HOW TO QUANTIFY THE ENVIRONMENTAL SERVICES: A CAUSE FOR CONCERN?

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ABSTRACT

The production and consumption of environmental goods are not under the control of identifiable owners who make allocation decisions in response to price signals. Prices provide the wrong incentives, leading to mechanism failure. Thus setting a price on environmental goods may seem very difficult and impossible. Without a market, how does anyone decide the value of a good? Complicating matters, some environmental "non-market" goods such as clean water or endangered species may at first seem "priceless." Nevertheless, people will have conflicts that involve environmental goods without markets. Assigning no value at all for environmental goods or stating them priceless does not allow for negotiation. Thus this article serves to discuss about the methods that can be used to value the environmental services, including non-market value. An in-depth discussion about how to use "stated preference" and "revealed preference" valuation methodologies is also provided. For full accounting of environmental goods both use and non-use values should be considering. Hopefully this article will benefit to the knowledge in environmental valuation method and contributed significantly for the sustainability of the nation development process.

Keywords: Environmental services, economic valuation, revealed preference and stated preference

1. INTRODUCTION

Environmental issues were highly debates around the world since the early 1970's (Ward and Beal, 2000). One of the main issues in such debates has been the appropriate use of natural environments. Rapid population growth in developing countries and high levels of resource consumption in developed countries are considered to be imperative causes of environmental damage. Then the effect of such unsustainable pattern of consumption has worst the environmental problem such as global warming, pollution, ozone depletion, loss of biodiversity, ocean, fisheries and freshwater resources. Solution from the political process often suffers from the problem that little is done about an environmental issue until it becomes more critical (Ward and Beal, 2000). Nevertheless, concern about environmental

degradation has reached the world political stage such as the Rio Earth Summit in 1992 and the International Conference on Greenhouse Gas Emissions Trading (1997) which held in Kyoto, Japan. Twenty years after 1992 Earth Summit, the world leaders have come together in Rio+20. Moreover, the world leaders commit in 2012 Rio+20 with highlighted to improve international coordination for sustainable development.

However, the fluctuating importance attached to the environment by governments also reflects the inherent problem facing the public sector, namely quantifying and comparing benefits arising from spending in a diversity of areas and thus maximising the welfare of society. Where a policy affects goods and services that are traded in normal markets, changes in prices and income can be linked to consumer behaviour. But in the absence of an observable market how can the benefits of health care, education or protection of the environment are compared? A solution to this problem involves defining the benefits arising from differing sectors in terms of a single unit, money. In the context of public benefits arising from natural resources, this approach was first suggested in the 1940's (King, 1995). This development stems from a belief that unless the value of natural resources is expressed in monetary units, it will continue to be assigned a zero value, and will not therefore be incorporated into the decision making process. Money may not be ideal but, as it has been argued by Mitchell (1989) monetary valuation is a means of systemising and rationalising behaviour. Thus this study serves to discuss about the methods that can be used to value the environmental services, including non-market value. An in-depth discussion about how to use "stated preference" and "revealed preference" valuation methodologies is also provided. Hopefully this article will benefit to the knowledge in environmental valuation method and contributed significantly for the sustainability of the nation development process. This article was organized as the first section will discuss about the link between economic and environment that serves the understanding relates with why we need to value such environmental services. After that this paper were highlight the concept of economic valuation methods which divided by revealed preferences and stated preferences. Later this article came with the discussion with previous studies with many application of environmental value for many type of environmental goods and services.

2. WHY VALUE THE ENVIRONMENT?

Ecological economics literature was referring environmental services as "any functional attribute of natural ecosystems that are demonstrably beneficial to humankind" (Cohen & Robbins, 2011). Environmental issues now take ever greater prominence in decision-making. Realizing of the important of sustainable development and improved management of environment resources, then economics provides an array of techniques and methods for putting economic values on the environment. To help us understand these methods of evaluation, first we consider the sustainable development in broadly defined. Then from there we discuss how does valuing the environment relates to sustainable development. Basically, there are five concepts of sustainable development, which are efficiency, social equity, environmental integrity, quality of life and participation. Table 1 explain the important point for each concepts of sustainability development.

