CHAPTER SIX

VALUATION OF ENVIRONMENTAL GOODS AND SERVICES

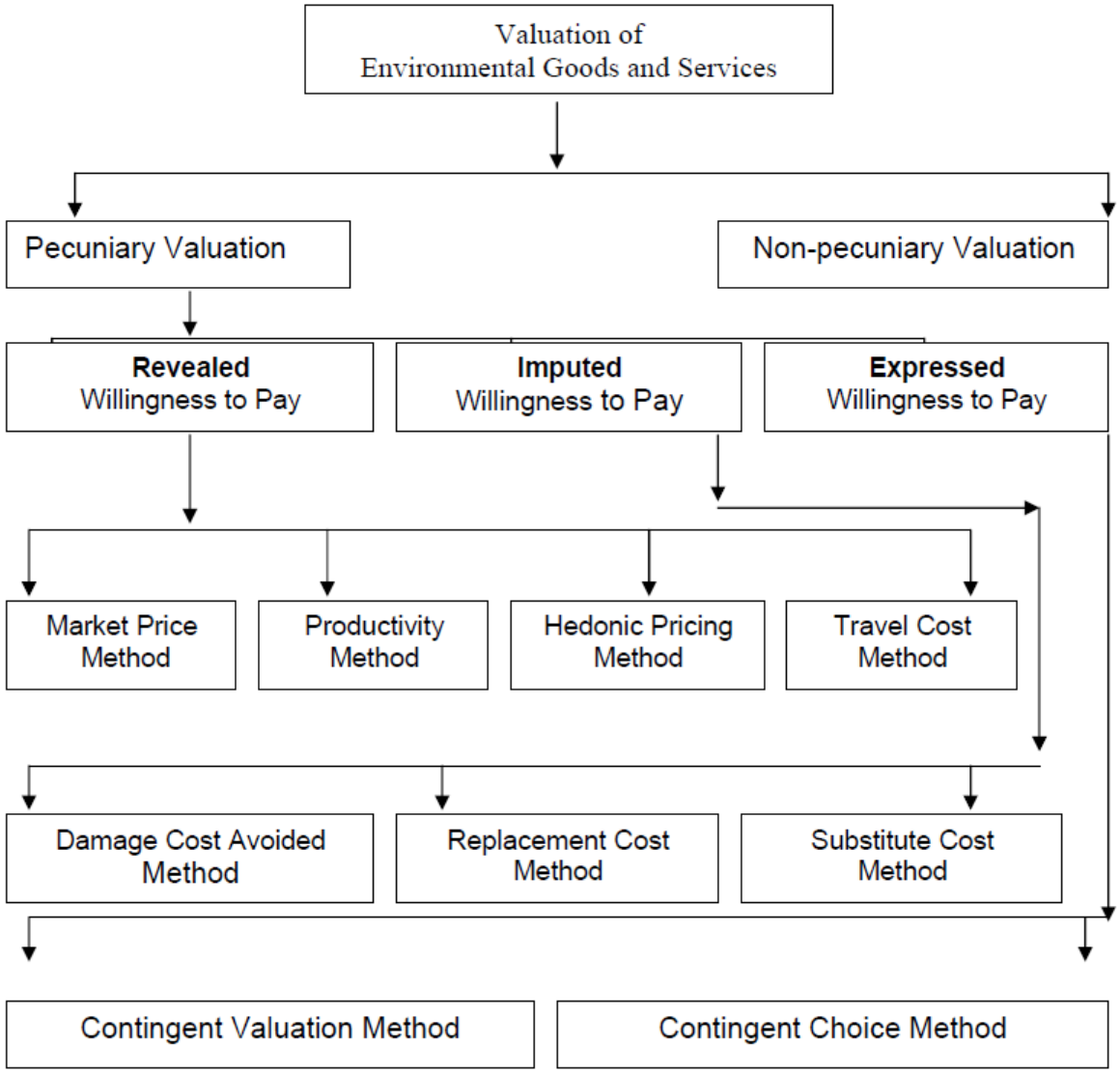
6.1. Introduction

Environmental goods and services are the biogeochemical processes, attributes or the products thereof that relate to the self-maintenance of an ecosystem, provision of wildlife habitat, cycling of carbon, nitrogen, phosphorus, sulphur, water or the trapping of nutrients, etc. and make the basis of sustenance as well as prosperity to the human society. Only some environmental goods and services have markets, and therefore, prices of only a few of them are available as data. These prices too, are only the indicators of the minimal payments at which the consumers and the producers have agreed to enter into transactions. At these prices, there may be substantial consumer and/or producer surpluses that may go unaccounted. The worth of environmental goods and services include these unaccounted surpluses, but their prices do not generally reflect their worth. However, a greater part of environmental goods and services have no markets and, therefore, no prices at which they are available to the consumers. Valuation of such goods and services is much more relevant.

Environmental goods and services are often public goods, which to some extent, may be harnessed by many without adversely affecting each other's interest. However, these goods and services have a limit to their bearing capacity, beyond which they cannot sustain their use. Crowding on their use can decrease users' utility. Public goods often suffer free-riders' problem. Although each user values them, none has an incentive to pay to maintain them. These goods and services may also be affected by externalities, or uncompensated side effects of human actions. Market mechanism cannot often regulate their consumption, production and allocation. That necessitates a collective action for their upkeep, which incurs considerable public cost. Hence, the valuation such goods and services may help the resource managers to deal with the effects of market failures, by measuring their social and opportunity costs. The costs to society can then be imposed, in various ways, on those who are responsible, or can be used to evaluate and regulate environmental impacts.

6.2. Alternative Methods of valuation of Environmental Goods and Services:

