ECONOMIC VALUATION FOR WATER SUSTAINABILITY

By: Homero Castanier Muñoz

Environmental Management Department - Water and Sanitation Company of the City of Quito

ABSTRACT

The ecosystems integrate the environmental systems under which the socioeconomic system, with public and private goods, takes natural resources and particularly water as a source for its functioning. The values of ecosystems' services and functions can be estimated based on applications of a series of methods of environmental economics, being especially important the contingent valuation method, since it estimates the use and non use values, which correspond to the total economic value.

The interrelations between the environmental and socioeconomic systems can be analyzed under different approaches of economics, depending on the results of the analysis of the total benefits and costs involved in conservation and development processes.

The economic valuation of water ecosystems' functions and services has special relevance in relation to the conservation of water sources, its quantity and quality, determination of economic liabilities for environmental damages or natural resources damages or degradation, and compensation for restrictions on land use regulation for environmental services protection.

KEYWORDS

Water, valuation, sustainability

INTRODUCTION

Although world governments, through international agreements and protocols such as the United Nations World Summits on Environment and Development (UNCED, 1992. Río de Janeiro), Sustainable Development (WSSD, 2002. Johannesburgo), Climate Change (COP 15, 2009. Copenhague), or the Convention on Biological Diversity (CBD, 1992) and the International Trade Agreement (WTO, 1995) of the United Nations system, have increased the urgency for development based on ecological and economic sustainability, many development policies still conflict with the sustainable use of scarce resources. Funding for implementation of development projects extended by financing agencies are commonly evaluated, although this system is slowly changing, by standard estimation and analysis of benefits and costs that arise from the project proposed based on utilitarian theory of values determined by market prices and quantities, which do not account for environmental damages (or gains) in general, neither for resource depletion in particular (Pearce and Warford, 1993: pp. 61, 164).

Human welfare is so connected and dependent on the short-term inequitable behavior and patterns of the economic system that people tend to believe they are better-off exploiting the natural assets than by conserving them for long-term sustainable use (Pearce, 1998: p. 23, and Dixon and Sherman, 1990: pp. 1-5), that is, prices in the market system are the basis for allocating land, labor, and capital among producers, and goods and services among consumers without any consideration of values and of affected present or future third parties not involved directly in the market exchange (Breedlove, 1999).

More than 1500 studies and papers from over 40 countries on many topics, including transportation, sanitation, health, the arts and education, as well as the environment (Carson et al., 1994, cited in Hanemann, 1994) (and involving the provision of public goods as ecosystem's functions and services) have been carried out worldwide in the last three decades. Recent institutional and legal frameworks have contributed to that effect, as the United States' National Environmental Protection Act of 1969, the posterior Clean Air Act, and Clean Water Act, and the Ramsar Convention Bureau for Wetlands that requires economic valuations of wetlands intending being part of its conservation and development program, just to mention a few. These studies have been accomplished with different degrees of scientific rigor and level of detail depending on the state-of-the-art of valuation theory and methodologies at the time when they were done or on the purposes of the valuations.

METHODS

A key concept for the preparation of this paper is the total economic value of environmental resources and services, which has to be elaborated based on different valuation approaches and benefit measurement.

The economic theory on natural resources and its practical implications play an important role when discussing environmental economic valuation. The contingent valuation method is analyzed in detail, as an important sample method to estimate non-use values.

The main findings fully justify applications for natural resources valuation, particularly water resources and its components related to quantity, quality, and regulated flow.

It is important to highlight that environmental economics is not the application of economic sciences in general to environmental issues, but the interpretation of a neoclassic school of economic thought, that concentrates on the analysis and valuation of scarce goods, and being it in general the current condition of environmental services and public goods, incorporates the environment as a subject of study.

The close interrelations between economic and environmental systems are shown in Figure 1.

Figure 1

ECONOMIC – ENVIRONMENTAL SYSTEMS

MODERN TRENDS

ECONOMIC DYNAMICS		ENVIRONMENTAL DYNAMICS
▪ Production increase ▪ Consumption increase ▪ Technological development ▪ Production value vs Utility value	⟷	▪ Natural resources scarcity ▪ Pollution and environmental degradation
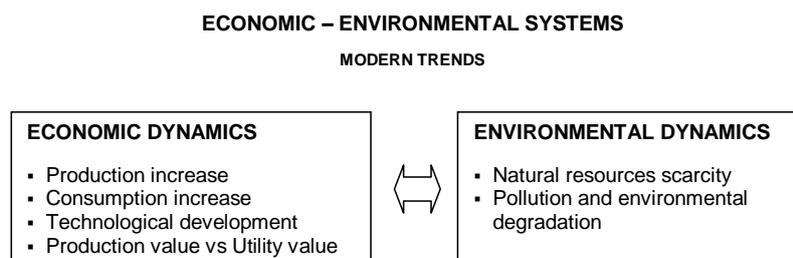
Ecosystems' goods and services consist of flows of materials, energy and information of the reserves of natural capital that combine with services of the manufactured capital and human capital to produce human well being (Costanza, R. et al. 1997).