How the five concepts are interpreted yields different interpretations of sustainability. The most common distinction is between 'weak' and 'strong' sustainability. Weak sustainability is typically understood as the requirement to keep the sum of capital (that is, natural plus man-made capital) intact over time. Strong sustainability is interpreted as the requirement to keep each individual type of capital stock intact over time. Thus, there is no ability to simply substitute human capital for natural capital which is allowed under weak sustainability.

Table 1: Concepts of sustainable development

Concept	Explanation
Efficiency	Ensuring the efficient use of resources (including environmental and natural resources) and the integration of environmental values into decision-making, policy design and implementation
Social equity	A commitment to meeting at least the basic needs of the poor of the present generation (as well as equity between generations)
Environmental integrity	A commitment to protecting environmental resources and amenities and to living within the limits created by the carrying capacities of the biosphere.
Quality of life	A recognition that human well-being is constituted by more than just material wealth and economic growth
Participation	The recognition that sustainable development requires the political involvement of all groups or stakeholders in society

3. A CAUSE FOR CONCERN

Many studies have shown the links between the economy and the environment. In general economy can be divided into two sectors which are production and consumption. These sectors use the environment in three main ways: as a supplier of natural resource inputs; as a supplier of environmental and amenity goods; in its capacity as a waste sink.

A. As a Supplier of Natural Resource Inputs

Supplier of natural resource inputs land, water and stocks of raw materials are important inputs to production. These resources frequently vary between countries and so will affect the country's economy. Some countries will have large stocks of minerals, while others have good arable land. Natural resources are either renewable (eg. trees) or non-renewable (eg. crude oil). This distinction is important as it influences the way the resources have to be managed in production. These resources are used by the production sector to create goods and services for use by consumers, or as inputs for another part of the production sector, but in the process waste products will also be produced. For example, coal which is used to generate electricity. As the coal is burned, it produces electricity, but at the same time, carbon dioxide and sulphur dioxide are also produced and these may have detrimental effects on the environment.

b. Supplier of Environmental and Amenity Goods

Economic benefits may be directly derived from the consumption of the flow of services that are forthcoming from a stock of environmental goods. There are many examples of where the environment provides amenity benefits for society. For example, some countries enjoy beautiful landscapes and the public benefit from these via their associated recreational services and tourism. Environmental stocks of trees can offer global services such as climatic regulation because the trees absorb carbon dioxide, which might otherwise contribute to climate change. Many people get enjoyment from the biodiversity that exists in the world, and this can also be considered as a form of public consumption of environmental good.

c. Waste Sink Capacity

This is the capacity of the environment to assimilate the waste products of production and consumption and convert them into harmless or ecologically useful products. The environment is not only affected by waste products, but also by intentional release of chemicals, such as pesticides, food preservatives, paints and lubricants. The impact of human

activity on the composition of chemicals in the atmosphere is clear. Since 1750, the pre-industrial period, carbon dioxide concentrations have changed from 280 parts per million to 380 parts per million in 2000. There have also been significant increases in other gases such as methane and nitrous oxide. There are serious concerns being expressed about these increasing concentrations in the atmosphere and climate change.

4. HOW TO QUANTIFY OR VALUE THE ENVIRONMENTAL SERVICES?

Environmental resources convey a complex set of values to individuals and various benefits to society. Environment valuation is based on the assumption that individuals are willing to pay for environmental gains and conversely, are willing to accept compensation for environmental losses. Individuals demonstrate preferences, which, in turn, place values on environmental resources. Abdullah (1994) mentioned that all environmental valuation techniques seek to assign a monetary value for the environment. The purpose of the assignment is not to facilitate profit maximization, but rather to live an indication of the utility derived from the environment. Environmental economists have developed a number of market and non-market-based techniques, based on the preferences, to value the environment. These preferences can be either revealed preferences or stated preferences. Figure 1 shows these two environmental valuation methods.