Methods of valuation of environmental goods and services may broadly be classified into two categories: (1) Pecuniary, and (2) non-pecuniary. Pecuniary valuation methods obtain the 'money equivalent' of these goods and services – money is used as the numéraire, while non-pecuniary methods, more general in nature, may use any numéraire for valuation. Our primary concern here is to discuss only the methods of pecuniary valuation. These (pecuniary) methods may again be classified into three: (i) based on Market Prices or Revealed Willingness to Pay, (ii) based on Circumstantial Evidence or Imputed Willingness to Pay, and (iii) based on survey of Expressed Willingness to Pay. In each category, there are several alternative methods.



I. Valuation on the Revealed Willingness to Pay:

Whenever an environmental good/service or a product using it as an input has a market, the buyers reveal their willingness to pay, since they buy the good/service at a price. On this principle four methods have been developed. They are: (i) The Market Price Method, (ii) The Productivity Method, (iii) The Hedonic Pricing Method, and (iv) The Traveling Cost Method. In this section we discuss them in some detail.

a) **The market price method**: This method estimates consumer's surplus and producer's surplus using market price and quantity data regarding the environmental goods/services (e.g. fish, timber) traded in the market. Consumer's surplus is the benefit enjoyed by the consumer over and above the cost that he has paid for commanding them. Similarly, the producer's surplus is the benefit that he enjoys over and above the cost that he has incurred in producing and marketing the output. The total net economic benefit, or economic surplus, is the sum of consumer surplus and producer surplus. Environmental goods and services that generate larger net surplus are more valuable.

This method has several limitations. First, since only a few environmental goods/services are bought and sold in the markets, its coverage is limited. Secondly, market imperfections distort prices and, therefore, the efficacy of such prices in measuring the net benefits. Prices also vary seasonally and cyclically. Further, the ambit of market economy depends on the level of development of an economy. In less developed economies many resources that contribute to the produce brought to the market go unaccounted and thus are not reflected in the prices.