In Figure 2 is presented a general scheme of the ecosystems' services and functions.

Figure 2

ECOSYSTEMS	⟺	FUNCTIONS AND SERVICES

Marine

Open Ocean

Coastal
    Estuaries
    Sea grass and algae
    Coral reefs
    Ocean platform

Terrestrial

Forests
    Tropical forest
    Dry forest
    Template forest
    Planted forest

Grass and cultivated land

Wetlands
    Marshes
    Mangroves
    Swamps
    Flood plains

Rivers and lakes

Tundra

Desert

Ice and rocks

Urban

General

- Provision of elementary resources:
  Air, water, land, soil
- Consumptive resources:
  Biomass, food, raw materials, fuels
- Ecosystems production resources:
  Biodiversity
- Aesthetic resources
- Services of assimilation:
  Waste assimilation and recycling

Specific

1. Gas regulation
2. Climate regulation
3. Disturbance regulation
4. Water regulation
5. Water supply
6. Erosion control
7. Soil formation
8. Maintenance of nutrient cycling
9. Waste assimilation
10. Pollination
11. Biological control
12. Refuge of fauna
13. Food production
14. Raw materials
15. Genetic resources
16. Recreation
17. Culture

The classification of the different types of goods are closely linked to their total economic value, as is detailed in Figure 3, based on the characteristics of Rivalry and Excludability.

Figure 3

TYPES OF GOODS			
		Rival	
		High	**Low**
Excludable	**High**	**Private Goods** Cultivated or processed food Clothing Housing Vehicles	**Collective Goods** Fire protection. Cable TV Ungongested toll roads
	Low	**Common Goods or Resources** Clean air Clean water Oil fields Fishing, whales, wildlife, others Public parks	**Public Goods** Ecosystems (wetlands, oceans, others) (buffer impacts of production and consumption processes, and supply environmental services). National Defense. Basic research. Public Radio. Fireworks. Poverty reduction programs.

FINDINGS AND DISCUSSION

Valuation Approaches and Benefit Measurement

As many natural resources like water and some non renewable energy sources, show signs of scarcity and predictable exhaustion horizons, the environment had started getting a status of economic good, nevertheless that many environmental goods like water and minerals have a price depending of their extraction and distribution costs, but not of the good itself according to its production cost. For this reason, the environment is outside the market, and environmental economics deals mainly with its monetary valuation, based on the application of instruments of economics and on the scientific knowledge of the biophysical and socioeconomic characteristics of the environment.

In the graphs on Figure 4 is possible to observe the population projection and the supply-demand of drinking water in the Metropolitan District of Quito, which reflects the increasing pressure on the use of water resources.

Figure 4

POPULATION PROJECTION AND WATER SUPPLY-DEMAND IN THE CITY OF QUITO

Actualización del Plan Maestro de Agua Potable y Alcantarillado. Informe de Estudios Básicos (Hazen and Sawyer / EPMAPS-Q. 2010)
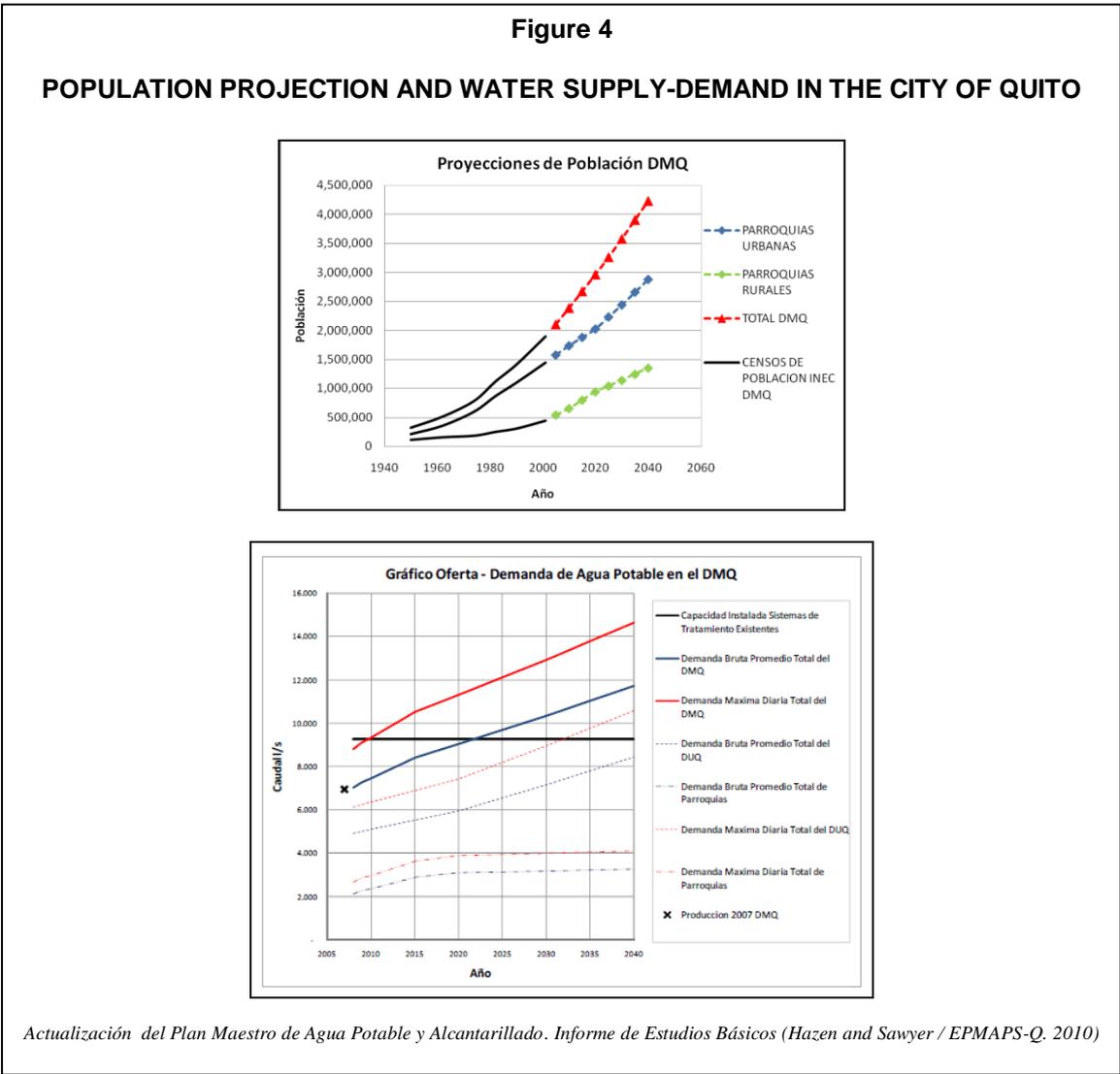
The discussion on environmental issues takes force particularly in the eighties and nineties, when it becomes more evident that the increase in production comes along with an intensification of environmental degradation that turns to acquire global dimensions (Chang, 2005).