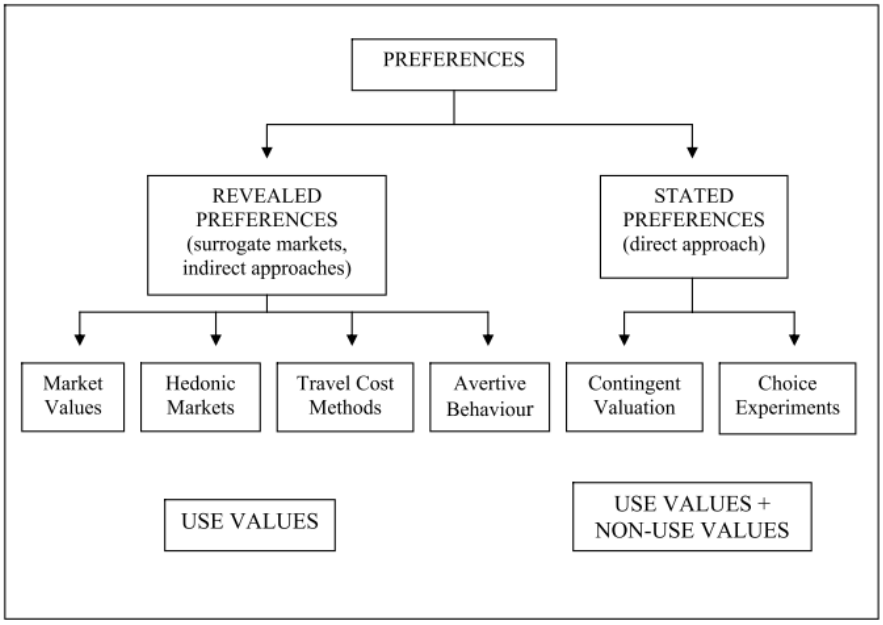
a. Revealed preference

Revealed preference refers to the method which applied in the absence of clearly defined markets. The value of environmental resources can be derived from information acquired through surrogate markets. There are a few techniques in this approach such as Hedonic Price method (HPM), Averting Behavior Approach, and the Travel Cost method (TCM). The Hedonic Price method is based on consumer theory, which seeks to explain the value of a commodity as a bundle of various characteristics. Market goods are often regarded as intermediate inputs into the production of more basic attributes that the individuals really demand. The demand for goods, for example housing, can therefore be considered as a derived demand. A house, yield shelter, but through its location also yields access to different attributes such as different quantity and quality of public services (such as schools, shopping facilities, etc.) and different quantity and quality of environmental goods (such as open space, peace and quiet, sceneries, etc.). As the theory of demand predicts, the price of a house is determined by a number of factors: structural characteristics such as number of rooms, plot size, etc.; and the environmental characteristics of the area. Controlling for the non-environmental characteristics which affect the demand for housing permits the implicit price that individuals are willing to pay to consume the environmental characteristics associated with the house to be estimated. The method seeks to determine the increased WTP for improved local environmental quality, as reflected in housing prices in cleaner surroundings. It assumes a competitive housing market, and its demands on information and tools of statistical analysis are high.

Averting Behaviour Approach assesses the value of non-marketed commodities such as cleaner air and water, through the amounts individuals are willing to pay for market goods and services to mitigate an environmental externality, or to prevent a utility loss from environmental degradation, or to change their behaviour to acquire greater environmental quality. For example, people may install air purifiers in their homes to improve air quality; or they might install double glazed doors and windows to prevent road traffic noise in their homes. Where such preventative and mitigatory expenditure is made by individuals or private conservation groups, then there may be a reasonable expectation that the benefits derived

