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Chapter

Environmental valuation

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1. Introduction: Why do we need environmental valuation?

The aim of this chapter is to provide an overview of issues related to environmental assessment in project appraisal. As entire books have been written on this very subject trying to capture all of the relevant issues in the space of a single chapter is an impossible task. [1] –The chapter has a modest aim of providing an overview of environmental valuation in the context of cost benefit analysis or investment appraisal of projects.

, It is now widely recognised that if environmental impacts are not taken into account, costs can be significantly under-estimated and project decisions can be biased.[2] .. Just as the London smog of 1952 led to air pollution control regulation, a second wave of environmental regulations emerged after major industrial disasters such as the Bhopal Gas Disaster which occurred in the Union Carbide plant in December 1984 or the Chernobyl nuclear reactor accident which occurred in April 1986 contributing to raising public awareness of environmental risks. As a result, there is now some evidence to suggest that investors take into account environmental performance of firms and that oil spills or other such industrial accidents do affect how a company's stock is valued by investors (see Yamaguchi, 2008; Capelle-Blancard and Laguna, 2010). In fact, institutional investors such as pension funds and ethical (or socially responsible) funds have begun to exert significant influence on firms that contribute to harmful environmental impacts (see Kreander et al, 2005). A survey by Standard Life (2010) indicated that when asked to rank among 42 different items or aspects to consider when choosing an ethical fund, the top three issues chosen by investors were: the clearing of tropical rainforests, making of chemicals without adequate attention to environmental impacts and human rights. Thus, it is clear that investors respond to environmental performance by firms and that this is having an impact on the way firms consider environmental issues. Increased awareness has also led to more stringent environmental regulations.

The various services provided by nature are broadly considered in terms of three or four categories- namely: resources or materials (R), where the environment provides raw materials or inputs to production or consumption; sink or assimilation (S) – where the environment receives effluents and emissions from production and consumption; amenities and vistas (A) – where the environment makes a place special because of how it is. [3] Some of the cultural and identity aspects of environment can be included under this third category. A fourth aspect may be considered as 'existence' or 'ecosystem services' (E).

As an illustration of the multiplicity of environmental services consider coral reefs. Such reefs provide the necessary condition for a wide variety of fish to breed. As a result, the fisheries in the area of seas surrounding the coral reefs may be a direct result of the reefs. This is the R component of coral reefs. The rich diversity of species in and around coral reefs attracts tourists who want to enjoy the amenity value (A). Coral reefs may also help in controlling erosion and sedimentation in the beaches nearby and this is an example of the S aspect. However, coral reefs themselves may be very valuable to us not because of any of the immediate or direct and indirect benefits they bring to us but for the crucial role they play in maintaining biodiversity and for this reason we may value them. This is the E aspect of their value. Studies by World Resources Institute are in progress to estimate the economic values of coral reefs. In a study already completed, Burke et al (2008) estimated that in the case of Tobago, direct and indirect benefit of coral reefs to fisheries is estimated to be US$0.8 to US$1.3 million. The direct and indirect impact due to tourism is estimated to be US$101 to US$130 million and shoreline protection due to coral reefs is estimated be worth US$18 to US$33 million. For comparison, the authors suggest the island's GDP is around U$286 million.

An important study by Costanza et al (1997) identified up to 17 ecosystem functions including gas regulation, climate regulation, water regulation, soil formation, nutrient recycling, recreation and cultural aspects. In that study, based on a synthesis of over 100 published studies, Costanza et al estimate the value of global ecosystem services, most of

[1] See for example, Johansson (1987); Hanley and Spash (1993), Dixon et al (1994), Weiss (1994), Bateman et al (2002), Dasgupta,(2004) and van Beukering et al (2007).
[2] For an intellectual history of environmental economics and its use in cost benefit analysis, see Pearce,(2002).
[3] For a discussion on the difficulty in classifying ecosystem services see Fisher et al (2009).

which are not marketed, to be in the range of U$16 to 54 trillion per annum with an average of U$33 trillion or approximately 1.8 times the then global GNP.

Table 1: Four categories of ecosystem functions and their correspondence with 17 functions identified by Costanza et al. (1997)

	Four categories of ecosystem functions	Correspondence with 17 ecosystem services [and values in US$ trillion] as identified by Costanza et al	Value in trillion US$ (and share of global value)
R	Resources-materials	Soil formation[0.05] Water supply [1.69] Pollination [0.12] Food production [1.38] Raw materials [0.72]	3.96 (12.2%)
S	Sink-assimilation	Nutrient recycling [17.08] Waste treatment [2.28] Erosion control and sediment retention [0.57] Biological control [0.41]	20.34 (62.5%)
A	Amenities and vistas	Recreation [0.8] Cultural [3.0]	3.8 (11.7%)
E	Existence or ecosystem services	Gas regulation (1.34) Climate regulation (0.68) Disturbance regulation (1.78) Water regulation(1.12) Genetic resources (0.08) Habitat, refugia (0.12)	4.44 (13.6%)

Source: Author's estimates based on Costanza et al (1997).

That landmark study highlighted that though many of the environmental goods and services are 'difficult to value' as markets may not exist for some or most aspects of such goods and services, it is possible to estimate such values and that these are not trivial.. The standard economic argument for valuation is to say that non-valuation of impacts on environmental goods and services would result in excessive consumption, distort the allocation of expenditures and would systematically disadvantage those in future generations. The purpose of environmental assessment in project appraisal is to anticipate and assess potential and actual environmental impacts of investment and operations of a project and the resultant loss of well-being.

The concept of valuing raises several ethical or normative issues: who is doing the valuing, what is to be valued, how far should non-consumptive or existence values be incorporated,

is the act of valuing essentially *anthropocentric* (i.e., centred on human beings) and hence, is it biased in favour of aspects of environmental services that are of direct use to humans? . Related to these issues are questions such as whether environmental assessments should recognise only the impacts which are of consequence to human well-being or whether impacts must be considered irrespective of consequences. Further, it is possible to ask whether such an exercise should recognise the universalism of life claims – i.e., claims of both present and future generations of human beings. Others could raise objections on the grounds that universalism requires that along with rights of present and future generations of humans, rights of other living organisms must also be recognised. However, this can result in a breakdown of reason as soon as the existence of one living organism erodes the right to life of its prey. A compassionate or non-violent ethic such as that in Budhist and Jainist writings elevate a stewardship role to not merely the absence of violence by humans against other beings (achieved for example by preventive action such as covering one's mouth with a cloth to avoid involuntary killing of invisible microorganisms) but a positive requirement to do something to protect and nurture such organisms wherever possible. Thus, it is important to recognise that the utilitarian ethical framework which underpins economic valuation is simply one among several alternative ethical frameworks. We shall return to these ethical issues in the final section of the chapter.