The efficiency analysis of economic investments and resource allocation, particularly in the public sector, has traditionally been done using a benefit-cost analysis approach (Pearce and Warford, 1993: p. 164), in which the corresponding monetarized benefits and costs involved are compared prior to deciding on an efficient policy choice, or determining liability when natural resources have been harmed or degraded (Bockstael et al., 1999: p. 3). The current issue in economic assessments is not the evaluation approach itself but the conceptual framework when assessing the nature and the range of benefits that are to be valued, with all the economic, social, environmental, as well as procedural implications.

As a result of decades of argument it is commonly agreed that non-marketed goods and services should be given equal standing as marketed goods since total value is estimated based on a choice of a state of welfare made by individuals or by society as a whole (Bockstael et al., 1999: pp. 3). Today, the most commonly accepted practice regarding benefit valuation, implies to make the best possible effort in calculating all the benefits involved as a consequence of a policy choice no matter if they are part of well defined markets or if they are not marketed goods at all, the latter being generally the case of public goods or environmental services. This is reflected for instance in Executive Orders (Presidents Carter, Reagan, and Clinton) and various federal regulations of the United States as the Comprehensive Environmental Response, Compensation, and Liability Act (Portney, 1994: p. 12).

The benefits from the provision of public goods arise from the value individuals assign (Brown, 1984, cited in Mitchell and Carson, 1989) to the services or functions they provide, as for example the value assigned to improvements in air visibility or water quality. Deficiencies in the services may be thought of as damages, the distinction being made based upon a reference level of the good (Mitchell and Carson, 1989).

The value of a good is the most an agent is willing to give up in exchange for the good out of the resource it controls (Mitchell and Carson, 1989: pp. 20-21), and still be as well off as before the exchange of the good (in the case of a quantity increase), that is maintaining the same level of utility or satisfaction, otherwise variations in levels of well-being will have to be taken into consideration for the estimation of the total value. This clearly means that an agent or society as a whole could never value a good or service by means of stated willingness-to-pay exceeding their actual ability to pay (Pearce, 1998: pp. 25-26, and Bockstael et al., 1999: pp. 8-9).

For resources that are marketed commodities, measurement of benefits is relatively uncomplicated and information on prices and quantities can be used to derive the demand curve. Once the demand curve is defined, that is the aggregated relationship between a range of prices corresponding to different quantities of a good, it can be used to quantify the willingness-to-pay (WTP), the concept used to measure benefits, since the points on the curve represent the amount of money some person is willing to pay for the last unit of the good. The total willingness to pay for some quantity of the good is the sum of the willingness to pay beginning at quantity zero, and can be calculated measuring the area under the demand curve from the origin to the point of the quantity in question (Tietenberg, 1996: pp. 21-22, 68). Since the willingness to pay is in exchange for the benefits derived from the provision of a good or service, the traditional measure of consumer benefits is consumer surplus, which is defined as the area under the ordinary (Marshallian) demand curve and above the price line (Mitchell and Carson, 1989: pp. 23-26). In order to correct for maintaining constant the level of utility or satisfaction, (Hicksian) compensating surplus measures have to be introduced (Mitchell and Carson, 1989: pp. 23-26).

