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Applying resource economics to integrate sustainable development principles in SIDS

Chapter 8

Introduction

Though small island developing states (SIDS) are defined in Agenda 21 (Chapter 17) as ecologically fragile and vulnerable entities (measured by the number of natural disasters), whose small size, limited resources, geographic dispersion and isolation from markets (measured in terms of transportation costs), place them at a disadvantage economically and prevent economies of scale (mainly linked to domestic population) generally, it is important to note that SIDS are a complex mix of heterogeneous islands and countries (see Encontre, 2004). Furthermore, from a social and economic standpoint SIDS exhibit significant diversity, with some such as Bahrain, Malta and Singapore, being well developed, with low HIV/AIDS rates[1], crime and incidence of natural disasters, but the reverse situation tends to be present in others such as the Comoros and Guinea Bissau with relatively high crime and HIV rates, and States like the Maldives, Seychelles, and Mauritius that are subject to natural disasters. Comparisons, as seen in Table 8.1, with regards to other socio-economic variables demonstrate wide dispersions amongst SIDS and emphasise the contrasting states and trends in social and economic characteristics as evidence of inherent vulnerability and the performance of some in overcoming these challenges (Briguglio, et al., 2005; Prasad, 2007). At the same time, the threat of global warming is a distinct challenge with the need to reconcile and synergise conservation of SIDS's environmental and natural resources with their development policies, programmes, and plans in the face of globalisation and profound economic changes.

Ecology, and by extension resource economics, which are often credited to the writing of Rachel Carson's *Silent Spring,* which aroused a greater level of environmental consciousness globally, was in fact being discussed since the 19th Century by Karl Marx and Frederick Engels who had a profound interest in the interactions between the human economy and the natural environment, particularly as regards capitalist agriculture (Foster, 2007; Martinez Alier, 2004)[2]. They indicated that capitalism degrades the environment in a way that disproportionately affects the poor and the colonised in a concept that has become known as the 'metabolic rift'[3]. As such, resource economics provides us with the analytical tools to reconcile and prioritise the diverse objectives identified above and allocate the limited resources to their most economically efficient uses; in an administratively cost effective, and socially equitable manner in pursuit of the goal of sustainable development (Ison, et al., 2002; Tietenberg, 2002; Stavins, 2005; and Martinez Alier, 2004).