2. Environmental valuation within project appraisal

Environmental valuation has several distinct aspects. Environmental impact assessment (EIA) is concerned with identifying and measuring the impact of an activity on the environment. The focus of EIA is to establish clearly with a scientific basis, how an activity is likely to impact on the environment. Initially, the purpose of EIA was to identify impacts on the biophysical environment. Over a period of time, in recognition of the difficulties in deciding the boundaries between where the bio-physical domain ends and where the cultural, social and economic environment begins, EIA studies began to embrace these dimensions as well. Measuring the impacts of an activity or project can involve significant scientific and technical work including measuring and modelling and thus can be quite expensive. Therefore, it makes sense to develop some subjective criteria to determine when incurring such expenses is justified.

At early stages in project identification and preparation of feasibility reports, potential environmental impacts can be flagged up even without detailed environmental impact studies. During project design phase, when comparing alternatives, it would be useful also include potential environmental impacts of the alternatives as part of the assessment process.

When a final design is being considered in terms of investment appraisal, detailed environmental impact assessment is essential. However, not all investment projects may involve significant environmental impacts. Consider for example, a project to promote

literacy or a project aimed at improving hygiene awareness amongst school children. In such projects, there will be both positive and negative environmental impacts (for example, are any leaflets or educational material being published, if so where and using what methods, will there be an increase in chemical pollution during the production process and so on). However, in these two examples, it is highly likely that positive environmental impacts outweigh negative impacts.

Organisations such as the World Bank and Asian Development Bank consider projects in terms of categories and then require environmental assessment in the case of some projects and exempt others. For example, operational policy 4.01 of the World Bank considers various categories: category A projects are those with significant and irreversible adverse environmental impacts and hence a comprehensive environmental assessment is required for project appraisal; category B projects are those with potential adverse environmental impacts – in most cases mitigation measures are considered feasible and are included in the project; category C projects are those with minimal or no adverse environmental impacts.

Identifying an impact is just the first step. Suppose that a project impacts on 40 acres of land and results in additional water pollution to the tune of 40 tonnes per day of various chemicals in a local river. What does this mean to an analyst appraising the project? Information on physical impacts in itself is of limited use unless it can be translated into how it affects the well-being of affected citizens. Environmental valuation helps to convert the information in physical magnitudes of impact into monetary measures, which can then be used in investment appraisal.

3. Externalities

In an ideal world, individuals (and firms) acting as moral agents take into account consequences of their actions for them and others. However, in the real world, our capacity to act as complete moral agents may be hampered by self-interest, ignorance, uncertainty or simple callousness. When actions of an individual (or a firm) impact on other individuals (or firms) and there has been no compensation exchanged between the parties concerned, such impacts are externalities. Many actions involve externalities – social norms at a given point in time may dictate what is acceptable and what is not acceptable. The role of regulation in this is complex and evolves over time. Between the extremes of 'do nothing' or 'impose an outright ban' there exists a grey area where we need to exercise reason weighing the costs and benefits of actions.

Unmitigated environmental impacts of a project are the classic textbook case, of externalities , where decisions taken by one person or organisation in relation to a project activity affect other persons or organisations without any compensation. If an externality is

not internalised, then there would remain a difference between marginal social costs and marginal private costs. The individual or organisation concerned will compare marginal net private benefits with the marginal private costs and will choose a magnitude of activity (that is a magnitude of pollution) where marginal benefits equal marginal costs. However, as can be seen from figure 1 below, this results in setting the magnitude of activity in excess of what is socially desirable.

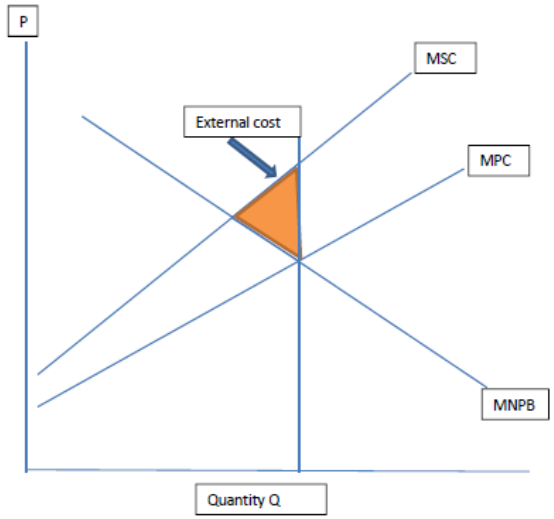

Figure 1: Marginal social and private costs in the case of an externality

One theoretical solution to the problem of externalities is the so called Pigouvian tax – to impose a tax on the polluter of an amount equal to the difference between marginal social and private costs. Thus, the difference between marginal social and private costs disappears and the individual or organisation will then choose a quantity of activity up to a point where marginal private benefits equal marginal social costs. However, imposing a Pigouvian tax is not straight forward in practice – there must be a regulator, the regulator must know both the social and private cost profiles for each firm, then set marginal rate of taxes just equal to the divergence between social and private costs and maintain this dynamic given technical progress and market structure for pollution abatement technologies. Though this idea has been developed and applied mainly in relation to pollution taxes (and hence the 'polluter pays principle'), the basic idea about internalising an externality using the concept of

divergence between marginal private cost and marginal social cost remains relevant to most classes or categories of externalities. An alternative solution to internalise the externalities was proposed by Ronald Coase. In this solution, the main problem is identified as lack of ownership of common resources, such as clean air or an unpolluted water resource such as a lake. Clarifying property rights produces the same effect of collapsing the divergence between marginal social and private costs and thus internalising the externality concerned. The concept of tradable emission permits has been developed from this perspective.

This discussion points a way to connect an EIA study and its consequences. As an EIA study of a project identifies potential impacts, the logical next step is to find ways to 'internalise' these externalities by way of mitigation measures – some of these may be changes in design specifications such as 'height of the chimney' or 'location of the dam' and others may require activities throughout the life of the project such as 'install and operate a wastewater treatment plant' or 'install and operate a water sprinkling mechanism to reduce air borne particulate emissions' (for example in the case of quarrying, open cast mining or storage of excavated earth or fly ash). These activities or necessary changes will need to be included as part of project costs in the revised financial and economic analysis.

The purpose of *ex ante* EIA is thus two-fold – a) to identify 'reversible' impacts of the project and to internalise such externalities by way of mitigation measures; and b) to identify impacts or externalities that have not been mitigated and thus result in a loss of social welfare. The rest of the chapter discusses various methods that can be used for valuing environmental impacts especially when these have not been mitigated.

4. Micro-economic model of consumer

The economic value of a good exchanged in market is the Marshall-Dupuit consumer surplus estimated from the demand curves. Thus, the various ecosystem services or functions of the environment affected by a project activity can be considered under three types

- those that are traded in markets (food production, raw materials such as timber or minerals);
- those that are not themselves traded but form part of other commodities that are exchanged in markets (such as recreational use, amenity, flood protection, gas regulation);
- those that are neither traded directly nor as part of other commodities (such as climate regulation, habitat protection).

Environmental valuation methods initially focused on the first two types of environmental goods and more recently have aimed to address the third type.