In economics, valuation concepts are related to the contribution of goods and services to human welfare under the circumstances that individuals make decisions regarding a choice of comparing well defined alternative states in a particular socioeconomic context that takes into account income, wealth, environment, and individual concepts of well-being (Bockstael et al., 1999: pp. 3-6).

As noted earlier, many environmental resources are not handled through normal markets posing some challenges for their valuation, and making necessary the application of alternative methods and surrogate markets for the estimation of benefits encompassing both use and nonuse values (Breedlove, 1999). Eliciting people's preferences or willingness-to-pay and inferring from this information the true value of a good by means of alternative methods and markets is still a controversial issue due to biases and subjectivity of the results, and in order to solve for these contested arguments a series of considerations on methodological approaches for surveying people's

preferences, as well as technical and statistical procedures have to be taken into account to obtain results as accurate as possible, which is particularly important when assessing and ruling about liability of damages, or when deciding on conflicting alternative programs for the provision of public goods, as in the case when timber production conflicts with the supply of clean water (Breedlove, 1999). Due to the lack of direct markets, eliciting nonuse values from people's willingness-to-pay for can be done by means of physical linkages, and behavioral linkages, the latter including the Contingent Valuation Method (Mitchell and Carson, 1989: pp. 74-75).

Economists recognize two main classes of value for environmental resources: use value (created directly or indirectly by the current use of resources) and nonuse value (existence) (created by the desire to assure continued provision of the resource for others in the future). The total value is the use value plus the existence value. This total WTP can satisfactorily be used in most benefit-cost analysis (Mitchell and Carson, 1989).

Total Economic Value = Use Value + Non-use Value

TEV = UV + NUV

A scheme of the total economic value of environmental resources and services, is represented in Figure 5, while in Figure 6, the main services of water resources are summarized.

Figure 5

Total economic value of environmental resources and services
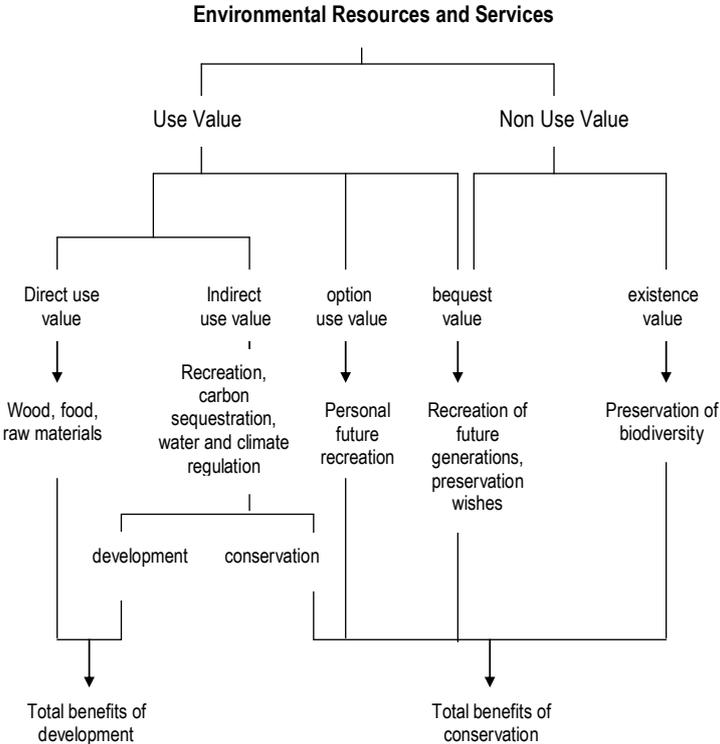
Figure 6

Main Services of Water Resources
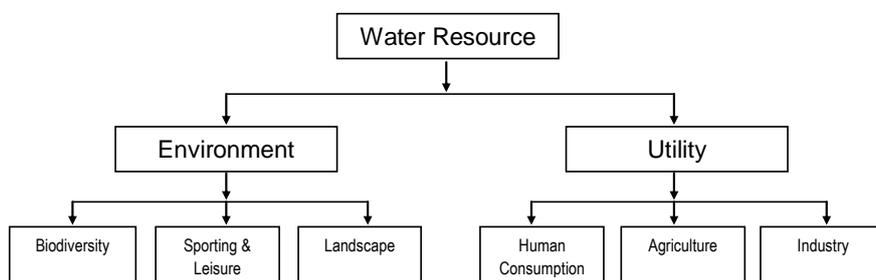
The contextual framework of the processes of valuation of environmental services and public goods, starts with the interactions of environmental and socioeconomic systems, where the use values and non-use values have to be estimated for public and private goods, and ecosystems services. The application of the total economic value should be considered for the estimation of total benefits and costs related to development and conservation actions. The results feedback the economic approach that controls and regulates the interactions of environmental and socioeconomic systems. See Figure 7.

