CHAPTER 5

Economic Environmental Valuation

Nelson H. W. Wawire[1] and Aggrey.D.M Thuo[2]

5.1 Introduction

This chapter attempts to place a monetary value on environmental resources describing various methods of valuing an environmental resource with respect to costs and benefits. This is because externalities do arise from production and consumption of goods and services that are not accounted for in a competitive market due to market failure (Stiglitz, 1988; Hyman, 1996 and Kolstad, 2000). Markets fail if prices do not communicate the society's needs and constraints accurately, thereby understating the services provided by an environmental resource. In the worst scenario, prices do not exist to send a signal about the value of a resource within the environment.

Causes of market failure ranges from incomplete markets due to undefined property rights system; existence of externalities such that the costs or benefits of market transactions cannot be captured in the prices; non-exclusion and common property where it is impossible or expensive to deny somebody access to an environmental resource (Freeman, 1993); non-rivalry such that one person's consumption does not reduce another person's consumption; and asymmetric information where one person in a transaction does not have full details about the action and character of the other person (Samuelson, 1954; Stiglitz, 1988 and Hyman, 1996 and Hanley, Shogren and White, 1997). Therefore, due to the failure of the market system to allocate and price an environmental resource correctly, there is a need to explain some economic measures of value of these resources in order to guide in policy making. This is the central theme of subsequent section of this chapter.

5.2 Economic value of an environmental resource

Economic value comprises any direct use value of an environmental resource plus whatever non-market values it may give rise to. Total economic value of an environmental resource comprises of use value, option value and existence value. The use value refers to the practical uses to which an environment resource is currently being put (Hussen, 2000). Forests for example, are sources of timber,

[1] Kenyatta University, Department of Economics: Email: nelsonwawire@yahoo.com
[2] Kenyatta University, Environmental Planning and Management Programme: Email: aggreythuo@gmail.com

medicine, absorbs carbon dioxide that is harmful for human beings and animals and releases oxygen that is useful for animal life, help prevent soil erosion and floods among other uses. Therefore, the economic value of the use of forests can be estimated by placing a monetary value on these forest products and services.

Option value refers to the value placed on an environmental resource now as per the uses that resources might be put sometimes in the future. This is in a form of insurance value and measures the willingness to pay to conserve an environmental resource now so that it is available for future use. On the other hand, existence value is the value placed on an environmental resource presently irrespective of its current or future uses. Willingness to pay in this case emanates from the wishes of the people for the resource to exist in its current form. Individuals subscribing to a Non-governmental Organization that seeks to conserve wildlife, natural habitats or forest for future generation is an example.

5.3 Methods for economic valuation of environmental costs and benefits

Willingness to pay can be used to place an economic value on costs and benefits of an environmental resource where no market price exists. Information on willingness to pay for such a resource, whose production is subject to market failure, is collected through the use of questionnaires or surveys. Individuals are asked how much they are willing to pay for some specified environmental resource such as conservation of a threatened species of wildlife or improved water quality. If they are willing to pay a substantial portion of their incomes, for example to buy water from door-to-door vendors due to convenience and time saving, instead of getting the water from kiosks or wells, such results will indicate a need to extend reliable water supply to the communities by the government and other stakeholders.

Private good whose consumption is complementary to the consumption of the environmental resource being examined can also be used to place a value on the environmental resource in question. For example, in a recreation case, travel costs incurred by the individuals to the recreation sites could indicate the price one is willing to pay for the recreational service in question. Therefore, through observing the price people and firms are willing to pay for the private complementary good the price for non-priced environmental resource can be inferred. The following is a discussion of the methods of valuing environmental costs and benefits.

