# Economic Valuation of Watershed Services of Commons: Marginal Opportunity Cost Approach within the Environmental Accounting Framework.

**Lingappan Venkatachalam**

Assistant Professor
Economics Unit
Institute for Social and Economic Change
Nagarbhavi, Bangalore – 560 072, India
Phone: 91-80-2321 5463
Fax: 91-80-2321 7008
E-Mail: venkat@isec.ac.in

## Introduction:

The role of different kinds of 'non-market services' provided by common property resources (CPRs) is generally overlooked by many researchers and policymakers because of yet unresolved theoretical and methodological problems in the natural resource management literature. While the theoretical problem emanates from the way in which the CPRs are being defined and understood, the methodological problem lies in the difficulty of measuring the size of the economic value of these non-market services. Conventionally, CPRs are defined in many different ways and one of the definitions goes as follows: CPRs are those resources whose services are consumed by a 'well-defined group' of people (or communities) but the groups outside could be *excluded* from consuming these services (see Singh, 1994; also, Berkes and Farvar, 1991). While defining who has the 'right' to consume the flow of services from the resources, the institutional arrangements or the 'rules and regulations' framed collectively by the groups play a dominant role. More precisely, either *exclusion* or *inclusion* of members in the group and the rules framed for that purpose depend mainly on the nature and size of the 'use values' generated by the commons. However, economic values generated by commons are broader and include 'indirect use' values and 'non-use values', in addition to the 'use values'. All these values together constitute the 'total economic value' (Freeman, 1993) generated by CPRs. Therefore, in defining CPRs as well as in formulating normative rules governing CPRs, the other forms of total economic values such as indirect use values and passive use values (or the non-use values) are, in many cases, not being taken into account. It should be noted that it has been demonstrated by many empirical studies that indirect use values and non-use values constitute a larger portion of the total economic values generated by CPRs (see Adger et al., 1995; Furst et al. 2000). It should also be noted that these values are usually consumed by larger groups of people outside the 'well-defined group'. In the CPR literature, all normative solutions (such as community management) for managing CPRs are analysed within this 'narrow definition'. The underlying problem with the existing approach based on this narrow definition is that in many cases, solutions such as the community management, are prescribed for management of CPRs. However, the community management, for instance, may not take into account the 'externality' of management due to asymmetric information about the size of the externality (both positive and negative) and therefore, there exists a possibility that the resource would be managed 'sub-optimally'. This is because, the community may be concerned only about the direct use values and their associated costs of managing the CPRs in their own cost-benefit analysis, bypassing the costs and benefits associated with the indirect and non-use values. Even in the case of other forms of institutional arrangements such as management by government, the traditional cost-benefit analysis of the government agencies focuses mainly on the use values. Therefore, there will be a trade-off between different types of benefits (e.g. direct vs. indirect) and between different types of stakeholders (e.g. upstream vs. downstream), ultimately leading to 'loss of social welfare'. This entire issue leads to the following questions: Can the normative solutions for managing the CPRs be adequately dealt within the existing approach? AT the empirical level, who are the gainers and who are the losers of CPR management and how to identify them for the purpose of maximizing the overall benefits? What is the size of the gain and loss to various stakeholders? How to 'internalise the externality' so that a 'non-zero sum' game through a Pareto movement can be achieved? What kind of the alternative institutional mechanism/mechanisms (such as, payment mechanism, compensation mechanisms, introducing market forces, etc) that ensures efficient management of CPRs? These kinds of methodological and empirical questions form the second set of issues in CPR management.

To illustrate how these specific questions could be addressed both theoretically and empirically, the present paper extend the theoretical, conceptual and methodological developments in mainstream environmental economics literature to a particular case, namely the watershed services provided by the forests. Apart from discussing the conceptual issues such as trade-off between different kinds of benefits and the negative externality issues specifically relating to watershed services, this paper discusses how the size of the watershed benefits (as well as costs) could be estimated in a systematic and scientific way by using the various kinds of economic valuation techniques and '*environmental accounting*' methodology. On the economic valuation of watershed services, this paper focuses exclusively on how the '*marginal opportunity cost*' approach could be an appropriate valuation framework to properly estimate the size and magnitude of the externality experienced by different stakeholders, as well as the associated policy issues such as determining the the size of the payment and compensation. Let us first discuss the different types of economic values within the framework of total economic value.