exceed that expenditure, or at least equal it at the margin. Other technique is Travel Cost Method. The Travel Cost method is a method which attempts to deduce values from observed (i.e., revealed) behavior. TCM has been used to measure the value of an ecosystem used for recreational purposes, by surveying travellers on the economic costs they incur (time, out-of-pocket expenditures) when visiting the site from some distance away. It determines the WTP for access to the recreational benefits provided by the site, as a function of variables like consumer income, price, and various socio-economic characteristics. The price is usually the sum of observed cost elements like entry price to the site, costs of traveling to the site, and foregone earnings or opportunity cost of time spent. The consumer surplus associated with the estimated demand curve provides a measure of the value of the recreational site in question. More sophisticated versions include comparisons across sites, where environmental quality is also included as a variable that affects demand.

Figure 1: Environmental Valuation Methods



b. Stated Preference

Stated Preference Methods seek to measure individuals' value for environmental goods directly, by asking them to state their preferences for the environment. In other words, the economic value is revealed through a hypothetical market based on questionnaires. Unlike Revealed Preference Methods, these are used mainly to determine non-use values of the environment such as existence value, altruistic value and bequest value since these values do not turn up in any related markets. The contingent valuation method (CVM) has been widely used to estimate WTP and a more approach is the Choice Experiment approach.

Contingent Valuation Method (CVM) was first used by Davis (1963) in a study of deer hunters in Maine. The CVM method to ascertain non-use values first came into the public spotlight in a significant way with the Exxon Valdez disaster of 1989. The National Oceanic and Atmospheric Administration (NOAA) of the US constituted a panel with Nobel laureates Kenneth Arrow and Robert Solow to determine whether CVM was a reliable way to ascertain lost existence values in the accident. Using the recommendations of the panel and several others, the NOAA conditionally accepted CVM as reliable, subject to elaborate guidelines for

its use. In a choice experiment, individuals are given a hypothetical setting and asked to choose their preferred alternative among several alternatives in a choice set, and they are usually asked to perform a sequence of such choices. Each alternative is described by a number of attributes or characteristics. A monetary value is included as one of the attributes, along with other attributes of importance, when describing the profile of the alternative presented. Thus, when individuals make their choice, they implicitly make trade-offs between the levels of the attributes in the different alternatives presented in a choice set. This enables the researcher to derive the value of each of the different attributes of a particular alternative (Alpizar, Carlsson and Martinsson, 2001).

CE involves considerable effort in the design of relevant scenarios with appropriate attributes and in the use of statistical methods. Using CE, the WTP for specific "attributes" of the proposed environmental change or alternative can be derived. This disaggregation allows for the possibility of compensating some attributes of the situational change in kind and others monetarily (Adamowicz et al., 2005). CE also enables much greater accuracy in framing the final alternative. Overall, there are three important advantages that CE has over CVM (Alpizar, Carlsson and Martinsson, 2001): (i) reduction in some of the potential biases of CVM (ii) more information is elicited from the respondent compared to CVM and (iii) the potential of testing for internal consistency. The only major disadvantage of CE is that is it far more complex and expensive to administer compared to CVM. Table 2 summarizes some of recent studies that applied different techniques of economic valuation for specific context of environmental goods and services.

Table 2: Some Recent Studies on Economic Valuation

Author/s &/ Year	Country	Types of goods/ services	Method of valuation	Finding
Awad & Hollander (2010)	Palestine	Domestic water services	CVM	Mean annual WTP of improved domestic water supply services was about NIS 627 per annum
Rodriguez, Lacaze and Lupin (2008)	Argentina	Organic food: regular milk, leafy vegetable, whole wheat flour, fresh chicken and aromatic herbs.	CVM	The empirical results reveal that consumers are willing to pay a premium for these products and that although prices play an important role, lack of store availability and of a reliable regulatory system to mitigate quality risks constraint consumption of organic products in this country
Owusu & Anifori (2013)	Ghana	Organic fruit and vegetable	CVM	The estimated mean consumer willingness to pay premium for 1 kilogram of organic watermelon is GH¢0.5554 (US$ 0.4575) and that of organic lettuce is GH¢1.2579 (US$1.0361).
Abdul Kadir & Hua (2009)	Malaysia	Sarawak Culture Park	CVM	Study result shows that the average WTP for individual is RM45.90. This results show that visitors are