Hedonic price method

Hedonic-price method is used where no price exist. It involves the estimation of the extent to which people are willing to pay for an environmental resource. The prices are based on the theory of consumer behaviour, which suggests that individuals value an environmental resource because they value the characteristics of the

resource rather than the resource itself. Housing is an example in which individuals are willing to pay for environmental quality. Housing prices are related to a variety of characteristics that include the attributes of the house itself such as number of rooms, their size, number of bathrooms, finishing touches; quality of construction and neighbourhood attributes such as distance to the workplace, level of crime, air quality among other factors. The value a person is willing to pay for a house for the benefit of living within easy access of an environmental feature can increase if the feature is viewed as attractive or desirable, or the value can reduce if the feature is viewed as undesirable because of being a nuisance and dangerous characterized by odour, noise, rotten, garbage, polluted air or health risk among other bad features that reduce environmental quality.

Therefore, given a choice between two houses offered for the same price and in every other respect, except that one is closer to a garbage dumping site, a person looking for a house to buy will choose the house that is further away unless the one near the dumping site is quite cheap. In this way, willingness to pay is implicitly revealed by people avoiding to pay due the nuisances associated with a dumping site while paying higher prices for a house that is far away from such a site. This example on housing is a good case of hedonic pricing where the value of an environmental feature such as neighbourhood amenities, clean air, clean water, among other factors, is assessed by using actual markets in which the attributes are traded (Hanley, Shogren and White, 1997).

Hedonic price method has three stages. First, hedonic price function is estimated using a regression technique after identifying the factors that affect hedonic prices. In the housing problem for example, data need to be gathered on house sale prices and on all characteristics of the houses that are relevant to their value. The regression equation takes the following form:

$H = f(S_i...S_m, N_i..N_n, Q_i..Q_p)$

Where:

H is the price of the house, $S_i...S_m$ are site characteristics such as number of rooms, size etc. $N_i..N_n$, are neighbourhood characteristics such as crime rate, distance from the work place etc; and $Q_i...Q_p$ are environmental characteristics such as air quality and noise levels. A linear equation in this regard can be specified as:

$H = \delta + \sigma S + \alpha N + \beta Q + e$

Where:

δ σ, α and β, are parameters to be estimated, and e is the disturbance term or a random variable. Hypothetical results from running an ordinary least square regression are given in the table 1 below.

Table 1: **Hypothetical regression results for hedonic price method**

	Estimate of			
Constant (δ)	σ	α	β	- R^2
100	0.55	- 0.23	0.07	0.98
(3.1)	(2.2)	(2.4)	(2.1)	

( ): The student's t-statistics

Since all the t-statistics are significant, (> 1.96), the variables captured by the model explain up to 98 percent changes in house prices as indicated by the adjusted R-squared of 0.98. From these results, a regression line is derived and presented as:

$$H = 100 + 0.55S - 0.23N + 0.07Q$$

The model implies that when the air quality (Q) deteriorates by one unit, the house price (H) decreases by 0.07 shillings and vice-versa. This means that there is a positive relationship between air quality and the house price.

The second step is to compute implicit price using the estimated model for the environmental variable of interest. If for example, S = 10, N = 20 and Q = 100, then the house price will be 107.9 shillings. The third step is to construct a demand curve for the environmental variable. As the prices of the houses increase, quantity (units) of houses demanded decrease. Hence there is a negative relationship between units of houses purchased and their prices. This is presented in the diagram that follows.

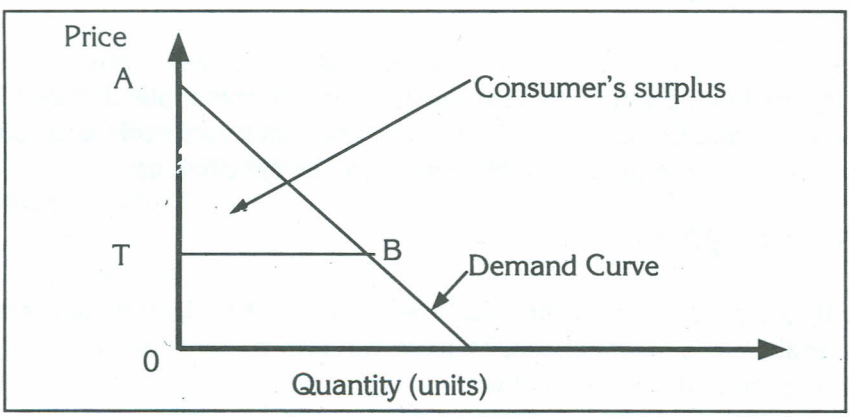

Figure 1: Demand curve showing the willingness to pay. (The willingness to pay is computed from the consumer's surplus given by the triangle ABT)