It may also be noted that estimation of net economic benefits depends on estimation of consumer and producer surpluses, which in turn, depends on the specifications of the demand and the supply curves. Depending on the specification, the functional relationships between demand, supply and their determinants may be overwhelmingly complicated or too simple. The functional relationships may be linear or non-linear, bivariate or multivariate and so on. The list of determinant variables (such as income, prices of substitutes, prices of other goods, etc.) may not be an easy task to make. Due to all these, the estimation of consumer as well as producer surplus will be model dependent. Consequently, the estimated net benefits also would be model dependent.

b) Productivity Method: This method is applicable in cases where the environmental goods/services are some (or one) of the inputs to produce a marketed good. An appropriately specified production function may indicate the contribution of these inputs to the output and from this information one may deduce the benefit due to these inputs. This method requires that data must be collected regarding how changes in the quantity or quality of the environmental resource affect - (i) costs of production for the final good, (ii) demand for and supply of the final good, (iii) demand for and supply of other factors of production. This information is used to link the effects of changes in the quantity or quality of the resource to changes in consumer surplus and/or producer surplus, and thus to estimate the economic benefits. However, not all environmental goods/services are related to the production of marketed goods. This fact limits the scope of application of this method. In making policies, one has to understand the relationships between actions to improve quality or quantity of the resource and the outcomes of those actions. These relationships are not obvious. If the changes in the availability, quantity and quality of environmental goods/services affect the market price of the final good, or the prices of any other inputs, the method is difficult to apply. Specification and estimation of a suitable production function is not an easy task. Moreover, the very concept of production function presumes optimal utilization of inputs, which, in the real life is not always feasible. There are many obstacles to optimal utilization of inputs, such as X-efficiency, moral hazards, premium for uncertainties, robust local optima, rational ignorance and so on. It has also been pointed out that activity analysis, rather than production functions, give a true picture of the relationship between inputs and the output. If activity analysis of production process is carried out as a background to productivity method of valuation, a better and more reliable valuation would be possible.

c) Hedonic Pricing Method: Consider a (marketed) good/service as a bundle of characteristics (as Lancaster has suggested). The producer enriches his product with the characteristics in demand (and some more that may induce product differentiation and/or cover the demand of a larger or heterogeneous clientele). A buyer has a demand for a number of these characteristics (maybe, not all characteristics that the said bundle possesses) and pays for them. A diminution in the desired characteristics will lower the demand for the bundle (good/service) and thus will affect its price adversely and vice versa. In this vein, some marketed products are tied with some environmental goods/services. When a person buys those goods/services, he also buys the environmental goods/services tied with them. The buyer pays not only for the marketed goods/services, but also

for the package that includes the tied up environmental goods/services. A diminution of environmental goods/services, therefore, degrades the package and lowers its price. This fact is used by the hedonic pricing method for valuation of environmental goods and services.

Therefore, this method is most suitable to assess the value of local environmental attributes. It is used to estimate economic benefits or costs associated with environmental quality, such as air pollution, water pollution, or noise, and environmental amenities, such as aesthetic views or proximity to recreational sites, etc. These attributes directly affect house rents and land prices in a locality. From changes in house rent or land prices, the valuation of environmental attributes is done.

This method is applicable only to valuation of those environmental goods/services that are tied to a marketed goods/services and the prices of the latter respond to changes in the quality/quantity and attributes of the former. It is also assumed that nothing else modifies the relationship between them. Further, this method demands a rich data base and reliable estimation method. It is also susceptible to the choice of model specification used to estimation at hand. A wrong specification of the model or the method of estimation may easily underestimate or overestimate valuation of environmental goods/services.

d) Travel Cost Method: The travel cost method is based on the assumption that the cost that people incur to visit a site is the payment or the "price" of access to the site and its environmental services. It may be measured in the money value of time as well as the cost of journey. Peoples' willingness to pay to visit the site may be estimated based on the number of trips that they make at different travel costs. The travel cost method is often used to estimate economic use values of recreation spots or sites, effects of changes in access costs for a recreational site, elimination of an existing recreational site, development of a new recreational site and addition or removal of some environmental services or alterations in the quality of services available at a recreational site. It may also be used to evaluate the location decision of a public service to which many people visit.

The travel cost method is uncontroversial, inexpensive and reliable, but it has its own limitations. Especially, it is difficult to assign pecuniary value to time cost of the visits to a site. If the visits serve many purposes of a visitor, or very different mix of different purposes of different visitors, the method may cut a sorry figure in estimating the use value of services/characteristics of a site.