## Total Economic Value Concept:

The mainstream environmental economics literature broadly classifies the benefits of environmental and natural resources into two major categories, namely, use values and non-use values (see Freeman, 1993) which will be useful for not only defining CPRs appropriately but also for formulating normative solutions. The use values are defined as values derived by individuals from the 'actual use' of the environment (Bateman and Turner, 1993) or immediate use of the environment (see Murty and Menkhaus, 1998) or the *in-situ* use of the environment (Freeman, 1993). The use values are further classified into two categories namely, direct use values and indirect use values (Bateman and Turner, 1993). In the case of watersheds, direct use values include water used for irrigation purpose, drinking purpose, etc. Apart from these direct use values, watersheds generate indirect use values such as erosion control, enhanced soil quality, and improved water yield, stabilisation of stream flows. It should be noted that the size and the composition of these two forms of values may differ among different watersheds.

The scope of the purview of environmental benefits in the environmental economics literature expanded after the concept of *option value* was identified by Weisbrod (1964) and *existence value* by Krutilla (1967), which became important components of environmental benefits. Option value refers to the amount that the individuals would be willing to pay for using a particular resource in future, in addition to the their expected consumer surplus (Smith, 1987). Option value is equal to the premium that the individuals would be willing to pay to ensure the future availability of an amenity (Randall, 1991). Alternatively, option value is defined as the difference between the expected consumer surplus (ES) from an amenity and the 'option price' (OP) defined as the maximum amount the consumer, under conditions of demand and/supply uncertainty, is willing to pay for an option to have a resource available for use in time period 2 and each year for which payment is made (Randall and Stoll, 1983). Existence value refers to individuals' willingness to pay for the mere existence of a resource irrespective of their use - including the possible future use (Krutilla, 1967). The existence value, according to Krutilla (1967) is associated with two aspects: (i) individuals may be willing to pay for preserving the option for future use irrespective of whether they would use it or not; and (ii) they may be willing to bequeath natural resources for their future generation. Hence, the existence value is supposed to be arising out of the altruistic attitude of the individuals[1] (Freeman, 1993).

Added to option and existence values was the *quasi-option value* introduced by Arrow and Fisher (1974). The Quasi-Option Value refers to the value that individuals are willing to pay for delaying a decision until full information is available about the environmental amenity, while faced with information uncertainty (Mitchell and Carson, 1989). Another form of non-use value is *bequest value* arising out of the intergenerational altruism, which is an individual's willingness to pay for preserving an environmental resource that could be used by the future generation (Randall and Stoll, 1983). It should be noted that the natural forests in developing countries are supposed to generate considerable amount of non-use values arising from unique species. Even though the scope of

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[1] However, the practical problem with the notion of altruism associated with the existence value is the problem of double counting that may occur if the value elicited from each individual in the economy would reflect not only her own benefit but also the benefit derived by others (Diamond and Hausman, 1994).

environmental benefits expanded over a period of time, different kinds of values and their classifications led to confusion and controversy[2] (Markandya, 1998; Randall, 1991). To avoid any practical problem, the values are broadly classified into use and non-use values (see Randall, 1991) and adding up both use values and non-use values would provide us the 'total economic value' concept (Randall, 1991; Randall and Stoll, 1983).

From the above discussion, it is clear that the environmental economics defines the economic value in a broader way. But the question is whether the CPRs like watersheds generate all these values or not. In other words, what proportion of the total economic value is constituted by indirect and non-use values is the question that needs to be addressed properly. The answer to this question depends on the characteristics of the watershed under consideration. For example, if a watershed harbours some unique or endangered species then it may be assumed that this watershed could generate a considerable amount of non-use values to the society.