The above discussion limits the application of hedonic price method to cases where environmental attributes can be inferred from the market prices for housing, land or, in general, property values. In cases where such data are available, a hedonic price method can be used to estimate the value of an environmental resource since it is based on people's actual behaviour.

Problems associated with the hedonic price method

(i) The approach is completely dependent on property values and as such has limited application. For example, it will not be applicable to measure costs and benefits to national parks, endangered species and ozone depletion among others due to absence of values.
(ii) There is biasness in the estimated coefficients caused by omitted variables and yet if included these variables could significantly affect the outcome.
(iii) Choices of functional form may be a problem because economic theory does not specify the type of function to use. For example, econometric considerations should be linear or non-linear. This will influence the value of implicit price estimated.
(iv) Some environmental variables may be highly collinear requiring that some important variables be dropped from the model for it to be statistically sound
(v) Sales may depend on expected future environmental conditions in addition to actual characteristic levels, which creates biases in pricing.
(vi) It assumes equilibrium condition in the market where demand and supply for a good in question are equal yet this might not be the case
(vii) Attitudes to risk within the environment will affect pricing of an environmental resource. Peoples' subjective values of losses due to risks such as earthquakes, health risks among others may be either less or more than the endowed probability

Hedonic wage method

This is another method under the revealed preference technique that is applied in economic valuation of changes in human health conditions, such as mortality and morbidity. If two jobs are identical except for the risk of accidental death, then the wage rate of the riskier job should be higher so as to induce people to accept that job (Kahn, 2005). In this case, willingness to pay is inferred from available information on medical expenditures which an individual is willing to incur to avoid mortality or morbidity at the work place. Using this method, the economic value of morbidity is approximated by the society's loss of labour productivity as a result of an individual's premature death caused by specific pollution-related ailments (Hanley, Shogren and White, 1997).

Peterson (1977) estimated the social cost of Reserve Mining Corporation discharges on nonmagnetic rock or tailings into Lake Superior that exposed individuals to serious health risks because the people draw water from the lake. It was found that contamination of the lake water would increase the average annual number of deaths in the area by 274 over the 25 years of remaining operation of the plant. It was also determined that the mean age at death of the North shore victims would be 54 years of age, or12.8 years less than the average life expectancy of a U.S. male, which was 66.8 years by then (See also Hanley, Shogren and White, 1997).

The household production function method

In this method, the value of an environmental resource is measured by looking at the consumer's expenditures on the resource. Examples of such types of expenditures include purchasing water filters to reduce the risk of drinking contaminated water and frequent visits to a medical doctor to reduce the chance of serious ailments from prolonged exposure to air pollution. In these cases, the individual is willing to pay a price so as to avert an environmental damage. Therefore, these expenditures are used as measures of individual's willingness to pay for a certain level of environmental quality such as clean water, clean air etc. Where several types of expenditures are undertaken simultaneously, total value is measured by adding together the expenditures that are needed to attain the desired level of environmental quality (Hussen, 2000).