When valuing, what the analyst is trying to estimate is often considered as the 'total economic value' (TEV). This includes various components, namely:

- ***Direct use value***- where the magnitude of value is directly related to the use to which the environmental good or service can be put. Thus, direct use value is closely related to consumptive or extractive use of the resource or good concerned. In the case of a piece of land, this can be estimated as the present value of a stream of income that can be generated by the most direct or 'next best' use. Suppose an acre of land in a given region can be used only to grow a certain crop, the projected annual yield and market price for the crop can give us an estimate of the direct use value. There, is, however a judgement involved in assessing the next best use.
- ***Indirect use value*** – where the magnitude of value is related to experience rather than consumptive or extractive use. If a piece of land offers a view of a national park or an aspect of nature, there can be an indirect use value.
- ***Option value*** – the value of keeping an option open, that is not making an irreversible decision. The estimation of option value depends on probability of a high value event occurring and the corresponding magnitude of the benefit. For instance, in the case of the plot of land mentioned above, even if this is presently some distance away from the peri-urban fringe, depending on the nature of urbanisation and infrastructure investment decisions there is a possibility that this piece of land may become quite attractive in terms of real estate in the future – say it can fetch £1 million in today's prices. However, the probability of such an event could be very small as the city may not grow or it may grow but not in this direction and so on. So let us say, the probability that this particular plot would become a real estate 'gold mine' is 1 in a million (so there are a million other similar plots which face the same prospect). Thus, the option value of keeping this option open is in essence £1 million times 0.000001 which is £1. While this is just an illustration, option value can sometimes include cultural or identity issues which are extremely difficult to value[4].
- ***Bequest value*** – in addition to the direct and indirect economic benefits that a plot of land offers, it brings with it some heritage and the potential to pass on that heritage to future generations.

Existence value – as the name implies, this is the value of a piece of land not related to its economic benefits but for its existence itself. Sometimes, this can also be referred to as 'intrinsic value'.[5] Total economic value is supposed to encompass all these aspects. However, for some of the environmental goods and services, some components or values of TEV may be more important or relevant. Plottu and Plottu (2007) argue that option and non-use values should be considered differently as compared to use values.

At the centre of most environmental valuation methods is the micro-economic model of individuals and their utility and consumer demand based on concepts developed by Marshall and Dupuit. Such an individual is assumed to have well-behaved preferences (that is preferences are complete, transitive and reflexive). Such an individual may trade their

[4] Perhaps, in that case, option value overlaps with other dimensions of value such as existence value.
[5] See Samuelsson (2010) for a discussion of existence value.

income (and other resources they possess) in order to produce a bundle of commodities they wish to consume. The consumer's well-being is reflected in their utility function – the consumer compares alternative consumption bundles and chooses that bundle which gives greater utility or well-being. Thus using the concept of demand functions, consumer surplus can be estimated as an indicator of change in well-being due to either price or quantity changes caused by the environmental impacts of a project.[6] Thus if a change in environmental quality affects consumer well-being, the aim of valuation in project analysis is to estimate this change in well-being through appropriate methods.

It should be noted that this approach to environmental valuation based on rational consumer choice whilst now very widely used has also been controversial. Environmental philosophers and other social scientists are critical of this approach of the rational choice-utility maximising model for various reasons. These criticisms can be grouped under four major categories.

(a) A set of criticisms focuses on the utilitarian perspective at the centre of rational choice theory. [We can call this 'utilitarianism' criticism.] Such critics argue that people may value the environment for many reasons (including cultural, social, historical, metaphysical reasons) and not because of direct utility that they expect to gain from 'consuming' the environmental goods and services.

(b) A second set of critics challenge the underlying assumptions of rational choice model-whether consumer has all the information, whether preferences are stable, whether consumer maximises or simply uses a satisficing calculus, whether a consumer converts all information into one metric (commensurability) and how events over different time periods are compared (discounting and inter-temporal choice issue). [We can call these 'questioning the assumptions' criticism.]

(c) The third set of criticisms are also related to the model of a consumer with examples including the 'citizen-consumer' dichotomy (Sagoff,1988) that is whether individuals use the consumer choice model for certain goods and services, but behave as citizens when considering other issues such as environmental resources and sustainability.[7] Another example includes the question of whether consumers use different approaches when making decisions for private matters as opposed to social goods (see for instance, Rabin, 2006, Loewenstein et al, 2007, and Hards, 2011; Fehr and Hoff,2011).

[6] For a discussion on basic model of consumer choice see Varian,1988; for a discussion on consumer choice model to environmental valuation, see Johansson,1987. A number of criticisms of the rational utility maximising individual are in Sen,1984 and 1987.

[7] Sagoff (1998:68) provides the example of the difficulty in explaining why he may have obliged and bought the Girl Scout cookies made by his neighbour's nine-year old daughter: "…I might have wanted or preferred (1) to support the Scouts; (2) to avoid friction with my neighbour; (3) to appear generous; (4) to spare my own daughter from embarrassment among her friends; (5) to do the right thing; (6) to feel a warm glow that I did the right thing; (7) to avoid guilt; or (8) any of a hundred reasons."

(d) A fourth set of criticisms suggest that instead of using a rational choice-consumer utility model, whether alternative mechanisms such as referendum or citizen jury or participatory methods such as community based social accounting approaches may be better suited to understanding how communities or groups of individuals value environmental resources. [We can call this 'participation' or 'democratic process' criticism.] Some critics suggest alternatives instead of using an individual centred approach to valuation (see Sagoff,1988, Orr, 2006; and Spash,2007).

While these debates have certainly informed environmental assessment approaches and methods, there is still merit in using the micro-economic model as a limited but useful approach especially as an input to cost benefit analysis and project appraisal. The other approaches usually produce information that may be valid but difficult to incorporate as a qunatitative input in cost benefit or project analysis.

5. Examples of practical valuation methods

In this section, an attempt is made to briefly discuss a number of practical methods that can be used in environmental valuation. Various methods are discussed, in each case with some examples of applications in developing countries drawn from literature. Some shortcomings of each method are also discussed.

The valuation methods that can be used depend on which aspect of the total economic value concerned is the most important. . For whatever aspect , it will always be useful also to ask whether market prices already exist for the good concerned. If they do then market prices can be used in estimating the environmental impact. If they do not exist, then it may be useful to ask whether the good or service in question affects the value of something else-then by observing decisions concerning this latter good, we may be able to draw some conclusions about the preferences for the original good in question – hence such approaches are termed *revealed preference* methods. Certain goods or services (aspects of the environment such as biodiversity or existence value) do not have markets nor is it easy to deduce revealed preferences for them by observing something else. In such cases, consumers (or a representative sample of such consumers) need to be asked directly for their willingness to pay. This decision tree is summarised in figure 2 below.