II. Valuation on the Imputed Willingness to Pay:

The value of some environmental services can be measured by estimating people's willingness to pay, or the cost of actions they are willing to take, to avoid the adverse effects that would occur if these services were discontinued, or to replace the lost services or revive the services. Three very closely related methods have been proposed that are based on these considerations. These methods are: (a) Damage Cost Avoided Method, (b) Replacement Cost Method, and (c) Substitute Cost Method. These methods are based on the assumption that, if people incur costs to avoid damages caused by lost environmental services, or replace them in case they are lost, then those services must be worth at least what people paid to maintain or replace them.

Are costs of damage avoidance or replacement of an environmental good/service commensurate with the benefits they provide? Possibly, costs are the lowest limit to the benefits when purely economic considerations are made. Sometimes non-economic considerations dominate the economic ones and in those cases, costs may be overwhelmingly higher than the economic benefits. It is assumed that man is rational (in economic sense of rationality). But in fact, man is so much guided by emotions, feelings, etc. On these considerations, damage avoidance or replacement methods of valuation are best suited only to cases where damage avoidance or replacement expenditures have actually been, or will actually be, made. These are risky and inaccurate methods to use.

III. Valuation on the Expressed Willingness to Pay:

As it has been mentioned earlier, many environmental goods and services are not traded in markets, nor are they closely related to or tied with any marketed goods. Therefore, people cannot "reveal" their willingness to pay for them. Nor it is always possible to impute people's willingness to pay by their action or expressed intent to avoid losing those environmental goods and services or replacing them if they are lost. In such situations, therefore, a survey designed to make the people face an artificial scenario may be carried out. They may directly be asked as to what they would be willing to pay, if that is the hypothetical scenario. In a simulated condition, people can be asked to make tradeoffs among different alternatives. From the data generated by such surveys, people's willingness to pay may be estimated. In a way, these surveys experiment with the people to know their willingness to pay for some environmental goods/services. Based on this scheme, two

methods have been suggested. These methods are: (a) Contingent Valuation Method, and (b) Contingent Choice Method.

a) **Contingent Valuation Method:** The name 'contingent' valuation is based on the characteristic feature of this method as it works on asking people to state their willingness to pay, contingent on a specific hypothetical scenario and description of the environmental goods and serviced. It is based on an assumption that people would do what they say. Indeed this assumption makes the foundation of this method rather shaky because the congruence in thinking, saying and doing is not necessary. It is not unusual to experience that in saying people are guided by the 'ideals', but in doing they quite forget the ideals. It is easy said than done, goes the proverb. However, if there is some significant association between saying and doing, this method may be very successful in eliciting the willingness of the people to pay for the environmental goods and services and thus, their value. Therefore, granted that its assumption is correct, the contingent valuation method is a very versatile method which can be applied to valuation of almost any kind of environmental goods and services irrespective of their being marketed or not marketed. It can be used to estimate use value, non-use (passive) value, option value (reserved for one's future use) or bequest value (reserved for the use by the future generation). On the other hand, it is also the most controversial among the non-market valuation methods, mainly on account of its shaky assumption.

It would be worthwhile to describe the steps to be followed in the application of this method to valuation of environmental goods and services. To begin, the evaluator has to define the valuation problem, describing its nature, relevance, implications, etc. It may be borne in mind that relevance and implications of the valuation problem vis-à-vis the population to be surveyed for eliciting their expressed willingness to pay may be important. It is easier and more natural to express one's willingness to pay for a good or service which one is concerned with than for those goods and services one has no concern, relevance or even meaningfulness. In the second step, the nature and procedure of survey are decided. What would be the mode of obtaining the replies or 'data' on the expressed willingness to pay? Which questions are to be asked? Who will be surveyed? What would be the sample size? And such details about the instrument, respondent and procedure of the survey must be carefully determined. These surveys may be quite expensive if the respondents are to be met in person. In such cases, the cost constraints on survey are to be looked into. The

instruments and the procedure of survey are to be tested and perfected before they are finally executed. In the next step the actual survey is implemented on the sample respondents chosen by a well-designed sampling method. Finally, the data obtained through the surveys are analyzed to estimate the expressed willingness to pay. In the analysis one may deal with the non-responses suitably.