Travel cost method

This is a method of valuing an environmental resource that is associated with recreation activities. It is a variation of the household production function method that involves the valuation of an environmental resource from recreational sites such as national parks. This method measures the willingness to pay for a recreational experience, by looking at households' expenditures on the cost of travel to a desired recreational site. The argument is that the services of a recreation site, for example a camping ground, cannot be adequately measured by the entry prices, which in most cases may be very low. The value for an environmental resource in this case is inferred from the amount of money an individual incurs in order to enjoy the benefits of a resource. The travel cost to the site being regarded as the price of access to the recreation site or resource. The number of trips taken by an individual who goes for recreation and the cost paid to the site is used to estimate a demand curve for that recreation site. If you assume that the visits to a recreation site is determined by a trip generating function (Roger *et. al,* 2003) such as:

$$V_i = f(C_i, X_i...X_n)$$

Where: V_i is the visit from the i^{th} individual; C_i, is the cost of a visit from the origin that comprises both travel cost that vary from individual to individual and admission

price that is constant across individuals, and that visitors treat travel costs and admission price as equivalent elements of the total cost of a trip; ($X_1 \ldots X_n$) are other relevant variables. Using regression analysis, a line is fitted on the data of travel cost and the number of trips reported by the individual and this line is the demand curve (Figure 2).

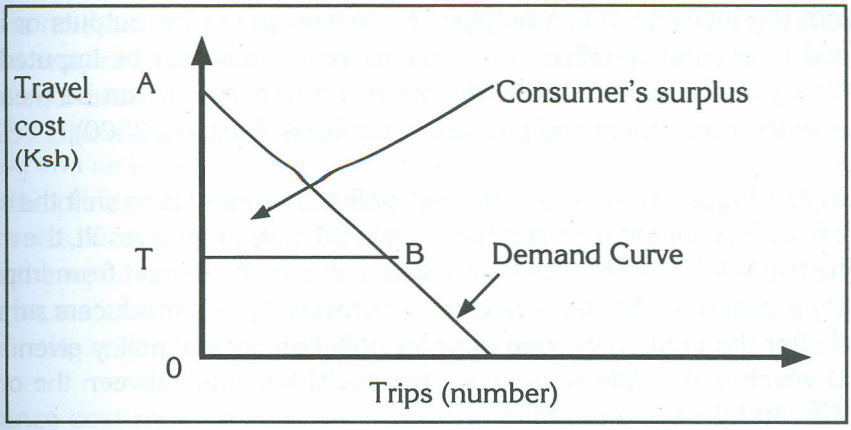

Figure 2: Hypothetical demand curve for the travel cost method. The value of the recreation site is computed from the consumer's surplus (area under the demand curve and above the travel cost that an individual actually incurs (ATB) times the number of people who visited the site within a given period.

This method has the advantage of being cost effective since data gathering is at the site of the recreation and it allows the use of other methods of gathering data at the same time, such as direct observations. The disadvantages include among others:

(i) The effects of other substitute sites being difficult to include in the valuation especially when estimating the demand curve
(ii) The choice of a value for the cost of travel time and the functional form may cause significant changes in the estimates of consumer's surplus.
(iii) A multipurpose trip in which the visitors to a site form only part of their journey may require the cost to be apportioned between the trips and this might prove difficult.
(iv) Can only be used to measure use-values but not non-use values since it is a revealed preference method.
(v) Difficult to measure recreational quality and to relate it to environmental quality.
(vi) Biased results due to econometric estimation problems as discussed in the Hedonic pricing method.
(vii) The application of the method is limited to the valuation of the recreational sites.
(viii) The valuation itself is incomplete, since the method does not account for a recreational site's existence value. People may still value a recreational area even if they themselves have never been in the area.

The market pricing method

This is used to value an environmental resource, which causes an increase/decrease in real outputs and/or inputs. If for example, the Kenya government implement a new water pollution control policy, the value of unpolluted environment will be inferred from the increase in fish output. The market prices for outputs or inputs are expected to accurately reflect their scarcity values that can be imputed. The benefits directly attributable to the environmental improvement can be measured by changes in the consumers and producers surpluses (Hussen, 2000),

As an example (Figure 3) the effect of water pollution control is to shift the supply curve from S_o to S_1, indicating an improvement in fish output. As a result, the market price for the fish will fall from P_o to P_1. As stated above, the benefit from improved water quality is measured by the difference in consumers' and producers surpluses before and after the implementation of water pollution control policy given by the area ABCD which is the difference in the net social benefits between the original triangle, ACF, and the new one, BDF.