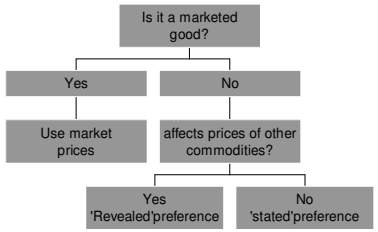

Figure 2: Decision tree in choosing valuation methods

The most obvious examples of market price based methods is the change iin production method. Examples of revealed preference methods include the travel cost method of estimating recreation benefits and the hedonic price method of estimating amenity, as well as the contingent valuation method (CVM) and choice modelling (CM).

5.1 Change in production method

When an environmental impact directly affects the production of a good or service which has market prices, valuation can be quite straight forward. Three main issues are: first establishing a clear link between the environmental change and production activity, secondly tcomparing impact this to the situation without the project and thirdly deciding which prices to use to value this net effect. To take a simple example, suppose that a project results in increased water pollution (due to discharge of effluents) in a river. In such cases, the change in production method can be used to translate the impact of increased pollution on downstream fisheries. Long term data on fish production in the river may be helpful to establish the 'without project' trend. Experience from other similar projects or models may be necessary to estimate the extent of impact of increased pollution level on fish production. These models may be used to forecast fish production 'with the project'. The reduction or difference between without and with project is the net impact of the project. If the impact constitutes only a small proportion of national production, it can be assumed that the reduction in fish production on this site would not result in changing prices. Thus, the magnitude of loss of production can be converted into monetary terms using existing price data. However, if the magnitude of the impact on this site is likely to have a significant impact on national production (for example, in small countries such as the Caribbean islands

or when the project is very large in magnitude as in multi-purpose dam projects or super thermal power stations or petro-chemical complexes), then the dynamics need to be analysed with the help of macro-economic models to forecast the likely equilibrium price 'with project'. This price will then be used to estimate the value of the magnitude of net reduction in fish production due to the project. If the change in production mainly affects firms, then we will need to estimate producer surplus using a combination of prices with and without the project.

A good example of this method is the study of change in fish production in evaluating the impact of various projects associated with Lesotho Highlands Development Project (LSDP). For example, Turpie (nd) reports the use of the change in production method which was used to value fisheries in the Malibamatso, Matsoku, Senqu and Senqunyane rivers. In that study various surveys were used including a household survey of 1,680 households. Based on these surveys, current production and prices were obtained; project impact was valued in terms of anticipated reduction in fish catch. Similar results are also reported in table 2 in Matete and Hassan (2006).

Related to this type of approach are 'dose-response' methods. While the change in production method is mainly used to value the impact of a project on goods or services that are directly marketed goods (with prices), dose response methods are mainly used to estimate the magnitude of project impact on the health of the population affected. An example of this is a study of the health impact of air pollution in Hong Kong by Brazer et al (2006). In that study, the authors use extensive data on pollution in the Pearl River Delta region to make projections of pollution levels under different scenarios. Then they use Hong Kong based epidemiological data to construct pollution-response functions. They then estimate averted mortality and averted morbidity (in terms of hospital admissions) for two scenarios, namely adapting of World Health Organisation (WHO) standards and the second scenario of bringing down pollution in Hong Kong standards and these are compared with the business as usual scenario. They then apply the value of statistical life from other previous studies to estimate the value of number of lives saved by reducing pollution to WHO standards. The value of averted morbidity is estimated using data from previous surveys of willingness to pay to avoid a day in hospital. Based on these approaches, they estimate that the value of health benefits from reducing air pollution in Hong Kong to WHO standards is approximately US$ 5.5 billion (with a range from US$ 2.4 to $8.5 billion). On annual basis, they argue that this compares to about 12 per cent of government health expenditures.

The main advantage of production methods is that in most cases converting information on the magnitude of impact into monetary values can be fairly straight forward. However, the main criticism is that they tend to focus only on environmental goods or services which already have a market price. Thus, many non-marketed aspects would remain omitted. Therefore, change in production could significantly under-estimate benefits from

ecosystems which provide multiple benefits or services. As we saw in table 1, resources or materials account for only 12 per cent of the total value of global ecosystem services. Another potential drawback of change in production methods is that certain environmental impacts may take a long time to feed into production processes or to impact on health, so change in production methods are likely to be better at dealing with more immediate and direct impacts than long term and indirect impacts.

5.2 Revealed preference methods

As mentioned earlier, this class of methods is based on the principle that changes in environmental quality affect some other marketed goods, so that by establishing a connection between environmental quality and change in price, some evidence of how consumers value environmental quality can be deduced.

Defensive or preventive expenditures

While some environmental impacts themselves may not be valued, they may in turn require individuals or firms to undertake preventive or mitigating actions. The cost of such actions can be used as a guide to the value of the negative impacts. For instance, in order to avert noise pollution from roads or air ports, households adjacent to such roads or directly in the flight path of aircrafts landing or taking off from an airport may have to incur additional expenditure in double or triple glazing their windows or have other insulation installed. This additional cost of such measures can give an indication of the negative externality imposed by the aircraft or road noise. During the May-August 2011 period, a consultation by Heathrow airport was in progress with regard to its noise mitigation measures (due to the ending of the existing Cranford agreement preventing easterly take offs from the northern runway over the village of Cranford). In this consultation, Heathrow airport was offering four types of assistance- residential day time noise reduction, residential night time noise reduction, community buildings noise reduction, and financial help with moving costs to those who wanted to move. The values residents place in the loss of amenity or inconvenience due to aircraft noise is reflected in such offers by airport operators.

The replacement cost method or 'shadow project' methods are essentially based on the same principle. When a particular environmental resource is likely to be used up or damaged by a project, regulators or funders may require that the environment is restored to its original state or the community is compensated in terms of the creation of an equivalent site elsewhere. For example, in the case of oil spills, one of the starting points of a discussion on damage estimation is usually about the impact of an oil spill on local beaches. Among various methods that can be used (including the change in production approach to estimate the value of loss to fisheries or the sea food industry), one is the cost of cleaning up of beaches and restoring them to their original condition. For example, the British Petroleum (BP) Sustainability Review 2010 includes data pertaining to the consequences of the Deepwater Horizon accident in April 2010. Compared to about US$ 2.4

billion in environmental expenditures in 2008 and 2009, in 2010, environmental expenditures were to the tune of US$ 18.4 billion. In a previous oil spill of Exxon Valdez in Alaska, the replacement cost method was used to estimate damage caused to sea birds and mammals (Brown, 1992).

The main advantage of the replacement cost method is that it would require 'like-for-like' compensation or restoration after damage. However, there are many shortcomings. Baseline information must be available as a reference point for comparison. [8] Secondly, institutions are supposed to be working effectively and factors such as corruption do not exist. However, in reality, environmental regulations can present themselves as a rent-seeking opportunity. For example, when MV Rak carrying coal to Gujarat sank near Mumbai in India in August 2011, the consequent oil spill damage raised debates whether ships may be sunk deliberately by companies at certain locations due to lax regulations rather than others to avoid costs of decommissioning and try to get away with washing their hands off any liability. Thirdly, legal instruments must be in place to enable courts to enforce replacement cost methods. Otherwise, the exercise would remain a hypothetical tool rather than a useful policy instrument.