Neglect of the total economic value concept in the CPR literature, leads to serious policy issue, namely, whether the management of CPRs like watershed by a particular institution will lead to optimal level of management at which the marginal benefits and the marginal costs are equated, in pure neoclassical economic terms. In the case of community management, the community will always try to balance the marginal benefits and marginal costs of managing additional area of watershed and if the marginal costs are greater than the marginal benefits from the community's point of view, then it will not have any incentive to manage the additional area of watershed. As we have already seen, the community will take into account mainly the direct use values in their benefit estimation, while they will include the opportunity cost of managing the watershed in calculating the costs. Community's decision to manage additional area of watershed (i.e. beyond the optimal level) depends on the amount of information about the total marginal benefits generated by the additional area, as well as the marginal transaction cost of the extra effort on management. Since there is an asymmetric information about the benefits or obtaining adequate amount of information is costly to the community, the community's decision about the size of the watershed to be managed is constrained. Moreover, if the community feels that the marginal benefits of managing the additional area of watersheds would lead to 'free-riding' by the outside groups, then the community will have less incentives to manage additional area of watershed. However, from the society's point of view, increased size of the watershed would lead to increase the size of the indirect and non-use benefits to the outside groups and therefore, the optimal level of watershed to be managed is greater than what the community would actually manage. The point to be noted here is that social welfare maximisation

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[2] For instance, the distinction between the existence value and the bequest value is very vague and the option value consists of both use as well as non-use value component (see Randall and Stoll, 1983) and therefore, the major problem that would be encountered during estimation of these values is another form of double counting. Another related issue is whether the option price or the option value should be considered for benefit estimation (see Randall and Stoll, 1983).

through watershed management, as an objective, will not be fulfilled if the 'total economic value concept' is not being taken into account in the ultimate analysis.

The crux of the problem still lies in determining how to increase the incentives for the 'group' that manages the watershed so that the flow of the benefits to the outside groups could be maintained or increased. The solution comes in the form of Hicks-Kaldor compensation criterion. According to this criterion, the Pareto-optimal condition in the management of watershed could be achieved if the gainers (say, the outside group) could compensate the losers (or, the community in our case) and still remain the gainers. Though theoretically sound, the Hicks-Kaldor criterion poses lot of empirical problems in providing actual compensation to the losers. Apart from the problem of identifying the gainers and the losers, the major empirical problem is, what is the size of the benefits and costs occurring to different types of stakeholders and how to measure it. In many cases, the benefits and costs are mainly 'non-market' in nature (Markandya, 1998) and therefore, there exists a need for measuring the size of these benefits and costs so as to determine the size of the compensation required. Measuring the benefits and costs occurring to the society is a difficult task and in the following section we would discuss the methodological and empirical problems in measuring the values in real world.

## Economic Valuation of Watershed Benefits:

The central focus of the environmental economics literature is how to value the benefits discussed above, in monetary terms (Markandya, 1998). In the case of marketed goods and services, the economic value is reflected through the market price determined mainly by the demand and supply of the goods and services concerned. However, many of the environmental goods and services are either "non-marketed" in nature or traded in imperfect markets and therefore, their true opportunity cost has to be estimated properly for efficient resource allocation (Barbier, 1998). Neglecting the importance of non-market values would result in depletion, degradation and over-exploitation of the environmental resources and eventually lead to loss of social welfare since these resources form the basis for the basic livelihood of a considerable number of households in developing countries (Barbier, 1998). This has larger implications for the re-distribution of income as well. This is one of the major reasons why economic valuation of environmental resources assumes paramount importance especially in developing countries.

The extensive literature on economic valuation techniques – classified into revealed preference and stated preference methods – that are being applied in the area of non-market economic valuation (see Bateman, 1993) suggests that using different methods for a specific environmental good/service would lead to different kinds of answers consequently leading to the central question of which is the true economic value. The implication is that the economic values derived from different valuation techniques lack precision (Turner, 1993), even though considerable amount of progress has been made and is being made to improve the sophistication of the economic valuation techniques in estimating the non-market values of environmental resources (Cropper and

Oates, 1992). However, the lack of precision of values should not be considered as a great problem because "their existence still leaves us in a much better position (in decision-making terms) than we would be in if such value information did not exist or was totally ignored" (Turner, 1993; p.27). Hence, there is a need for economic valuation.