Figure 7

Processes of Valuation of Environmental Services and Public Goods
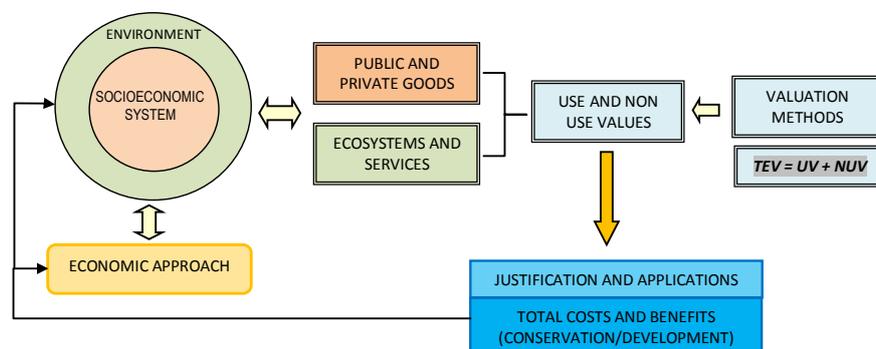
The Willingness to Pay represents the tradeoff with the benefits derived from the provision of a good or service.

The contingent valuation method (CVM) constructs a hypothetical market to elicit the willingness-to-pay of the people surveyed. It is the only method that measures the option and existence values, and provides a true measure of the total economic value, although the results are sensitive to several biases in the design and implementation of surveys.

The Role of Economic Theory on Natural Resources and Practical Implications

Eliciting the appropriate individuals' willingness-to-pay for public goods or environmental resources and estimating the aggregate value to society requires overcoming a series of complexities and limitations related to the required proper gathering and processing of data, and economic and social analysis. Besides the advancement of neoclassical economic theory, of welfare economics, and of

operational applications, economists, research scientists, and ecologists have devoted through the last two or three decades a big deal of time and resources in order to improve the methodological approaches for the economic evaluation of environmental services. These attempt to control for the limitations and biases of benefit measurement, as described by Mitchell and Carson (1989), and summarized below:

- Design, application, and assessment of benefit measurement methods
- Definition of the correct economic measures of consumer benefits
- Solutions proposed in order to deal with externalities as property rights regimes, uncertainty, as well as willingness-to-pay versus willingness-to-accept measures (compensations)
- Exhaustive systematization and classification of the full range of possible benefits
- Aggregation and distribution issues (aggregation of individual benefits, subcomponent aggregation, distribution of individual willingness to pay, and identification of all the potential beneficiaries of a given change)
- Appropriate survey design

Behavioral Linkages Methods of benefit measurement (Mitchell and Carson, 1989: p. 75).

- Observed/Direct: Referenda, simulated markets, parallel private markets
- Observed/Indirect: Household production, hedonic pricing, actions of bureaucrats or politicians
- Hypothetical/Direct: Contingent valuation, allocation game with tax refund, spend more-same-less survey question
- Hypothetical/Indirect: Contingent ranking, willingness-to-(behavior), allocation games, priority evaluation technique, conjoint analysis, indifference curve mapping

Key properties required of appropriate benefit measurement methods (from Mitchell and Carson, 1989: pp. 87-90).

- Obtain option price estimates in the presence of uncertainty
- Value goods not previously available
- Estimate all existence class benefits
- Relevant ordinary (or inverse demand) curve is directly estimable
- Relevant Hicksian compensated demand (or inverse demand) curve is directly estimable

Extensive research done for the improvement of hypothetical/direct methods, among which is the contingent valuation method, has allowed for their compliance with key properties of benefit measurement methods, as the ones listed above.

The creation and analysis of hypothetical and potential markets for public goods or ecological services is based on the principle of "(scientific) demonstration-capture" (Pearce, 1998: pp. 23-24), in order to convert them into real benefits. On the other hand, people's preferences or individuals' willingness-to-pay for a change in a state has to be approached on the basis of marginal analysis since only small changes in the supply and demand of goods and services allow for prediction, which is the result of substantial contributions made by economics for the analysis of tradeoffs of specific changes in specific resources or ecosystem services.

Hypothetical or potential extensive environmental changes can hardly be accepted as plausible markets because the new environmental state cannot be predicted with any degree of certainty, and even the global economic system could well go under unpredictable changes. Under these circumstances, society may erroneously be elicited to place a value on these changes, which of course would occur on a wider or diffuse spatial context of generally unknown characteristics. And what is even more erroneous is to utilize elicited values for a change in the state of an environmental amenity obtained for a specific socioeconomic and spatial context, for extrapolating or aggregating them in an attempt to calculate values for different or wider contexts.

Regarding aggregation and distribution issues, regression analysis of subcomponent aggregation, "suggests that independent estimates of different benefit categories cannot be aggregated together to obtain a combined benefit, that studies done on different locations cannot be aggregated together to obtain estimates of the larger area under consideration, and that benefits of different policy components cannot be estimated independently. Further, even estimates of individual benefit

categories, spatial areas, or policy components made by using the same method and the same sample may be different if they are estimated as parts of different sequences." (Mitchell and Carson, 1988).