The outcome of the exercise based on the contingent valuation method may be susceptible to many biases: (i) Biases due to divergence between the intended import (of the evaluator) and received import (by the respondents) of the hypothetical scenario put up in the survey, (ii) Biases due to association of different scenarios with the one put up by the evaluator before the respondents – once the evaluator puts up a scenario before the respondent, it may invoke other scenarios in the minds of the respondents inhibiting or promoting/boosting up the appreciation of the evaluator's scenario. This may lead to biased responses, (iii) Evaluator's scenario may invoke 'warm glow' effect – feeling good to pay for the public good, or it may dampen the actual response due to political biases evoked by the scenario – thus making the response biased, (iv) Biases due to casual dealing of the respondents with the whole exercise of the survey may be there, (v) If people are first asked for their willingness to pay for one part of an environmental asset and then asked to value the whole asset, the amounts stated may be similar. This is referred to as the "embedding effect." Due to this effect, the responses are biased. (vi) Strategic bias - when the respondent provides a biased answer in order to influence a particular outcome. (vii) Information bias – it arises when people have to express their opinion of something of which they do not know properly. In the application of contingent valuation method, many respondents may not be able to appreciate the problem and their expressed willingness to pay may incorporate this kind of bias. The success of this method lies in drawing conclusions net of these biases. This is a stupendous task.

Although it is claimed that this method is equally effective in obtaining various types of values – use value, non-use value, optional value and bequest value – one must look into the biases that people exhibit between choice of the present over the future and the choice of themselves over the others (their children). The future is uncertain. People experience and see change in things only in the part of their life time. Uncertainty always costs and this cost is very likely to be incorporated in the values that the respondents express. In using the contingent valuation method, this fact should not be lost sight of.

b) The Contingent Choice Method: Much like the contingent valuation method, the contingent choice method is a very versatile method, which can be applied to valuation of almost any kind of environmental goods and services irrespective of their being marketed or not marketed. It can be used to estimate use value, non-use (passive) value option value (reserved for one's future use) or bequest value (reserved for the use by the future generation).

Contingent choice method is also referred to as the conjoint analysis. It was developed in the fields of marketing and psychology to measure individual's preferences for different characteristics or attributes of a multi-attribute choice problem. This method is similar to the contingent valuation. Like the contingent valuation method, it is based on asking people to state their willingness to pay, contingent on a specific hypothetical scenario and description of various environmental goods and serviced of which they have to make a choice. Making choice among different alternatives (environmental goods and services) in a simulated or artificial scenario – rather than directly assigning pecuniary values to the goods/services as done in the contingent valuation method – is the characteristic feature of this method. From the data on contingent choices or tradeoffs made by the people, values of different (alternative) environmental goods/services are inferred by using different methods. The method elicits information from the respondent on preference between various alternatives of environmental goods and services, at different price or cost to the individual. Suppose, there are five alternative baskets/bundle of characteristics – A, B, C, D and E. They are available at prices P(A), P(B), P(C), P(D) and P(E). The prices may be single or multiple valued. The alternative commodity/service baskets may vary in quantity, quality, structure, coverage or a mix thereof. The full details on these baskets or combinations are given to the respondents. The respondent is made to choose A, B, etc. at different prices. This exercise provides the preference structure of the respondents and associates that structure with the prices.

There are several alternative formats to carry out the contingent choice analysis. Some of them are: (a) Contingent Ranking – in the surveys individuals are asked to compare and rank alternative action outcomes with various characteristics, including costs, (b) Discrete Choice - respondents are simultaneously shown various alternatives and their characteristics, and asked to identify the most preferred alternative in the choice, (c) Paired Rating -- respondents are asked to compare two alternate situations and are asked to rate them in terms of strength of preference. The choices made by the respondents are statistically analyzed using discrete choice statistical techniques, to

determine the relative values for the different characteristics or attributes. Since price is one of the characteristics of the alternatives, the choice is tagged with the pecuniary measure. It is possible, therefore, to compute the respondent's willingness to pay for the other characteristics.