As we have already seen, the major focus of this paper is on economic valuation of watershed benefits generated especially by forest resources. It should be noted that the economic benefits of protected watersheds are rarely quantified (Georgiou *et al,* 1997) and even attempts to quantify the benefits could not fully succeed in doing so. During the past three decades, environmental economists have developed various kinds of economic valuation techniques that have been widely used for valuing the non-market benefits and costs associated with the environmental and natural resources. Before going to review the economic valuation literature on watershed management, let us briefly discuss some of the important valuation techniques and their merits and demerits.

**Economic Valuation Techniques:**

The existing valuation methods can be broadly classified into revealed preference methods and the stated preference methods (Hufschmidt *et al*., 1983)[3]. Some of the important revealed preference methods are: (a) travel cost method: (b) hedonic pricing method; (c) production function approach; (d) defensive expenditure method (see Bateman, 1993). In the case of stated preference method, the Contingent Valuation Method (CVM) is the one which is being widely used for estimating the non-market economic values of natural resources. Let us briefly discuss about each one of these methods so as to understand the issues involved in the application of these methods.

**Revealed Preference Methods:**

The revealed preference methods basically rely on the information about the individual preferences for the environmental and natural resources that are revealed either through direct market or through surrogate markets. The travel cost method is a revealed preference method by which the consumer's preferences for environmental amenities are estimated on the basis of the travel cost incurred in relation to enjoying the benefit of a natural resources. This method, though widely used for valuing the improved amenities of national parks, could be used to estimate the opportunity cost of time spent on collecting fuelwood and fodder in the watershed areas and this value would be used as a lower-bound value of benefits/costs of change in the watershed management.

Even though the travel cost method is a success story in the area of non-market valuation (Smith, 1993) of recreational benefits, it has some problems. One of the problems with this approach is that at the macro level, total benefits and total number of visits by the individuals are assumed to

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[3] Alternatively, the valuation techniques are classified as: indirect methods and direct methods (Hanley *et al*. 1997); demand curve approaches and non-demand curve approaches (Bateman and Turner, 1993).

be constant whereas these aspects may differ among different individuals. In the case of watershed benefits, one needs to understand not only the total benefits and total number of visitors but also how these benefits are being distributed among different individuals. Another issue involved is how to value the time spent by the visitors (Hanley *et al.* 1997) since the 'opportunity cost' of time determines the value. When the nominal wage per hour in the agricultural sector is taken to impute value for time spent in collecting fuelwood and fodder, one has to take into account the employment scenario in that sector as well. When the time is used for multiple purpose (grazing as well as fuelwood collection), one can not attribute the entire opportunity cost to only one of these activities. However, recent developments in the travel cost method have provided insights into some of these methodological issues therefore, in future one could try to use the travel cost method directly to estimate the recreational benefits and indirectly to estimate the value of drinking water, value of fodder and value of fuelwood.

The hedonic pricing approach is based on the assumption that the environmental factors are attributes of goods or factors of production that are traded in the market. Based on this assumption, the benefits due to improvement in economic benefits of say, improved watersheds could be captured through the market prices of the related goods. For instance, other things remaining constant, the benefits of improved watershed area could be obtained through increased land prices. But the prices of the land in a particular region are affected by many different factors such as neighbourhood and environmental quality characteristics (Hufschmidt *et al.,* 1983). This can be expressed as follows:

$$P_i = f(N_i, Q_i)$$

In the above function, $S_i$ stands for characteristics of the $i^{th}$ parcel of land such as soil quality, distance between the road and the land, distance between the urban area and the land, transportation, access to markets, etc. and $Q_i$ is the improved water supply (due to watershed management) for the $i^{th}$ site (see Freeman, 1993). Using this function, the implicit land price due to improved water availability could be estimated through statistical analysis. In the case of water availability for agricultural activities, the land prices in both 'with' and 'without' situations are regressed against various factors influencing the land prices, including availability of water. For instance, the increased availability of water will enhance one more crop in a year and this will be one of the influencing factors. This method can also be used for estimating the value of drinking water used in the households, using particularly the rent of the houses in a particular locality.