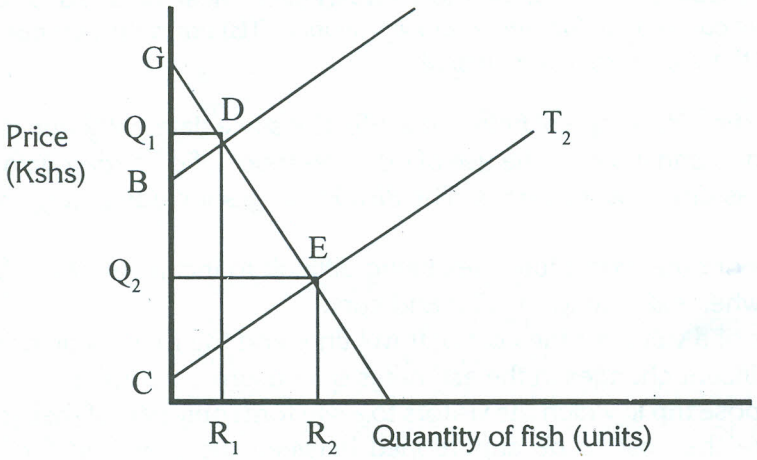

Figure 3: Changes in consumers' and producers' surplus using the market pricing method

The replacement of cost method

This approach is used to value an environmental resources in terms of the cost of re-creating what was lost as a result of environmental change. The value is approximated by the market value of what it cost to restore or replace the damage to the environment. In case of an oil spill for example, this will require repairing the environmental damage. This will involve the cost of cleaning the oil spill and the cost of re-introducing plant and animal species that might have been destroyed or killed by the oil spill. The method elicits individuals' willingness to pay because

the reduction in replacement and restoration costs due to improved environmental conditions reflects their willingness to pay to avoid environmental damage (Pearce, 1993). The method is quite appealing because it is generally easy to find estimates for replacement costs.

However, the method should be used with some care because in some cases, the environment may not be completely restored to its original status. It may therefore not provide equivalent flow of environmental services of the same value as before (Kahn, 2005). Dixon and Hufschmidt (1986) used this method to estimate the cost of recovering and replacing eroded soil from an agricultural project in Korea. In this case study the productive asset that had been damaged was the soil in the upland areas. The costs of replacing lost soil nutrients were used as a benchmark by which to measure the replacement costs which were viewed as measures of the minimum benefits to be realized from preventive steps that could be undertaken to restore and maintain the original productivity of the damaged soil.

The avoidance cost method

This refers to the cost that individuals incur to prevent or avoid the adverse effects of an environmental change. Avoidance measures eliminate the negative consequences of an environmental change and therefore measures the social cost of the problem (Hussen, 2000). For instance, if drinking water from a stream polluted by a coffee factory upstream such that the water is no longer fit for human consumption, then those who use the water can avoid it by going for the well or spring water, or purifying it before drinking. In the process consumers avoid contracting water borne diseases. The use of avoidance cost method results in disutility to the individual because of inconvenience experienced by not using the resource that is readily available, for example the water from the stream.

The contingent valuation method

The methods considered so far share two common features. One is the willingness to pay measured either explicitly using market prices or implicitly using prices of substitutes and complementary goods and services traded in the market. Second, is the stress placed on estimating use values, which are benefits or satisfaction, received by individuals who are directly utilizing the service provided by an environmental resource.

There are several attributes of the natural environment from which individuals obtain satisfaction, and hence benefits (Hussen, 2000). The value of forests in Kenya for example, cannot be measured only by its recreational values to current users. It has non-use values to the extent that there are individuals and organizations that are willing to pay to conserve the forest for future uses. Such non-use value may not be captured by methods that focus on measuring the willingness to pay of resource

users at a point in time. According to Krutilla (1967) and Arrow (1974), thi serious problem when the environmental resource being considered involve time horizons, considerable uncertainty and/or irreversibility.