				willing to pay high price in restoring and preserving the beauty and recreational facilities at the Sarawak Cultural Park. The respondents' income distribution is between RM1001 to RM1500 monthly. In this study, several strategies and proposals are recommended as a guide to the involved parties in ensuring that the value, culture and protection on the environment are given their due attention.
Ahmad (2009)	Malaysia	Marine Parks	CVM & TCM	The willingness to pay (WTP) per person per visit to moderate the environmental impact of inland development is RM23.79, which is lower than the WTP to reduce crowding, RM31.59. In addition, when both data were combined to estimate the differences between the WTP of foreign and local visitors, we found that the WTP of foreign visitors was much higher than the WTP of locals at RM39.11 and RM19.52, respectively. Analyses using the Individual Travel Cost Method gave quite poor results since two thirds of the visitors were first-timers. Therefore, consumer surplus cannot be obtained due to the insignificant result of the respondent's total spending on the number of trips. However, using the Zonal Travel Cost Method (ZTCM), the average consumer surplus was found to be the same, RM1,000 for each park. The ZTCM was also used to calculate the elasticity of demand. The results for the three marine parks were found not to vary much, ranging between 1.07 and 1.36.
Liu (2012)	Taiwan	Energy conservation	HP and CVM	Our empirical results indicate that consumers are willingness to pay about NT$4,784 (US$160) on purchasing the air-conditioner with the energy efficiency label. Furthermore, by using the

				contingent valuation method, the estimation results of consumer willingness to pay for the product with label are about NT$4,200, which are very closer to those estimated by the hedonic price method.
Rousseau & Vranken (2011)	Belgium	Labelled organic food products	CVM	we find that Flemish consumers are willing to pay a positive price premium of approximately 33-euro cent per kilogram for labelled organic apples. After the provision of information on the actual environmental and health effects of organic apple production, this price premium becomes even more pronounced and amounts to approximately 56-euro cent per kilogram.
Bhattacharjee, Petrolia & Herndon (2008)	US	E10 fuel	CVM	The simultaneous equation framework helps us to understand the way consumers' perceptions about ethanol are developed and influence their respective buying behavior. We fit various models and compare model efficacies and differences in WTP measure. Each model varies in the way we measure consumers' perception towards ethanol and in the way information is integrated into the random utility framework. Interaction between intended purchases of E10, perceived environmental, economic, and national security benefits are examined. We found self-described liberals have significantly higher WTP; WTP is higher for males; and WTP increases as familiarity with ethanol increases. Supporters of alternative fuels, but who are not sympathetic to ethanol, have significantly lower WTP for E10.
Wiser (2005)	California	Renewable energy	CVM	Result found some evidence that, when confronted with a collective payment mechanism, respondents state a somewhat higher WTP than when voluntary payment

				mechanisms are used. Similarly, private provision of the good elicits a somewhat higher WTP than does government provision. We also find that contingent valuation responses are strongly correlated with expectations for the WTP of others. Our results shed light on strategic response behavior and the incentive compatibility of different CV designs, and offer practical insight into U.S. household preferences for how to support renewable energy.

CONCLUSION

Environmental valuation techniques are primarily driven by the principle that individuals are self-interested and demonstrate preferences that form the basis of market interactions. Existence values are not demonstrated in the marketplace and are at least somewhat based on unselfish motives making them problematic to environmental analysts. To quantify existence values accurately within the framework of environmental valuation is difficult; for example, revealed preference methods, such as the travel cost method and hedonic pricing methods, measure the demand for the environmental resource by measuring the demand for associated market goods. Existence values are not adequately captured using these methods. Existence values are best revealed through surveys of individual willingness to pay for the environmental resource or willingness to accept compensation for environmental losses.

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