One of the problems with the hedonic pricing method is that the individuals are assumed to have full information about the environmental attributes of the land and therefore, their preferences reflect the value of the environmental attribute (in our case, water availability) under consideration. However, if their decision is based on imperfect information then the valuation on the basis of the individuals' preferences would also become imperfect. Moreover, Smith (1993) argues that the empirical record of this method is very limited and therefore, its utility for the current needs such as environmental accounting, cost-benefit analysis, etc is also limited. However, if adequate amount of information on various factors influencing the land prices is available the economic value of water used can easily be derived.

The production function approach, another variant of revealed preference method, basically establishes a relationship between the environmental input and resulting output and then utilises the (current) market price of the output to value the environmental input (Markandya, 1998). More precisely, estimating the economic value of change in the environmental resource input is to quantify the change in the output due to change in the input of environmental resource while other priced inputs remaining the same, and multiply this change in output with the market price of that output (Maler, 1991). This approach is valid only if the change in the input of environmental resource is such that it cannot allow the entire production function to alter. In other words, change in the environmental input should not change the quantity of other inputs used. In those cases where the change in the input of environmental resource alters the production function, according to Maler (1991), the value of the resource supply change must be measured as the difference between the profit after the change and before the change taking all adjustments in factor use into accounts. For instance if deterioration in irrigation water quality alters the entire production function (such as altering the amount of fertilisers used, pesticides used, etc.) then the economic value of the loss is measured in terms of the change in the agricultural profit taking all the adjustments into account. Here it is assumed that the price of the output is constant. If change in the input of environmental resource results in a change in the price of output, then estimation of the change in the profit of the producer alone will not capture the total value of the environmental input. In this case, the change in the consumer's surplus should also be taken into account, since the change in the price of output can be partially transferred to the consumers (Maler 1991). Hence, the total value of the change in the non-market input is equal to the producer's surplus and the consumer's surplus. A related version of the production function approach is called dose-response method that establishes a direct link between the changes in the welfare of the individuals (say, increased mortality and morbidity) and the changes in the water quality (increased level of air pollution). The production function approach is widely used economic valuation technique in estimating the hydrological benefits of watersheds (e.g. Acharya and Barbier, 2000).

The defensive expenditure method or averting behaviour approach is a simple valuation technique used mainly for estimating economic value of environmental damage costs (Hueting, 1990). This method basically looks at the amount of expenditure required for either averting a particular environmental damage or restoring a damage that has already taken place and treat that level of cost as the damage cost. Nowadays, this method is being widely used in developing countries to estimate the economic damages at the macro-level. One of the problems with this method is that since it is only a cost based method, the estimated value could be used only as a lower-bound value.

Using the defensive expenditure method, the economic value of improved availability of irrigation water in the watershed region can be estimated through the difference in the cost of pumping of groundwater. The cost of extraction of groundwater within and outside the watershed region could be estimated for a specified quantity of water pumped and the difference in the cost can be used for extrapolating to the entire amount of water pumped in the watershed region so as to find out the value of marginal increase in the groundwater recharge.

Apart from the specific criticisms about each revealed preference method, the important criticism is that the revealed preference method could capture only the "capturable" benefits of the environmental services that have the "publicness" character and therefore, "none of the available indirect methods will reflect these values" (Smith, 1993; p. 7). Two types of non-capturable benefits could be identified here. Firstly, many of the revealed preference techniques capture only that part of benefit equal to the price or the cost of the related commodity (see Winpenny, 1991). Take for instance, the hedonic pricing method. This method mainly tries to assign the value to an environmental amenity on the basis of the house price/rent. But the individuals may over and above the price or rent derive some hidden benefit from the amenity that might not have been reflected in the price or rent. Another example is that the travel cost method depends mainly on the actual cost incurred by individuals in visiting the site for deriving the demand curve for recreational sites. However, the demand curve does not capture the benefits derived by the individuals over and above the cost of travel. The second type of benefits that could not be captured by the revealed preference techniques is the non-use values (Smith, 1993; Freeman, 1993). This being the case, the only method which is supposed to capture these kinds of benefits is the stated preference method (see Smith, 1993), which we will discuss in the following section.