Non-use values have three separable components, namely option, bequest existence values. Option value refers to a kind of insurance premium indivi may be willing to pay to retain the option of possible future use. Individual example, will be willing to pay some amount of money for the conservatio forests or the protection of a unique site such as a water catchment area, because they are currently using them, but because they want to reserve an op that would guarantee their future access to these resources. Individuals behave way because of uncertainty regarding their future demand for and supply of environmental resource (Krutilla 1967 and Johansson 1990).

Bequest value refers to the satisfaction that people gain from the knowledge t an environmental resource is being conserved for future generations. Bequest va is relevant in a situation where the resource is unique and irreversible, and th is uncertainty about future generation's demand for and supply of the resou in question. Natural forests and national parks are examples in Kenya. This seen legislations being put in place to conserve them. An existence value refer the satisfaction that individuals derive from the conservation of an environme resource to keep a natural habitat for animals and plants.

The relationship between these types of uses could be shown by the follow identities:

- Total value = Use value + Non-use value, while
- Non-use value = Option value + Bequest value + Existence value.

As such the total value of an environmental resource consists of various types willingness to pay because the resource is characterized by economic factors well as special attributes including uniqueness, irreversibility and uncertainty as the future supply (Hussen, 2000). If any of the above characteristics are not tak into account, the results would be underestimation of the value of an environme resource. If for example, the decision to conserve forests is to be based solely the benefits derived from the use value, this might lead to insufficient protecti measures being undertaken.

Since it is impossible to assess non-use values by using implicit prices, real mar information cannot be used to elicit willingness to pay. The contingent valuat method measures willingness to be pay using hypothetical market conditions. T is done by conducting a survey in which a sample from the relevant populat responds to questions about their willingness to pay in relation to changes in availability and quality of an environmental resource. For example, an individ

might be asked how much money he/she is willing to pay to conserve the forest to assure him/her of its availability for use by the future generation. This captures the measure of bequest values. It is important that the questionnaire should be designed with knowledge of statistical survey methods, economics, and environment, in a creative manner (Hussen, 2000) so as to capture all the aspects required.

Table 2: Total annual consumer surplus in Kenya shillings from recreation site use and preservation value to individuals from increments in picnic site designation

Value categories	Existing potential picnic designation			
	Picnic areas, 2000 (50 acres)	Picnic areas, 2001 (80 acres)	Double 2001 Picnic areas, (160 acres)	All potential Picnic areas, (200 acres)
Recreation use value Per visitor day Total, million	31/11 29/61	31/11 36/11	31/11 46/11	31/11 71/61
Conservation value Per household Total, million	24/:2 26/61	31/11 36/11	39/81 47/61	56/51 65/11
Option value Per household Total, million	6/11 7/11	7/51 9/11	9/41 21/11	23/11 26/11
Existence value Per household Total, million	6/:1 5/61	9/51 9/61	:/:1 22/61	26/11 27/61
Bequest value Per household Total, million	4/12 6/11	6/61 9/61	21/61 26/11!	29/51 33/61
Annual recreation use and conservation value to households, million	45/11	61/11	82/61	225/61

Source: Constructed from hypothetical data by the author

The last row of the table shows the estimate of the total values of each of the four picnic sites. The total values of each picnic site are split into two categories, namely use value that represents the recreational use of the picnic site and non-use value that corresponds to the conservation of the picnic site. The picnic area of 50 acres, for example, has a total estimated value of Ksh 34 million for the year 2000 broken

down into a recreation use value (ksh. 18.5) and conservation value (ksh. 15.5 conservation value is further broken down into the option value (ksh. 6.0), exis value (ksh.4.5) and bequest values (ksh 5.0).

Advantages

(i) It can assess the total economic value that includes use values plus no values of any type of environmental resource.
(ii) Answers to the question on the willingness to pay are used directly to me the satisfaction of individuals.
(iii) Captures the intrinsic values (non-use values) of an environmental reso that cannot be captured through market information.