Travel cost method – forest recreation, tourism

The underlying premise of this approach is that resources are scarce and human beings would not incur resources to bother to travel to a recreational site unless the perceived benefits from visiting that site are at least equal to the total travel costs. Thus, travel cost provides a clue to demand for recreational use of a site such as a forest or beach. Thus, to operationalize this method a survey of users of a recreational site is conducted. Data collected from such a survey would include information on origin of the trip, mode of travel, journey time, frequency of visits, number of members in the party, data that would help in estimating capital and running costs of the vehicle used for the journey, and socio-economic details of the respondent. An inverse relationship is expected between travel cost and number of journeys.[9] To connect the sample to the relevant population, models need to be developed that can help estimate the number of trips from different zones. Such a trip generation function will include information on population, travel cost, distance and so on. Using this information, a relationship between travel cost and number of trips – a derived demand curve – is estimated. Travel cost includes both the actual cost incurred in terms of vehicle and fuel and also travel time cost in terms of actual time spent travelling. Though originally meant for estimating recreational values of day trips to forests over a period of

[8] This issue is of relevance to other valuation methods also- see Knetsch (,2007).

[9] In transport models, it is quite common to think of trips originating from zones. Early transport models were based on 'gravity' models suggesting that number of trips between two zones is directly proportional to the product of 'masses' of the two zones- in this case, populations - and inversely to the square of distance.

time, the method has been developed to cover recreational benefits of the entire tourism industry in the case of small islands.[10]

Chen et al (2004) use the travel cost method to estimate the value of recreational benefit of a beach in Xiamen island in south-eastern China. For this purpose, they conducted an on-site survey in 1999. Their sample of 560 visitors were each interviewed and were allocated to some 34 origin zones. There are two components- one is the travel cost to the island itself (which is zero for local residents) and the second is the travel cost within the island from the tourist's place of stay to the beach on the eastern side, where the survey was conducted. Since the beach surveyed is one of six other beaches on the island and many visitors visit the beach as part of multi-destination travel, the authors apportion travel cost to the island based on the survey respondent's views about how to allocate the total cost to the beach. After estimating trip generation functions one using education of respondent as an independent variable and another using income per capita as an independent variable, they estimate the total value of recreational benefits from the eastern beach on Xiamen island as US$ 53.5 million in 1999 or a per visit per visitor consumer surplus of US$ 16.9. They recommend the introduction of a user fee to recover the cost of maintaining the beach.

In another travel cost study of international wildlife tourism in Uganda, Andersson et al (2005) estimate that recreational benefits from wildlife tourism could be increased by between US$ 30,000 to US$220,000 by considering the market to be a monopoly rather than aiming to achieve cost recovery. Another study also from Uganda by Buyinza et al (2007) used two methods one of travel cost and another of stated willingness to pay. Based on the travel cost method, the authors estimated the recreational benefit from the Bujagali Falls Recreation Park to be approximately US$ 370,000.

Hosking (2010) used the travel cost method to estimate the recreation benefit of visiting seven estuaries in South Africa with and without improvement to freshwater flows. Change in consumer surplus is then attributed to the recreational benefits generated by the project. They conducted surveys and used this to produce trip generation functions. For example, in the case of Heuningnes estuary, there were three zones; after estimating visits per 1000 of population they proceed to estimate a regression equation where the visitation rate is the dependent variable and travel cost is the independent variable. Using this information and assuming various alternative entrance fee situations, they estimate the number of visits. By using this information, then then estimate a recreational demand curve between travel cost (price) and number of visits (quantity).

There are numerous criticisms of the travel cost method. The main criticisms can be divided into two groups as epistemic and methodological. Epistemic criticisms include issues such as: the problem of tourists versus the local population, who may value a resource highly but

[10] The travel cost method appears to have been proposed by Harold Hotelling in a letter to the National Parks Service in US in 1947.;see Pearce,(2002:66).

whose valuation is not captured in the travel cost calculation because they may live close to the site; recreation benefits versus non-use or intrinsic values which are not captured in the travel cost surveys; the problem of intra-household inequalities (one or two persons may have made the decision that the entire family must visit the site); the problem of captive visitors (having come to an island or a distant location, there is nothing else to do but visit whatever is there irrespective of the magnitude of recreation benefits). . Methodological criticisms include the problem of truncation bias (only those who visited the site are sampled- and hence, valuation by non-visitors is not taken into account); the problem of multiple destinations (and thus precise allocation of travel cost to different sites); the problem of having reliable data on vehicle capital costs and operating costs; the problem of valuation of travel time and whether or not it should be included in calculating travel cost.

Hedonic prices method (HPM)

Anyone who bought a laptop or a mobile phone or car would have implicitly conducted a hedonic price analysis when comparing two or more similar goods with different values of various attributes before reaching a decision. Hedonic pricing is based on the model of consumer choice set out in Lancaster (1966: 134) which relates goods and characteristics. The three main elements of this approach are that: (1) "the good per se does not give utility to the consumer, it possesses characteristics and these characteristics give rise to utility"; (2) a good may have "…more than one characteristic and many characteristics will be shared by more than one good"; and (3) when goods are consumed in combination the whole may be different from sum of parts i.e., "goods in combination may possess characteristics different from those pertaining to the goods separately". The use of this characteristics approach to examining housing prices or prices of relevant goods has come to be known as the hedonic prices method and by the late 1970s it had become a well-established method to understand demand for environmental quality (see Maclennan,1977; Myrick Freeman III,1979; and Malpezzi,2003). The essence of the method is to collect information on house prices and all the various attributes of houses that affect prices and express prices as a function of the various observed characteristics to estimate the hedonic or implicit prices of such attributes.

Applications of the hedonic prices method in Africa appear to be quite common in agricultural economics for example, to understand whether food prices are affected by quality (Dury and Meuriot,2010) or whether different aspects such as age and body weight affect livestock prices (Akinleye et al, 2005).

In a study of house prices in Windhoek townships, Humavindu and Stage (2003) find that apart from the usual housing attributes, environmental quality in terms of location close to a garbage (waste) dump has a significant negative impact on house prices. In their study, being close to garbage dump (less than 250 metres) reduces the house price by about 35,000 Namibian dollars (NAD) compared to average house prices of 60,000 NAD. Being close to Goreangab dam recreational site on the other hand increases house prices by as

much as 22,000 NAD. Though these results were statistically significant, we should interpret them with some caution because in their study out of 479 observations, only 6 per cent appear to be close to a garbage dump and only 1 per cent close to the Goreangab dam site.

A similar result has been reported by Belo and Bello (2008) in a hedonic price analysis of house prices in two locations within Akure, the capital of Ondo state in Western Nigeria. The authors surveyed 100 houses in each location. Their regression analysis had property value as a dependent variable; independent variables included eight variables depicting housing characteristics (wall material, ceiling, roofing material, window, room size, and whether a kitchen, toilet and fencing were available); eight variables representing environmental quality (condition of access road, regularity of electricity supply, condition of drainage, hours of water supply, crime rate, number of government approved private schools, public schools, and distance from a refuse dump) and five socio-economic characteristics. Access roads, electricity and distance from a refuse dump were statistically significant and positively associated with house prices.