**Stated Preference Method:**

The two major forms of stated preference method are: (i) contingent ranking; and (ii) contingent valuation (see Mitchell and Carson, 1989). The contingent valuation method, according to Portney (1994), is an economic valuation method that utilises sample surveys or questionnaires to elicit the respondents' willingness to pay for hypothetical projects or programmes. The value elicited through this method is dependent on the nature of the hypothetical or simulated market conveyed to the respondents. The CV method normally consists of three major parts namely, (a) the scenario or description of the policy or program by which the good/service is going to be provided; (b) value elicitation mechanism; and (c) the socio, economic, demographic and environmental factors that could potentially influence the value placed by individuals (Portney, 1994; Mitchell and Carson, 1989).

Summaries of CV studies by different authors reveal that the major criticism of CV studies revolves around two aspects namely, (a) validity and (b) reliability (Smith, 1993; Freeman, 1993; NOAA, 1993). In simple terms, validity refers to the "accuracy" and reliability refers to "consistency" or "reproducibility" of the CV results (Kealy *et al.*, 1990). Validity refers to the degree to which the CV method measures the *theoretical construct* of interest which is the true economic value of individuals (Freeman, 1993). The reliability of the results of the CV method refers to extent to which the variance of the WTP amounts is due to random sources (Mitchell and Carson, 1989). According to Loomis (1990), "Reliability requires that, in repeated measurements, (a) if the true value of the phenomenon has not changed a reliable method should result in the same measurement (given the method's accuracy) and (b) if the true value has changed a reliable method's measurement of it should change accordingly" (p.79)[4].

It should be noted that the reliability and validity of the CV results are generally affected by various kinds of biases and errors that occur during the valuation process. These biases and errors make the CV results less useful for policy-making purpose, especially in a developing country context (Saunders and Warford, 1978). However, many of the biases and errors are attributed to the implementation and administration of the CV method in the field (Mitchell and Carson, 1989; Portney, 1994); a good amount of guidelines are also available on how to properly conduct the CV studies (Mitchell and Carson, 1989; NOAA, 1993), including in developing countries (Whittington, 1996).

## Issues in Economic Valuation of Watershed Services[5]:

In the case of economic valuation of watershed benefits, a few studies are available at present (such as Acharya and Barbier, 2000; Bishop, 2002; Chopra and Kadekodi, 1999; Hufschmidt, 1986). Summary of these studies reveals that many of these studies, except few, focus mainly on the use values. Methodologically, many of the studies suffer from serious limitations. From the review of limited number of studies, certain broader issues for discussion have emerged. It should be, first of all, noted that there are not many developing country studies looking effectively into the economic value of watershed benefits. Even with the limited number of studies, what we have found is that only a very limited number of benefits - mainly, agricultural, fodder and drinking water benefits – were considered for economic valuation. One of the major problems with the economic valuation approaches used in almost all the valuation studies is that rather than estimating the 'marginal opportunity cost' (Pearce and Markandya, 1989) of water use, these studies have estimated only a fraction of the direct benefits of watershed protection. The ***marginal opportunity cost*** concept is found to be an appropriate measure of the benefits of watershed protection and this includes three components namely, the actual value of benefit, the cost of opportunity forgone due to non-availability of water for alternative use and the user cost (i.e. the inter-temporal cost of using water in time period 1). Though it is difficult to estimate the opportunity cost and the user cost empirically, the concept of marginal opportunity cost guides us on what to be estimated. For instance, many studies have tried to estimate only the increased benefits of watershed management only in the watershed region, without necessarily taking into account the cost of non-availability of water in the downstream area which would continue to get water in the absence of watershed management. In many cases, it is assumed that watershed intervention prevent the water from going as 'waste'. However, watershed intervention denies the opportunity for the downstream farmers of the water use that they had enjoyed prior to watershed intervention. Therefore, any estimation of economic value of water use within the watershed region should take into account the cost of negative externality imposed on the

[4] For detailed discussion about the validity and reliability issues, please see Venkatachalam (2004).
[5] Some of the arguments in this section are drawn mainly from Venkatachalam and Lele (2003).

downstream users. In other cases, some of the problems in the watershed area such as soil erosion may not always be a negative externality problem. In certain cases, the problem of topsoil erosion becomes positive externality in the downstream region. If the topsoil eroded is deposited on agricultural lands, then it will either increase the productivity or reduce the cost of production – resulting in increased profits to the farmers. Therefore, economic valuation studies should carefully look at the nature of the problem and its impact, and then carry out the valuation exercise.