The development of this scholarly advancement process for the adequate valuation of the benefits derived from public goods and environmental services has greatly contributed to a more efficient allocation of resources and to better and more equitable social welfare distributive actions. Now, this advanced set of theoretical basis and methodological tools can be applied and used as an important instrument for decision making insofar as its implementation by practitioners and researchers complies with its scientific principles on economics, social research, and natural resources, because on the contrary counteracting effects might occur, as a lack of credibility on the outcomes and on the integrity of the scientific method. If the process is flawed, and this is not readily noticeable by the decision-maker, erroneous decisions could well be made with unpredictable social, environmental, and economic consequences. This is particularly true when effective scarce resource allocation is in play as a result of a policy choice.

In Box 1 is summarized a basic model for estimations of the Willingness-to-Pay for improvements of water quality.

Box 1

Basic Model for Estimations of the Willingness to Pay (WTP) for Improvements in the Water Quality (Neuse River) (Whitehead, 2003)

It is assumed that the consumers have the utility function $u(x,q,z)$, where x is the use of natural resources, q is a measure of the quality of the resource, and z is the composite of all the market goods. The expenditure function, $m(p,q,u)$ is found solving the consumer's problem: min $(z + px) \rightarrow u = u(x,q,z)$ where p is the price of use and $p_z = 1$. The utility function measures the minimum quantity of money that the consumer must expend to reach the reference utility level, and is incremental in p and u and decreases in q.

The Willingness to Pay (WTP) is the maximum quantity of money that the consumers would give up in order to enjoy an improvement in the quality. The Willingness to Pay for the improvement in the quality is

$$WTP = m(p,q,u) - m(p,q^*,u)$$

where q is a degraded level of quality and q^* is an improved level of quality.

The expenditures to maintain the level of utility decrease with the increase in the quality, in a way that

$$WTP > 0$$

The Contingent Valuation Debate

Contingent Valuation Method (CVM) – Willingness-to-Pay or Willingness-to-Accept Compensation

Instruments of contingent valuation include consulting to individuals by means of experimental surveys about their personal valuation of increments or decreases of non marketed goods and services using contingent markets. These markets define the good or service of interest, the baseline of the level of provision and the increase or decrease offered, the institutional structure under which the good will be supplied, the payment method, and (explicitly or implicitly) the decision regulations that determines if the offered program will be implemented or not. (Randall et al., 1983).

Generally the debate on contingent valuation raises broad questions about what economists have to say about the values that individuals place on public or private goods. When attempting to infer values economists prefer evidence based on actual market behavior, whether directly or indirectly revealed. Thus a technique like the contingent valuation method, wherein values are inferred from individual's stated responses to hypothetical situations, has stirred a great deal of debate (Portney, 1994: pp. 1-6) and parallel research.

Particularly important are the debate issues when natural resource damage assessment or estimation of lost existence value is involved in order to determine economic liability of the intervening parties.

In *The Journal of Economic Perspectives*, Volume 8, Issue 4 (Autumn, 1994), of the American Economic Association, three papers were published regarding the contingent valuation debate. The first one (Portney, 1994) presents a rather impartial overview, and the other two make cases for and against the use of the CV method. Below follows a brief summary of the main points of the debate, as well as the main guidelines of the NOAA's (National Oceanic and Atmospheric Administration - Department of Commerce. 1993) Panel for CV surveys.

Supporter: Hanemann, W. Michael (Hanemann, 1994)

Feasibility of CV to measure people's value for the environment.

Common objections to surveys:

Vulnerability to response effects
The survey process creates the values
Ordinary people are ill-trained for valuing the environment
Survey responses can't be verified (replication, comparison with estimates from other sources, and comparison with actual behavior)

CV and economic theory:

Stating individual's preferences by voting for instance to raise the own taxes can't be considered "warm glow".
Altruism and double counting: Third parties don't get utility, and they will have to pay, too.

Values of Income Elasticity of Demand: falls within actual ranges of variation as in the cases of demand for state and local government services, and charitable giving by individuals.
Embedding effect (willingness-to-pay is the same whether one item is valued or several items are valued) due to:

- Scope or scale effect (preventing number of deaths of migratory waterfowl). Case is fowled. (the survey was conducted stopping respondents in a shopping mall).

- Sequencing effect and sub-additivity effect (expected to occur on surveys). Concepts of substitute and complementary goods (Madden, 1991).

"CV violates economics' commitment to *revealed* preferences": Revealed preference is complex or impossible to apply directly to public goods. Revealed preference involves extrapolation from observation to general conclusions often based on auxiliary assumptions. Observing people's behavior or asking them about behavioral intentions and motives should not be mutually exclusive.

Critics: Diamond and Hausman (Diamond and Hausman, 1994)

The absence of direct market parallels affects both the ability to judge the quality of contingent valuation responses and the ability to calibrate responses to have usable numbers.