Wen et al (2005) report a hedonic prices study of house prices in Hangzhou city in China. In that study, seven variables related to the housing structure, seven variables related to neighbourhood characteristics (including environmental quality indicators) and three location characteristics were used. About 60 per cent of the house price was contributed by structure characteristics, 16.5 per cent by neighbourhood characteristics and 19.8 per cent by location characteristics. Distance to West Lake had a negative sign as expected and had a hedonic price of -3.6 meaning a km increase in the distance from West Lake would result in house price decreasing by 36,240 RMB. After floor area, distance from West Lake appears to have been the second most important variable among the 14 variables affecting house prices.

The main advantage of hedonic price analysis is that policy makers perceive it to be based on real information as opposed to hypothetical information. House price information by way of databases compiled by mortgage institutions tend to be readily available. However, there are a number of issues that could potentially affect the reliability of this analysis. First, it is most directly relevant to environmental issues which affect house prices and hence, tend to be more relevant to urban areas than rural contexts. Secondly, the underlying assumption is that there is a well-functioning market for housing transactions. In many countries, housing markets are imperfect and even where they do function, they may consist of several individual sub-markets (for example, due to segregation, social exclusion, formation of ghettos, and social and historical factors related to identity which may lead to the concentration of one group or community of individuals in one part of the city). Each such sub-market may have very different drivers of house prices. In that case, unless hedonic analysis is done for each sub-market, city-wide hedonic price analysis could produce spurious results as upward and downward variations in the same factor or characteristic in different sub-markets could lead the researcher or analyst to draw incorrect

conclusions. For example, in areas near a university, for example, there may be demand for single bedroom apartments or those with four or more bedrooms (so that a group of students could live together and share the kitchen and other amenities). In such cases, in regression analysis, the second bedroom may appear with a negative hedonic price suggesting that somehow a house with two bedrooms is less valuable than one with a single bedroom while elsewhere in other housing markets, usually, an additional bed room has a positive impact on house prices. Third, data may not be available in sufficient detail to permit this type of analysis. Where data is available, there may be doubts on its reliability. For instance, in many countries, registered house prices may not reflect actual market prices due to corruption as a lower price may be declared to reduce the stamp duty payable.

In many cities in the developing world, rent control mechanisms or other forms of rigidities impose significant transaction costs which may not be captured fully in house prices. Sometimes, land values in large cities are so high that there is little variation caused by other characteristics of houses including environmental quality indicators. In such cases, factors external to housing or neighbourhood characteristics may have a significant influence on house prices in an entire location or area within a city which may not be captured by hedonic analysis (for example, speculation on the plausible location of a new international airport or route by which a metro railway is likely to be built in the near future).

Also, certain environmental quality parameters such as urban air pollution or noise may not show adequate variation to be captured by house prices. For example, the pollution level in an entire neighbourhood or city (such as Beijing or Shanghai) may be high and not be differentiated by residential zones. In other cases such as proximity to a polluted river or garbage dump, residents may have no option but live in such locations.

5.3 Stated preference methods

Contingent valuation method

Contingent valuation is one of the most popular amongst environmental valuation methods and is also the most controversial. In a contingent valuation analysis a survey is conducted in which a scenario is constructed whereby an environmental good or resource or situation which is currently not traded in the market is proposed to be traded or whereby a payment is required in relation an environmental good or service. An appropriate payment vehicle is described. Then the survey respondents are asked to express their willingness to pay (WTP). In early applications in an open-ended question, the respondent is simply asked 'how much are you willing to pay for X?' and the response is then considered as the WTP. However, many studies have indicated that such open-ended questions are not incentive-compatible – that is there is no incentive for the respondent to reveal their true WTP. Various

experiments showed that responses to open ended questions can become significantly biased by the language used in the survey or the way the surveyor is dressed or by other trivial factors which should not affect WTP. Alternatives included a bidding game in which the respondent is asked a series of closed questions until a 'tipping point' is reached.[11] Another alternative is a single close-ended question such as 'if this will cost you dollars X per month, would you be willing to pay?' (Bishop and Heberlien, 1979). Subsequently, it has been shown that instead of one, if two dichotomous choice questions were used, the statistical efficiency of responses in estimating WTP improved (Hanemann et al, 1991).

From the early attempts in 1960s, the number of such studies steadily increased such that by the 1980s, two influential studies were published on the 'state of the art' of the method (Cummings t al, 1986; Mitchell and Carson, 1989). However, the method really 'took off' after the 1989 Exxon Valdez oil spill near Prince William Sound in Alaska. In 1992 as part of the proceedings the District Court in Alaska commissioned a study of 'passive non-use values' using the contingent valuation method (Carson et al, 1992). At about the same time, a number of critics of published various findings questioning the validity and reliability of contingent valuation (Hausman,1993). This controversy led to the formation of a 'blue ribbon panel' co-chaired by two Nobel laureates, Kenneth Arrow and Robert Solow. After hearing the arguments for and against , the panel in its report concluded that contingent valuation can be a useful tool provided various measures are taken to ensure that results are internally consistent and meet various theoretical and methodological requirements (Arrow et al, 1993). Among the measures recommended by the Arrow-Solow Panel report include the use of a referendum format (dichotomous choice question), reminding respondents about an income constraint, making the payment vehicle as realistic as possible, designing experiments with care and including appropriate tests for scope sensitivity and tests for internal consistency including alternative methods to deduce WTP information in addition to contingent valuation alone. Though the 'passive nonuse values' study contributed to the Alaska court raising the overall damages payable to US$ 5 billion, subsequent appeals resulted in the Supreme Court decision in 2008 reducing the overall damages payable to around US$ 500 million. That judgement also set the standard that punitive damages in maritime accidents should be no greater than actual damages.

Among the main criticisms of the method are studies which indicated that respondents seemed to be insensitive to the scale or scope of the good being valued – an example being a study in which there was little variation in WTP for protecting 2,000 birds or 20,000 birds or 200,000 birds (Desvousges et al, 2010). This phenomenon is also sometimes referred to as 'part-whole' bias (see Bateman et al,1997, Whitehead et al,1998). A similar issue has also been termed an 'embedding effect' by Kahneman and Knetsch (1992) whereby WTP in two or more settings does not differ significantly even where we would conclude from economic theory that they should be significantly different. The issue has been considered in NOAA

[11] For example, in increasing bids, this is the point when decision changes from yes to no; in decreasing bids, this is the point where decision changes from no to yes.

panel report (Arrow et al, 1993) and subsequent discussions also (see Diamond and Hausman,1994, Carson,1997, Bateman et al, 2002). Notwithstanding the various criticisms, the number of contigent valuation studies has been steadily increasing because it is perceived as offering a practical means of eliciting household response to environmental concerns.