Another lesson that we have learnt is that only a limited number of economic valuation techniques has been used in estimating watershed benefits, empirically. To our knowledge, the production function approach and the CV method are the only methods which have been used in many studies. Since economic values derived from a single method may not provide valid results, the mainstream environmental economics literature suggests that we need to use multiple valuation techniques, provided the cost, time and labour permit us to do so. In future, for instance, the hedonic pricing method can be used along with the production function approach in the agricultural sector. In the case of benefits to households, the defensive expenditure method and the CV method can be used together. The major advantage of using multiple valuation techniques is that it is always possible to validate the results using cross-comparison methods. However, when using the valuation techniques we need to strictly follow proper guidelines.

Since we suggest that the marginal opportunity cost approach is the appropriate framework and in many cases the micro level cost-benefit analysis doe not take into account the 'negative externalities' caused to outside group, the costs of negative externality has to be 'internalised' so that the maximization of social welfare could be achieved. The 'internalisation of externality' can be made possible if the macro level system of Natural Resource Accounting (NRA) tool is adopted, especially at the river basin level. The NRA approach can be of two types, namely, the physical accounting approach and the monetary approach. The physical accounting is supposed to provide us information about the water balance, subtractions (such as water extracted for various uses) and additions (such as precipitation) to the existing stock of water at the river basin level. Apart from the quantity aspects, the quality related aspects such as pollution load from point and non-point sources should be accounted for in the physical accounting. Though the information in the physical accounts do not fully reflect the change in the economic welfare due to change in the water availability, this provides basic level information for estimating the welfare changes in terms of money. The monetary valuation depends largely on the valuation techniques that we have discussed. However, in many cases the macroeconomic valuation techniques such as the replacement costs are more appropriate. This type of NRA exercise is more appropriate to internalise the externality since the cost of negative externality is captured at the macro level. In recent years, the economic-hydrological modelling system (Rosegrant et al. 2000) is being used at the river basin level which is a step forward towards addressing different kinds of questions such as allocation of CPRs among different users efficiently and equitably. More of this kind of work should be initiated for different kinds of CPRs so that adequate amount of information for determining who has to manage CPRs and at what level.

**Conclusion:**

A larger part of the literature on the common property resource at present concentrates mainly on designing appropriate institutions for managing these resources at the local level. However, a possible problem with this part of literature is that all the normative suggestions such as community management are based on the narrow definition of the 'economic values' generated by the CPRs. In this paper we have argued that the economic values generated by the CPRs more broader and enormous than conventionally thought in the CPR literature and therefore, any possible suggestion for an appropriate management regime would ultimately lead to 'sub-optimal' management of the CPR under consideration. To overcome this problem, what we suggest is that there are important principles and techniques available from the mainstream environmental economics literature, with which a possible broader, systematic and scientific framework could be developed for analysing the theoretical and policy issues related to CPRs. More specifically, the opportunity cost approach is an effective principle within which the standard economic valuation tools could be used to estimate the true, total economic value of services generated by the CPRs. To address the problem of externality that could not be appropriately captured by microeconomic cost-benefit analysis, we propose the NRA framework at the macro level with which the 'internalisation of externality' is possible. One of the suggestions we have provided is that in future, inter and intra-disciplinary research has to be encouraged in the area of CPRs and in this direction, we have found the economic-hydrology modelling is a step-forward in water sector. Similarly, more innovative approaches need to be developed for other CPRs so that CPRs could be managed in an efficient, equitable and sustainable manner.

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