Underground					
Subterranean					
Wastewater					

Where

Soil Moisture = f (δ natural surface, δ hard surface);

Availability = f (Runoff, Retention, storage, plant uptake);

Potable = f Σ(pH, EC, Turbidity, taste, smell);

The above functions are illustrative only and are not intended to comprehensive of all items that would comprise the equation; to illustrate, functions that would supplement those presented above would include:

Use = *f* Σ(recreation, household, production);

EnvironValues = *f* Σ(animal population, diversity, quantity) + (environ use)

Table 2: Basic Concept of Eco-Dollar

Volume – free water [fluid currency], rivers and rainfall. – Soil water [deposits] – Subterranean [capital reserve] – Underground [capital reserve] – Artificially stored [capital reserve]	Mega litre % av. Soil moisture Mega litre	Retention in ecosystem Permanently removed from ecosystem Temporary removal and returned in modified into ecosystem Opportunity cost of stored water to the immediate ecosystem.
Quality – Soundness of Currency – Scaling of values derived from the volume of resource.	Potable and favourable to eco-system Potable and degrading to eco-system Non-Potable and favourable to eco-system Non-Potable and polluting to eco-system	Number of different flora species supported Number of different fauna species supported - nutrient availability – increased values - Toxicity to humans/ecosystem - devaluation
Change – Marginal Analysis – scaling of values resulting from the change in the eco-system resulting from the use of the water. The output belongs to the community … diminished value equates to subsidy.	Improvement in quality for - potable waters - ecosystem waters	Change in number of flora species supported by ecosystem Change in number of fauna species supported by ecosystem Change in number of micro-organisms supported by ecosystem
Tradability – acceptance in the market place – intersectional ownership before or after use.	Human use Ecosystem use	Urban use Crop and livestock production Flood = drought probabilities – equiv to inflation and recession on the money supply.
Impact on other investment	Community governance based on valuations from eco-currency	Inter-project through to international comparison of current and proposed developments.

6. APPLICATION OF ECO-CURRENCY

Fundamental to the TBL paradigm is the valuation of the social, economic and environmental aspects of any proposed or actual undertaking. While opposing viewpoints are maintained, assessment criteria will be interpreted by stakeholders in an oppositional or even confrontationist manner. Wetland conservation policies initiated the NSW command and control strategy for ecologically based conservation policies. Many of the matters remain unresolved nearly two decades after initiation [For wetland examples, see Brennan 1999 re an analysis of wetland confrontation at social and legal levels]. For example, legal argument is currently before the courts regarding the quantity and quality of water that should be allowed to enter an existing wetland; however, there does not appear to be any meaningful ecosystem measure by which the decision making process is being undertaken. Similarly, ongoing debate persists regarding the disposal of effluent, with the NSW State Government strongly concerned with on-site systems while justifying its own disposal of gigalitres litres of effluent into Sydney stormwater systems during the height of the rainfall in early 2003 (there is also the recurrent issue of the way in which sewage is disposed of). Clearly the community is confused and sceptical regarding the government's conservation policies. Community scepticism has been attenuated by recent policy pronouncements concerning the Australian Defence Industries[ADI] Site generating active debate between the Federal, State and Local Governments, and the community regarding the development of the ADI site, 2002 - 2003. A simple TBL assessment of the ADI Development is summarised in Table 3.

What is important from the above assessment is that there is no one common means of determining or monitoring the range of personal, community or governmental values relating to the ecosystem. To date the debate has revolved about one stakeholder presenting an economic statement that is then contoured by opponents with social or non-objective environment argument, invariably made without science or on spurious science. What is presented in Table 3 is a basis upon which the impact of the development and the outcomes of non-development in ecological terms can be measured in relative terms and therefore compared within a timeframe as well as overtime.

Critics of eco-measuring systems debase such proposals on the basis of accuracy, it can be more strongly argued that the non-descript valuation criteria such as 'immeasurable' are less constructive to the decision making processes as they are incomprehensible. Alternatively, water, as an eco-currency, has similar properties to 'money', as it can provide a means of valuation, and a measurable basis for relative values, and it is recognisable [albeit it takes a variety of formats] as well as infinitely divisible [Table 3].

7. Conclusion

This paper provides a limited overview to a means of addressing the universally complex problem of valuing ecological systems within a TBL framework. While based on the simplicity of water being the basis of life, the eco-currency application not only acknowledges, but in fact exploits, the complex array of water qualities needed for an efficient and diverse ecosystem. With the supplement and complement of good science to measure (sometimes) minute but critical changes in water plus acknowledgement that water is not a free good, we now have the two vital ingredients for water to be the eco-currency: measurement and value.

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Table 3: Comparison of TBL Analysis using traditional conservation assessments and Eco-currency

Stakeholders	Social	Economic	Environmental		
			Tradition Assessment	Eco – Currency [simple model]	
State and Federal Government	Electoral Popularity and impact on power Backlash from the conservation movement without appropriate deals.	***Rates and Taxes***: Additional funds to support local economy through additional Land Rates, and Stamp Duty and Company Taxes	Small Impact relative to the remainder of the Sydney Basin. Government insists that there are strict environment controls and other areas under heritage protection	Water Quantity [Insource]	Extent of Fauna and flora deprived of water as a result of construction – Total volume of water. Measure of water lost to the environment due to buildings, reduced infiltration due to landscaped surfaces. Change in water requirements of vegetation – natural and landscaped. External environmental cost of providing additional water from other eco-systems.
Conservationists	Negative, with the use of public appeals and demonstrations	***Subsidisation:*** Misuse of government funds as the value of the environment exceeds economic advantage.	Unacceptable: South Creek is deemed to be overstressed and any further development is unjustified. Salinity a major issue in Western Sydney generally	Water Quantity Out [Outsource]	Changes to water quality due to concentration of solids and dissolved contents – environmental impacts of these waters within the catchment. Need for cleaning of water by natural or artificial means if to be discharged into the broader environment Decrease in outsource due to reticulated sewage scheme – deprivation of water to catchment and adjoining eco-systems.
Developers	Industry and commercial influences	Investment Returns Direct return to Investment via rentals and commissions. Long-term capital gain due to increased land values. Share market dividends to investors	Additional costs re EIS. Land set aside for environmental protection, lowing profits - Custodian taxation	Water Quality In	Special needs by flora and fauna, including subsurface organisms. Changes in nutrient levels and associated impact on flora and fauna Changes in levels of salinity and sodicity and long-term impact on soils. Changes to ecosystem resulting from regeneration of native flora in reserve area.
Western Sydney Community	Health and education issues arising from additional investment	Important, in association with job security,	Mixed responses; concern of salinity levels in the adjacent creeks.	Water Quality Out	Alterations to environment as a result of changes in water quality and quantities. Flora and Fauna populations, diversity and ecosystem health.
National and International Community	Not considered	Potential for international companies to invest	Preservation based on existence values		

Source: This summary compiled from printed and digital media reports, July 2003.