Zhongmin et al (2003) report a contingent valuation study on the valuation of ecosystem services of Ejina region in the Hei river basin in Gansu province, China. In that study, they conducted a survey of 700 households – 324 households in urban areas drawn by random digit dialling of telephone numbers and 376 households in rural areas drawn by random selection from a sample frame of all households. The payment scenario was of a referendum whereby if a majority of households vote in favour of restoring the Ejina ecosystem to the level of the early 1980s, the programme will be implemented and if a majority of households vote against it, the project to restore it will not take place. If the respondent chooses to vote in favour of restoring then they are asked to indicate their willingness to pay by circling an appropriate number from a ladder with amounts per annum starting from 0 and going up to 300 RMB per annum. This was followed by an open ended question of single lump sum payment in the form of a capital contribution. 92 per cent of sample households were willing to pay some amount. Median WTP was just under 20 RMB per annum with those in the main valley having a higher median WTP than those living in surrounding regions. The regression results suggested that WTP was positively correlated with urban residence, education and income. It is not clear how the authors tested for and avoided collinearity, for example ,between education and income.

In a study of contingent valuation in South Africa, Turpie (2003) presents information collected from a sample of some 814 income earning (that is non-poor) households in Western Cape province. The survey elicited WTP for national biodiversity conservation at the broadest level and for actions to prevent climate change. After respondents gave their overall WTP for biodiversity conservation, they were asked to allocate their WTP to seven areas related to seven major biomes in South Africa. One of the main findings of this study is that WTP was positively associated with the level of knowledge about local biodiversity areas and interest in biodiversity conservation.

One of the main criticisms of contingent valuation studies is that of construct validity (how what is said in the survey relates to reality) and of the need to avoid hypothetical bias or freeriding whereby respondents may answer questions in a survey and indicate WTP even though in a real situation they would not be willing to pay. For this reason, many such studies try to include some measure of actual WTP and compare this with stated WTP. Two examples from Africa may be considered here.

In a study of farmers' willingness to pay to contribute to tsetse control in Burkina Faso, Kamuanga et al (2001) used a contingent valuation approach to survey 261 households. In this study, farmers are surveyed about their willingness to contribute by way of participating

in tsetse control programme, which requires farmers to spend either money or labour or both in setting up and maintaining traps to control tsetse flies. The authors used an open ended format with regard to WTP questions. 23 per cent of farmers were willing to pay money, 37 per cent were willing to contribute labour and 40 per cent were willing to contribute both. However, they also found that there is a divergence between the predicted and actual contribution: only 56 per cent of those who said they will contribute labour actually contributed labour in the previous period. Also, the predicted contribution was nearly 7 days per month per household, while actual contribution was only 2.1 days per month. Thus, the respondents appeared to be exaggerating not only their willingness to contribute but also the magnitude of such contribution. Though this is just one example, it highlights the potential problem of using private WTP as a mechanism to provide public goods whereby it is difficult to exclude non-payers.

Let us contrast this with another study which finds convergence between stated and actual WTP. Urama and Hodge (2006) report a contingent valuation study conducted in South Eastern Nigeria. In this study, the willingness to pay question was framed as a contribution to a river basin restoration trust fund. The survey covered 108 face to face interviews with farmers using an iterative bidding which started with an open ended question. The starting point from the open ended question was then increased by 10 per cent in each subsequent stage in the iterative process. The WTP values obtained were compared with another survey in the same region in which preventive expenditures by farmers to address soil and water pollution were collected. The authors find that WTP values from the contingent valuation study were fairly comparable to preventive expenditures obtained from the preventive expenditure survey. For instance, mean WTP was 925 Naira per hectare per annum while mean preventive expenditure was 1,551 Naira per hectare per annum. Thus, they find that while there is convergence in terms of predicted and actual WTP, the margin of difference is statistically significant. These results are interesting because stated WTP is smaller than actual preventive expenditures.- It is plausible that lower stated WTP is a reflection of lack of trust by respondents on local institutions which would be charged with the responsibility to provide pollution reduction services.

This brings us back to what we can refer to as the 'Sagoff dilemma'- just as in the case of Girl Scout cookies, when we are eliciting WTP in CVM surveys, we cannot be sure as to what motivates the respondents to express WTP.[12] There could be many reasons including some related to preferences for the environmental good or quality in question. The onus is on the survey designers to recognise this and be as clear and transparent as possible in describing the WTP scenario, to try to find information on actual payment as a reference point and to be open about the limitations of the contingent valuation instrument.

[12] See footnote 8.

Choice experiments or choice modelling

An alternative approach which shares some of the philosophical roots as contingent valuation is known as choice experiment or choice modelling . This method has its origins in transport studies and the marketing literature. To some extent, it also appears to draw upon Lancaster's characteristics theory though this is seldom directly acknowledged as such. In a typical such study researchers construct various options (the choice set). Each option will represent a unique combination of different attributes or parameters. For example, choices with regard to environmental impacts of energy use could include packages that a citizen can choose from. Each package may provide a certain extent of energy per month.Tt may cost the user a certain amount per month and there may be variations from one package to another for example in terms of how clean or green the energy is, which organisation produces and supplies energy, whether there is any lock-in period for moving from one company to another, whether it is possible for consumer to generate renewable energy and feedback any excess energy to the grid, and whether there is any technical or financial assistance provided to the consumer for changing their energy use pattern.. Using the information collected from such surveys, the analyst tries deduce the marginal values of different attributes and estimate the relevant welfare measure (such as compensating surplus or equivalent variation).

Choice modelling studies appear to be common with regard to choices regarding breeding of cattle in terms of the attributes of cattle such as weight gain, potential market demand, type of feed required, and resistance to disease. (see for example, Jabbar and Diedhiou,2003; Zander and Drucker, 2008).

The present author used a choice modelling study to understand WTP for drinking water supply in Chennai in the South Indian state of Tami Nadu at a time when acute water scarcity was prevalent (reported in Anand,2010). In that study, I wanted to explore citizen preferences for the quantity of water (hence this was one of the attributes), the role of private sector provision, willingness to share a water tap with other households, and willingness to commit to reducing water use and increasing recycling and reuse. Various options (or bundles) were created. My surveys seem to suggest that households in Chennai would prefer to receive a larger quantity of water, and receive this via a yard tap in their own house and as long as water quality is assured they seemed indifferent to whether the public or private sector provided this service. Further, I tried to see if households considered these attributes or characteristics of various options in a hierarchical manner (by estimating a nested multinomial logit model) and found that there was no evidence of this.