Judging surveys of willingness-to-pay for public goods

Verbal protocol analysis

Variation in willingness to pay across individuals
Variation in willingness to pay across surveys (single question and the embedding effect -including in the valuing responses additional goods and services than the question was focus on-, adding up test -the sum of elicited values for individual goods should equal the total stated value for all the goods taken together-, differing payment vehicles
Evaluation of bias: Calibration
Internal consistency test, particularly the adding up test

Voter ignorance
Variable attitudes of voters
Respondents should not contemplate what they think is good for the country (warm glow), but rather true economic preferences
Altruism and double counting (from Milgrom, 1993)
No scope effect

Main guidelines of the NOAA's Panel (1993) for CV surveys (Portney, 1994):

Given the magnitude of the values of damages produced by the Exxon Valdez oil spill and the controversy generated on the Contingent Valuation method, in 1993 the National Oceanic and Atmospheric Administration (NOAA/USA), organized a high level panel to answer the question "Is the Contingent Valuation a valid method to determine the lost economic value due to damages to natural resources?" The panel was integrated by several prominent economists, including two Nobel Prices, Kenneth Arrow and Robert Solow. Testimonies were presented from some of the most prominent supporters and critics of the Contingent Valuation method. The panel concluded that the CV method can produce reliable estimations, applying among others, the following general guidelines:

- In-person surveys
- Should elicit WTP to prevent future incidents
- Should utilize the referendum format, since individuals are rather familiar with political markets and in that setting they know the economic implications of their decisions
- Should have detailed description of scenarios (avoiding information bias)
- Must contain reminders of resulted budget reduction
- Must contain reminders of the substitutes for the "commodity" in question
- Must include follow-up questions (by asking "what if" any lower or higher value   -payment- than the previously expressed, offering opportunities for the respondents to revise their amounts after additional information is provided (Mitchell and Carson, 1989: ch. 4).

Justification and applications of environmental economic valuation

JUSTIFICATION AND APPLICATIONS OF ENVIRONMENTAL ECONOMIC VALUATION

APPLICATIONS	OPERATIVE INSTRUMENTS
Comparative economic analysis between short term actions of natural resources exploitation and the long term benefits of conservation	Integration of values in cost – benefit analysis
Project and policies evaluation for the allocation of economic and financial resources	Integration of values in cost – benefit analysis
Establishment and management of protected areas	Economic resources allocation / Potential economic use
Determination of economic liabilities for natural resources damages or degradation	Decisions in legal proceedings
Compensation for land use regulation for environmental services protection	Agreements between intervening parties
Environmental impacts valuation for its integration in economic analysis	Environmental impact assessment and cost – benefit analysis
Modification of the national accounting system to reflect the natural capital	Integration of natural capital in the estimation of GDP
Determination of the influence and contribution of environmental services to local, regional or national economies	Integration of natural capital in the estimation of GDP
Information and training to all levels to internalize the economic values in the decisions of individuals and institutions	Information and training programs on the values of environmental services

Some reference information on valuations and CVM applications

- In 1947 in the United States, S.V. Ciriacy-Wantrup: Measurement of benefits of the prevention of soil erosion.

- In 1963 Robert Davis in the United States: Measurement of the value of a recreation area for hunters and wildlife supporters.

- 1991. Environmental Protection Agency (EPA/USA): Valuation of the visibility of the Grand Colorado Canyon.
  Filters: $ 100 million/year
  Benefits: $130-150 million/year
              Other study: $50 million/year

- 1992. State of Alaska: Valuation of lost existence due the Exxon Valdez oil spill in 1989 (11 million gallons of oil in the Prince William's sound). The Contingent Valuation Method (CVM) was applied to know the people's willingness to pay for a case like this wouldn't have never happen. Survey applied to 91000 English speaking homes. The mean value of the WTP resulted in $31/home, with a total valuation of $2800 million.

  An alternative study on the losses for recreation resulted in US$ 3.8 million in 1989 and without any more future losses.

- 1972 - 1992. TEXACO - Ecuador

Lawyers representing a population of 30.000, argue that Texaco spilled approximately 18.5 billion gallons of water with oil during its operations, and demand from the company to pay for the cleaning, an estimated of US$ 1 billion. It is not known that the CV/WTP method was applied to value some of the damages.

- 2010. British Petroleum-BP
  Oil spill of 205 million gallons (4.9 million barrels) of oil into the Gulf of Mexico. There is an increasing dispute about how the States, individuals and businesses in Louisiana, Mississippi, Alabama and Florida should be compensated for the losses suffered as a result of the spill. BP has created a compensation fund of US$ 20 billion, administered by a lawyer (Kenneth Feinberg) to manage the claims. Furthermore, many demands have been presented against the company. It is not known that the CV/WTP method was applied to value some of the damages.

CONCLUSION

Decision making on how to best use natural resources and formulate environmentally sustainable policies must integrate the total value society assigns to goods and services, whether they are part of the market or if they are nonuse values. Only by integrating the total values in the benefits and costs estimation, economic analysis would be an appropriate appraisal and decision tool.

Scientific and methodological principles and guidelines have to be closely followed when valuing environmental services and carrying out economic evaluations of proposed alternative states, in order to properly assess policy options and avoid undermining important scientific advances in these fields.