It may be noted that derivation of values from the data on contingent choices is more difficult and demanding than that from the data on contingent valuation. Various methods have been developed for this purpose. A very potent method to this end is the 'Discrete Choice Analysis'. Discrete choice analysis encompasses a variety of experimental design techniques, data collection procedures, and statistical procedures which can be used to predict the choices that consumers will make between alternatives. These techniques apply when consumers have the ability to choose between distinct ("discrete") courses of action.

The contingent choice method is perhaps the most effective method to elicit the expressed willingness to pay for environmental goods and services that may or may not be traded in the market. However, it has several limitations due mainly to the methodology it adopts. First, **r**espondents may find some tradeoffs difficult to evaluate, because they are unfamiliar with them – which may introduce information bias into their choices. Secondly, the respondents may apply very simplified and routine decision rules if the choices are complicated. Thirdly, the complexity of survey, response and analysis grows at least at a quadratic rate with the number of alternatives included in the scenarios. When presented with a large number of tradeoff questions, respondents may lose interest or become frustrated and psychologically inconsistent. On the other hand, by only providing a limited number of options, the survey may force respondents to make choices that they were not to make otherwise.

6.3 Valuation by using Similar but Extraneous Information

Sometimes it is possible to obtain information on the valuation of environmental goods and services done elsewhere, in similar (or somewhat different) context. It is possible to use that information to valuation at hand. The method that does this is called the **Benefit Transfer Method**. Benefit transfer is often used when it is too expensive and/or there is too little time available to conduct an original valuation study, yet some measure of benefits is needed. It is important to note that benefit transfers can only be as accurate as the initial study. Moreover, since the context or locational attributes of the initial study do not fully match with the exercise at hand, this method

is prone to several limitations. Nevertheless, it may provide some measure to the importance and benefits of environmental goods and services.

It may be possible to reinforce or modify the benefit transfer exercise on evaluation by some limited study in the field under consideration. A suitable study that would not require much time and resources may be carried out to obtain some information regarding the valuation problem at hand and in the light of this information, the initial values may be modified. This is very similar to using the values of the initial study (or studies) as a 'prior', which is modified in the light of the new information yielding the 'posterior' values.

6.4 A Critical View of the Pecuniary Valuation Methods:

Although it may be argued that since the environmental goods and services are often public goods subject to the 'tragedy of the commons' and the public bodies/managers in charge of their creation, maintenance and development incur costs that are measured in pecuniary terms, their benefits too must be measured in pecuniary terms to keep the account straight and intelligible. However, the enterprise of measuring the benefits of such goods and services in money terms has a cultural bias often unnoticed or ignored. Long back, Thorstein Veblen (1899 a), pointed out that prevalence of pecuniary measures in all walks of life is a sine qua non and the characteristic feature of the Leisure class culture. In this milieu, pecuniary emulation, pecuniary standard of living and pecuniary canons of taste and dress preoccupy everyone's mind. Measurement of everything in monetary terms becomes the habit of mind since people cannot understand anything that does not refer to money. This habit enters into the collective unconscious. Valuation of environmental goods and services in pecuniary measures is only an expression of this habit of thought.

Additionally, we may also note that the pecuniary valuation methods assume a constant 'value' of money over time, generations, locations, income groups and individuals. This is a particular type of habit of thought, inculcated by the neo-classical economists, with which we think. This leads to deification of money. Assigning immutability to value of money introduces a serious bias in valuation, especially when the experience suggests that value of money varies over time, among income groups, etc.

We have pointed out the weaknesses of every method described above, irrespective of the fact whether a particular one is based on the revealed, imputed or expressed willingness to pay. Each

one is prone to give valuation that may not be sensitive enough to discriminate the less beneficial from the more beneficial. Their standard errors of estimate (interpreted slightly liberally) are so large as to make them insensitive measures of differential values.

It may also be noted that (possibly except the market price method) the pecuniary valuation methods are 'Indirect or proxy methods', which measure value of environmental goods and services indirectly, through some proxy variable. In the productivity method, the price of final good is a proxy variable, while in hedonic pricing method the price of tied good/service works as the proxy variable. In the travel cost method, the travel cost of visit is the proxy variable. Similarly, in imputed and expressed valuation methods also, valuation of proxy variable is carried out. The mute question is: is there a one-to-one linear relationship in the value of a proxy variable and the value of the 'object variable'? This is a difficult question to answer.