Disadvantages

(i) The instruments may not fully capture the total value of an environm resource. Biases may arise that undermine the validity of the inform gathered on the willingness to pay.
(ii) Informants may refuse to respond to some of the questions asked
(iii) The survey result on the willingness to pay for an environmental reso may depend on the quantity and quality of the information provide respondents including the way questions are constructed and structured
(iv) It is subject to hypothetical bias since the respondents do not make transactions. Hence they tend to be sensitive to the instruments used payment such as entrance fees and taxes.
(v) There is a potential failure to account for certain environmental factors. the extent that total value is based on economic values, it may fail to acco for the characteristics upon which all environmental functions are conting (Pearce, 1993). Since all matters in an environment are mutually interrelat the value of a particular good or entity (a river, a forest, an animal etc.) sho be assessed on the basis of its overall contribution to the sustainability of ecosystem as a whole. In fact assessing the total value of an environme resource as the sum of the values of the individual attributes does not acco for the whole.

Choice modelling method

The method is based on the argument in the contingent method that a resou consists of a bundle of characteristics that interests the users. Various dimensio of the decision are treated as characteristics, which can take a number of leve Each informant in the survey is presented with several sets of choices that requ him/her to select a preferred alternative from a single choice set. The status quo included as one of the alternatives.

Suppose for example, the government is interested in conserving the forest and in doing so, the species of birds and the acreage under the forest are expected to increase. In this case, it might be necessary to restrict visits into the forest to a particular number per year as a measure to conserve it. In order to carry out such a conservation activity, the government would be forced to raise the additional income tax revenue to fund the activity. Table 3 below shows one choice set for this hypothetical Choice model survey.

Table 3: One choice set for a hypothetical choice model

Consider each of the following options available and indicate which one you will choose

Characteristic	Status quo	Alternative A	Alternative B	
Increase in birds	200	350	450	
Acres of forest	3000	4500	5600	
Visitors per year	6000	4000	3200	
Cost to you	0	120	350	

Tick your preferred option
Status quo at no cost.
Alternative A at a cost of kshs 120
Alternative B at a cost of kshs 350

Source: Constructed by the author

The assumption in this method is that the informant chooses an alternative that yields highest satisfaction to him/her. The information obtained through the survey is analysed using an econometric technique known as multinomial logit model.

Advantages

(i) It can generate answers about a range of alternatives.
(ii) Controls the frame that an informant uses to choose between alternatives through forming his/her preference
(iii) Strategic behaviour by the informant may not be exhibited in this method

Disadvantages

(i) There is a great danger of the informant adopting the rule of the thumb to choose between alternatives
(ii) Biases may arise that undermines the validity of the information gathered
(iii) Informants may refuse to respond to some of the questions asked
(iv) The survey result may be dependent on the quantity and quality of the information provided to respondents including the way questions are constructed and structured.

(v) It is subject to hypothetical bias since the informants do not deal with real issues. Hence they tend to be sensitive to the instruments used for payment of taxes.

Benefit transfer method

This method uses estimates derived from both revealed preference and stated preference approaches to economic valuation of an environmental resource. Values are taken from other studies in other areas and applied to the area where a decision on the values is to be made. Care should be taken to choose the most appropriate reference study. For example, if a new paper industry is planned that threatens to pollute the nearby river with an acidic waste that will kill fish, to get the value of water pollution in that river, the value of fishing from a study that was done on fishing in the river is used. Where such a study is absent, a weighted average of the values from many other related studies may be used. The weights chosen will depend on the similarities between the reference study and what should be valued. Therefore, a large set of relevant studies should be used as suggested by Smith and Pattanayak (2002).

Advantages

(i) It is less expensive compared to those discussed earlier in terms of time and resource required.
(ii) It is simple and less complicated when applying it.

Disadvantages

(i) Its application is limited to availability of reference studies or similar studies.
(ii) It is not scientific since it does not involve hypothesis testing and formal statistical tests.
(iii) There is limited generalization of results since it uses other studies to make reference of the value of an environmental resource.