Since water as a public good doesn't have a production market value, and because of its scarcity trends, it is fundamental to estimate its non-use values in order to contribute to the development of a legal framework or to enforce it, as well as to the allocation of appropriate economic resources for the maintenance and preservation of its quantity, quality and flow regulation. Instruments for the design and implementation of programs for environmental services valuation will facilitate these processes.

REFERENCES

Barbier, E. B., Acreman, M. C. and Knowler, D. 1996. *Economic valuation of wetlands: a guide for policy makers and planners.* Ramsar Convention Bureau, Gland, Switzerland.

Bockstael, N., Freeman, A.M., Kopp, R., Portney, P., and Smith, V.K., 1999. "On Measuring Economic Values for Nature". In *Environmental Science and Technology.*

Breedlove, Joseph, 1999. RL30242: Natural Resources: Assessing Nonmarket Values Through Contingent Valuation. Congressional Research Service. Report for Congress. The National Council for Science and the Environment. http://www.cnie.org/nle/nrgen-24.html.

Castanier, H., 1999. "Economic Evaluation of Special Protected Area Punta de Manabique, Guatemala". EcoLogic-FUNDARY. Cambridge-Guatemala.

Castanier, H. 2000. Economic Valuation of Environmental Services and Public Goods. Some Theoretical and Practical Considerations from the Point of View of Economic Theory on Natural Resources. Directed Readings Prof. Robert Mitchell. Clark University. Graduate School of Geography. Worcester, MA, USA.

Chang, Man Yu. 2005. La economía ambiental. En Foladori y Pierri (2005), 175-188.

Costanza et al., 1997. "The Value of the World's Ecosystem Services and Natural Capital". *Nature: Vol. 387-May/15/1997.*

Daly, H. 1991. "Steady-State Economics". Island Press.

Diamond, P. y Hausman, J., 1994. "Contingent Valuation: Is Some Number better than No Number?". *The Journal of Economic Perspectives*, Volume 8, Issue 4 (Autumn, 1994), 3-17. American Economic Association.

Dixon, J., y Sherman, P. 1990. "Economics of Protected Areas. A New Look at Benefits and Costs". East-West Center. Island Press. Washington DC.

Fitchner / EMAAP-Q. 2010. Plan de Descontaminación de los Ríos de Quito. Evaluación Económica

Field, Barry. 1995. Economía Ambiental. Mc Graw-Hill Inc. Traducción de la Primera Edición. Bogotá, New York.

Goodland, R., Daly, H., and El Serafy, S., Editors. 1992. "Population, Technology, and Lifestyle. The Transition to Sustainability". Island Press. Washington D.C., Covelo, CA.

Green, C., Tunstall, S. 1992. *"The Amenity and Environmental Value of River Corridors in Britain"* in "River Conservation and Management". P. Boon, P. Calow, and G. Petts, Editors. John Wiley & Sons Ltd. London.

Hanemann, W. Michael, 1994. "Valuing the Environment Through Contingent Valuation". *The Journal of Economic Perspectives*, Volume 8, Issue 4 (Autumn, 1994), 3-17. American Economic Association.

Meadows, D., Meadows, D. L., Randers, J., Behrens. 1972. "The Limits to Growth". Universe Books. NY.

Meadows, D., Meadows, D. L., Randers, J. 1992. "Beyond the Limits". Chelsea Green Publishing Co. Post Mills, VT.

Mitchell, R. y Carson, R., 1989. "Using Surveys to Value Public Goods: The Contingent Valuation Method". Resources for the Future. NY.

Pearce, D. y Warford, J., 1993. World Without End. Economics, Environment, and Sustainable Development. The World Bank. Oxford University Press.

Pearce, D., 1998. Reviewer. "Auditing the Earth. The Value of the World's Ecosystem Services and Natural Capital". *Environment. Vol. 40, No. 2. 1998*. 23-28.

Portney, Paul, 1994. "The Contingent Valuation Debate: Why Economists Should Care". *The Journal of Economic Perspectives*, Volume 8, Issue 4 (Autumn, 1994), 3-17. American Economic Association.

Pushpangadan, P., Ravi, K., Santhosh, V. Editors. 1997. "Conservation and Economic Evaluation of Biodiversity". Science Publishers, Inc. USA.

Tietemberg, Tom, 1996. Environmental and Natural Resource Economics. 4th Edition. New York, NY. Harper Collins College Publishers.

Van Hauwermeiren, S. 1999. Manual de Economía Ecológica. Programa de Economía Ecológica. Instituto de Ecología Política. Chile. ILDIS. Ediciones Abya-Yala. Instituto de Estudios Ecologistas del Tercer Mundo. Quito.

Whitehead, J. 2003. Improving Willingness to Pay Estimates for Water Quality Improvements through Joint Estimation with Water Quality Perceptions. Department of Economics and Finance. Cameron School of Business. University of North Carolina at Wilmington.
http://www.rti.org/pubs/Whitehead_Improving_WTP.pdf