Earlier, we have tentatively hinted at other assumptions that are made to make these methods rest on. To recall, one of the assumptions is to identify the 'desired' with the 'desirable'. Willingness to pay is the measure of the intensity of desire, but not of the status of 'desirability'. There could be a serious and wide hiatus between the status of being desired and that of being desirable. Desires spring from instincts, emotions and habits. Most of the desires are rooted in the culture in which one lives and is brought up. With the economic progress, larger and larger part of desires become culture bound. A leisure class culture characterizes high valuation of conspicuous consumption and conspicuous leisure. Wastage is culturally supported. In this milieu, the desires of the people may suggest the value system that is characteristically wasteful and detrimental to the prudent allocation and use of scarce economic and environmental resources.

We have also seen that the valuation methods based on measurement of expressed willingness to pay assume that what people say they would also do. This assumption is far from being realistic. The divergence between saying and doing may cripple the contingent valuation method. Investigations have shown a considerable inconsistency in pair-wise comparisons of alternatives. Inconsistencies creep in even when the people making choices are dealing with the real world situation. When they are dealing with the artificial choice situation, inconsistencies may be much more alarming. Although it has been attempted to derive consistent and transitive preference pattern from the inconsistent choice data, the results are, in general, far from being satisfactory.

Otherwise also, the contingent choice method of valuation has not been put to empirical tests of validity. In this situation, one has to accept the validity of these methods only with a caution.

We may also see that behind all the methods described above, there is a single philosophy that the consumers and their ability to pay determine the value of environmental goods and services. The idea that the consumer assigns meaning to environment and the nature, places man in general and the consumer, his purchasing power and his willingness to spend in particular, in the center. This reflects the attitude of man towards the non-human environment - his sense of the collective power of human communities over the nature. This sense of power, especially underneath the contingent valuation and contingent choice methods, is not very eco-friendly in its nature and impact on human decisions regarding the environment.

6.5 A Quest for Non-pecuniary Measure of Value

As Veblen (1899 b) noted "the question of value is a question of the extent to which the given item of wealth forwards the end of nature's unfolding process. It is valuable, intrinsically and really, in so far as it avails the great work which nature has in hand". In this sense, pecuniary valuation of environmental goods and services is ill conceived. It is based on the mechanistic conception of the economy as well as the ecology that houses the economy. The valuation should be based on the organic balance and the position of an environmental attribute vis-à-vis the others in that grand scheme of nature. Looking at the problem in this manner suggests us to evolve non-pecuniary methods of valuation of environmental goods and services.

One may look into the possibilities of non-pecuniary valuation in economic models such as von Neumann (balanced) growth model and others developed along that line. The original von Neumann model of an expanding economy does not include consumption and makes several unrealistic assumptions. Michio Morishima (Takayama, pp. 499-501) included consumption into the von Neumann model and by altering some assumptions he made a more realistic model. The von Neumann-Morishima model of the expanding economy does not include money in it, and therefore, it does not give us prices in pecuniary terms. All the relations in the model are in physical terms. The model gives optimal (non-negative) outputs and prices. With suitable modifications, this model may be used to obtain non-pecuniary values of environmental resources in terms of (say) human labour or any other suitable numéraire.

Operations, expansion and structural changes in an economy and its place in the ecology may be viewed not from the angle of maximization of utility or economic gains, but from the angle of increase in the entropy of the ecological system in which the economy is placed. Increase in entropy over time is unavoidable, but the rate of its increase can be influenced by a deliberate policy implementation. Slower increase in entropy is environmentally desirable. If we chose to minimize the rate of increase in entropy, we have to choose the decision variables suitably (Georgescu-Roegen, 1971). In doing so, we would obtain the non-pecuniary shadow prices of each economic and environmental good/service in terms of entropy in the similar manner as we obtain prices by solving the mathematical model of an economy with an objective to maximize utility or satisfaction. This approach also looks at the economy as an evolving organism than a mechanistic system.