5.4 Problems associated with Economic Environmental Valuation

This chapter was devoted to describing the features of some of the methods that are used for economic valuation of the environment. These methods reduce environmental values to a single one-dimensional standard that is ultimately expressed in monetary value. The monetary value is assumed to be assigned to all aspects of an environmental resource. All the valuation methods discussed in this chapter suffer from several disadvatages in their application. The following is a highlight of some the general problems that are encountered in economic environmental valuation:

(a) Funtowicz and Ravetz (1994) argued that reducing values to a single standard is not acceptable because there are immeasurable intangible environmental characteristics that can be described only in qualitative terms. Examples include improved quality of life, protection of endangered species like white Rhinos and the preservation of scenic or historic sites such as Fort Jesus in Mombasa, Kenya. The values of these environmental resources cannot be captured either through the market or by survey methods that are designed to capture the willingness to pay.

(b) Survey techniques used to elicit willingness to pay may confuse preferences with beliefs. The main reason for this is that people's preferences for an environmental resource include aspects of their feelings that are not economic and may be based on aesthetic, cultural, ethical, moral and political considerations. The implication is that environmental valuation should be based not only on market prices but also on a decision-making process that captures aesthetic, cultural, moral and ethical aspects too.

(c) Important economic interrelationships may be missed when valuing components of a system separately. This is because environmental matters are mutually interrelated which requires a value of a particular resource to be assessed on the basis of its overall contribution to the sustainability of the ecosystem as a whole.

(d) High levels of uncertainty may make the measurements and the concept of total economic value meaningless. Uncertainties are important when the environmental resource is irreplaceable and has no close substitute (Krutilla, 1967). The potential costs of present environmental activities may be quite high. Examples include ozone layer destruction and global warming. According to Hussen (2000), the implications of uncertainty in the face of economic valuation includes:

(i) Compounding the difficulty of valuing an environmental resource

(ii) The damage being immeasurable or infinitely high where irreversibility is a serious concern which leads to a meaningless total economic value being obtained.

(iii) Misleading outcomes of an attempt to determine individual's willingness to pay for non-use values through the contingent valuation method where it is more difficulty to replace a loss of an environmental resource with other resources because the compensation needed for people to accept the loss is high.

(iv) Assigning a worst-case value to the uncertain outcome of present environmental activities and picking on the policy that minimizes the worst outcome, hence the need to conserve an environmental resource if costs are potentially large and long term (Perrings, 1991).

5.5 Conclusion

The specific technique used for measuring the willingness to pay depends on the nature of the environmental damages that have to be avoided in order to achieve the desired environmental quality. Examples include a higher risk of mortality and morbidity; loss of economic outputs; increased exposure to environmental nuisance, like noise, odour and debris; amenity and aesthetic losses; simplification of natural habitats; and irreversible damage to the ecosystem. Several methods are available for economic valuation of the environment as discussed above. However, there is no single method that has been developed to be used effectively in all circumstances. The choice of the technique is therefore an important decision to make taking in mind the circumstances. Above all, these methods need to be refined to suit the circumstances under which valuation is being carried out.

5.6 Review Questions

i. Saeni conducted a study on housing prices in Sivilie area and after analysing data, noted that everyone in the sample had exactly the same tastes and preferences: same income, likes the same music, and went to the same school etc. Explain whether or not Saeni had enough information to construct a willingness-to-pay function for pollution in this area.

ii. Given the following cases in which an environmental damage has occurred, choose the best technique to estimate the cost of damage for each case and provide a brief justification for your choice.

- Excessive noise from a near by factory.
- Loss of scenic beauty due to human activities
- Loss of habitat due to development projects
- Excessive soil erosion due to deforestation

iii. A vehicle manufacturer is interested in the marginal willingness to pay for fuel by consumers. Describe how you would carry out the analysis in terms of characteristics of the vehicles, measuring the hedonic price function and translating it into a willingness to pay function.

iv. Explain the problems associated with the economic approach to environmental valuation.

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