The main advantage of choice studies is that they may be slightly more useful than a contingent valuation design for eliciting WTP in the case of sensitive issues where even the suggestion of a private willingness to pay question may be considered as a major shift in policy and thus result in protest votes. Also, the experimental design permits the analyst to create hypothetical options alongside real options and test preferences for aspects which do

not yet exist, but may become prevalent after the project is implemented. However, the main disadvantages are that the computational burden of models may dictate how many variables and how many choices can be used. There is also a problem of information overload on the respondents- for example, while it may be quite easy to present a large number of options concerning goods or commodities that are in day to day use by respondents, presenting policy choices or scenarios which involve processing of abstract information may result in spurious results if too many options are presented. For instance, in the end respondents may lose interest or may become bored waiting for the researcher to finish the long monologue of description of options.

6. Challenges and Limitations

The purpose of environmental assessment in project appraisal is to provide information to decision takers on the nature, magnitude and distribution of the environmental impact of project investment and whether in spite of the impacts, the project is worth doing. The purpose of environmental valuation is to provide a link between the information on magnitudes of physical quantities and monetary valuation based on how consumers value such changes. Environmental valuation does not result in measuring environmental quality in purely monetary terms- environmental valuation is an attempt to merely quantify and translate existing preferences of consumers. Where the project environmental impacts affect the production of certain environmental goods or services which are traded in markets ('marketed goods'), the change in production method can be used. Where the environmental impact in turn affects some other 'marketed good' various methods of revealed preference can be used. Where environmental impact is not directly affecting marketed goods or services, nor is it captured indirectly in the prices of other things, then citizens may need to be asked directly about their values using contingent valuation approaches. There has been considerable progress with regard to both theoretical and practical applications in developing countries. The examples discussed here suggest that it is possible to adapt and extend many of the methods considered to be within the 'mainstream' of environmental valuation. However, there exist numerous philosophical as well as methodological criticisms on all the methods discussed here. Some have been already discussed in the earlier sections and will not be repeated. Here, we consider some important criticisms and alternatives by way of a research agenda.

While we have already considered criticisms of individual methods above, the main criticism of environmental valuation comes from those who feel that the very act of trying to place a monetary valuation on the environment and describing benefits received from the environment as 'goods' is symptomatic of a very narrow, anthropocentric and utilitarian world-view that cannot address methodological or procedural challenges Deliberative discussions and citizen juries are often suggested as alternatives (see Spash and Vatn,2006; Spash,2007). There is a need for further research into whether community based and participatory valuation exercises can be conducted using contingent valuation -type

scenarios. An alternative suggested by some such critics is to use the idea of capabilities and freedoms as suggested by Sen (2009) and Nussbaum (2011). On the face of it, it may appear that freedoms are anathema to the idea of conserving and protecting natural resources. However, the concept of universalism of life claims (of those present now but also those will live in the future; of humans and non-human species) within the idea of freedoms suggests that capability approach and sustainable human development should be central to the discussions on environmental valuation (Anand and Sen, 2000; Anand,2007).

Some studies have used alternatives such as the ecological footprint or carbon footprint. The Global Footprint Network (2010) presents data at the national level for several countries on their ecological footprint. Here, the aggregate environmental impact of all activities occurring in a nation in a given year is converted into an ecological footprint in terms of 'global hectares per capita' required to sustain all the production and consumption. It is possible to adapt a similar approach at the project level to estimate the ecological footprint of a project. However, to a critic, the ecological footprint is merely a different scale or metric as compared with monetary values in the case of environmental valuation and thus, however appealing it may appear, the ecological footprint approach too suffers from some of the same philosophical and methodological limitations as cost benefit analysis and environmental valuation. Footprints may not be able to adequately capture the stock versus flow problem in terms of various ecosystem services. Also, the calculations may not fully reflect the role of technical progress and innovative designs in reducing a footprint significantly. Further, it is one thing to conclude that globally, our footprint is larger than the earth's carrying capacity; to translate this to the national, sub-national and project levels poses the problem of open economies, trade and inter-regional compensation. It does not require a sophisticated calculation to reach a conclusion that most cities have vast footprints. While the broader message of reducing the footprint is valid, detailed calculations do not necessarily help in identifying or prioritising policy options.

Another alternative is the so called multi-criteria analysis or multi-dimensional assessment as opposed to the single criterion of monetary measure used in most of the valuation methods discussed above. In a typical multi-criteria analysis , instead of providing valuation information, a project may be appraised on various criteria for its environmental impacts. This can be done in various ways. For example, the project may be scored on a scale 1 to 10 for each of the environmental criteria or each of the dimensions identified. Alternatively, qualitative assessments may be used for example, with indicators such as red, orange and green or high, medium and low. Alternatively, objective indicators may be chosen and for each indicator appropriate units and scale may be used. Once again, all indicators can be normalised and transformed to produce comparable units or ratios and from these a composite index can be calculated. Acceptable limits can be specified, for example, that to be accepted a project must score above a certain level on each of the dimensions or on aggregate. Performance on some factors can be given higher or lower weight by specifying weights. While this approach has the advantage that dimensions or criteria can be chosen

such that aspects which are difficult to value and those that are easy to value can both be taken into account, as opposed to only the latter points which are captured in environmental valuation. However, to a critic, these methods are as much fallible as environmental valuation because the choice of criteria, dimensions, scales, units, and weights are all arbitrary and there is no correct or incorrect approach. Thus, it is quite possible to 'dress up' a project that was previously unacceptable to become acceptable simply by 'shifting the goal posts' in terms of which criteria are used and how much weight is given.

An important issue concerns the cost of and time required for conducting environmental valuation studies and whether this can add to delays in the process of project appraisal and decision making. One response is that if citizens consider the environment to be an important issue, then their preferences for environmental quality must be considered in project decisions before imposing irreversible changes. Another response can be called the 'benefit transfer' approach that is to develop a database of methods, case studies and results with a view to developing a potential range of values so that perhaps one day we may reach a situation whereby values generated from one study could be used as inputs in the appraisal of other projects without having to conduct a valuation study. In some cases, for example, WTP relationships estimated in one study can be used elsewhere keeping the estimated parameters but substituting the relevant values of variables. However, given that environmental quality issues can be highly contextual and that often what people express as values in one context may be quite inappropriate in another, it is unlikely that the benefit transfer approach can replace the need for conducting environmental valuation studies. Perhaps in the early stages of project cycle and in screening and scoping, the benefit transfer approach may be used to identify potential issues or aspects to consider.

A related issue concerns how to set standards such as quality assurance requirements by user-organisations such as Development Banks or Finance Ministries with regard to environmental valuation studies. The Arrow-Solow blue ribbon panel is an example of standard setting for one of the valuation methods, namely, contingent valuation. In the absence of specific standards, it is difficult for users to judge whether they are getting value for money for the resources spent on environmental valuation.

A final point to make is that environmental valuation is only as good as how well such information informs policy and institutional change. A clever design and a fine analysis in a valuation study without the necessary legal and institutional environment is an exercise in constructing ivory towers. Knowing the price tag of something people already have or something which is not being traded can be quite futile. Hence, environmental valuation studies must be careful not to fall into the trap of headline grabbing but entirely useless calculations and instead focus their attention on policy-relevant information or studies that advance our understanding of human behaviour and preference formation.

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