Table 8.1. Small states and some socio-economic statistics

Country	Land (sq km)	Population	GNI (Current US$m)	GDP per capita	2000–03 av. growth	Poverty index	Gini co-efficient
Antigua & Barbuda	440	75,779	716.0	9,134.65	2.47	12.0	0.53
Bahamas	10,070	311,560	4,840.0	15,591.00	1.23	9.3	0.46
Bahrain	620	690,865	610.0	11,851.67	3.47	6.0	
Barbados	430	268,788	2,520.0	9,372.93	–0.12	13.9	0.39
Belize	22,800	261,500	899.0	3,446.65	7.70	33.0	0.40
Bhutan	47,000	839,443	584.0	642.30	685	25.3	0.34
Brunei	349	347,270			295		
Cape Verde	4,030	452,230	784.0	1,251.78	5.00	44.0	
Comoros	2,170	578,993	323.0	364.98	1.46	60.0	
Cook Islands	240	18,250		5,349.28	7.57	12.0	
Cyprus	9,240	763,143	9,100.0	12,153.75	3.78	25.5	0.34
Djibouti	21,980	686,270	641.0	834.73	2.17	45.1	
Dominica	750	71,175	239.0	3,597.53	–2.24	30.0	0.35
Equatorial Guinea	28,050	475,930	454.0	3,215.10	8.81		
Estonia	43,211	1,361,125	8,510.0	4,418.70	6.65	8.9	0.37
Federated States of Micronesia	702	212,318	261.0	1,832.83	2.18	27.9	0.41
Fiji	18,270	821,800	1,960.0	2,222.50	2.25	2.25	0.49
Gabon	257,670	1,301,100	5,210.0	3,889.38	1.83	62.0	0.48
Gambia	10,000	1,368,400	370.0	321.07	3.70	40.0	0.40
Grenada	340	103,025	388.0	3,830.63	1.64	32.0	0.45
Guinea-Bissau	245,860	1,427,325	3,600.0	146.25	0.28	20.8	0.47
Guyana	196,850	763,935	698.0	950.16	0.08	43.0	0.43
Iceland	100,250	285,750	10,300.0	30,276.75	2.94		
Kiribati	717	93,647	84.6	569.09	1.73	51.0	
Luxembourg	2,586	442,250	23,600.0	45,398.75	3.56	5.5	0.31
Macao, China	21	437,000		14,956.00	5.65	19.0	0.40
Maldives	300	283,520	680.0	2,377.90	5.73	43.0	
Malta	320	395,250	3,660.0	9,706.65	1.42	15.0	0.30
Marshall Islands	181	52,325	139.0	1,903.30	140	20.0	0.54
Mauritius	1,850	1,204,800	5,220.0	3,973.55	4.58	12.1	0.37
Palau	458	19,792	130.0		185		
Qatar	11,437	604,158					0.38
Samoa	2,850	175,050	265.0	1,474.78	4.55	20.3	0.44
São Tôme & Principe	1,000	152,675	50.2	323.64	3.90	53.8	
Solomon Islands	27,540	437,425	247.0	621.60	–4.95		
St Kitts & Nevis	269	45,955	299.0	7,413.25	2.38	32.0	0.37
St Lucia	610	158,435	644.0	4,195.98	–0.44	25.1	0.43
St Vincent & Grenadines	340	109,833	356.0	3,125.48	1.83	37.0	0.56
Suriname	161,470	431,408	1,150.0	2,155.85	3.49	70.0	0.46
Swaziland	17,200	1,076,650	1,890.0	1,343.68	2.36	40.0	0.61
Seychelles	455	82,102	678.0	7,324.43	–0.54	19.0	0.47
Timor-Leste	14,609	819,500	341.0	438.44	5.01	41.0	0.35
Tonga	718	100,900	161.0	1,606.20	2.75	22.7	0.42
Trinidad & Tobago	5,130	1,300,525	10,100.0	6,708.85	6.57	21.0	0.40
Vanuatu	14,760	203,480	279.0	1,124.73	0.58	40.0	0.58

Source: WDI (World Bank 2006), for Gini coefficient various IMF country reports

Resource economics, which includes the study of environmental economics and resource utilisation, views the exploitation of the natural resources with which countries are endowed, inclusive of the SIDS, as being critical for economic growth. During the extraction, processing, and utilisation of some of these materials pollutants are produced that are emitted back into the environment (Kneese, et al., 1975)[4]. For the policy-makers in SIDS it is critical therefore, that ways be examined that would allow for this exploitation to occur to advance human welfare while minimising the negative externalities associated with the exploitation and utilisation activities.

However, before discussing the specificities of utilising resource economics to advance sustainable development principles, in particular valuation techniques and their applicability, it is useful to have a clear understanding of the conceptual issues. This approach will allow us to view the environment as a composite whole and to appreciate the interrelationships and complementarities present amongst its disparate parts.

Within this chapter, therefore, we consider the general tenets in mainstreaming resource economics for sustainable development, with specific reference to SIDS. The chapter reviews a number of approaches that seek to place a value on environmental goods and services, particularly when environmental changes, whether positive or negative, occur. This approach is offered here as an operational tool since traditional models have historically served two main functions:

1 applied as benchmarks against which to measure progress in the field, and
2 the provision of relatively simple frameworks to focus on crucial relationships.

We therefore commence by examining the relationship between human actions, as manifested through economic systems, and the environmental consequences of those actions. This then provides the basis for the establishment of criteria to identify the nature and severity of environmental problems confronting SIDS and to demonstrate how resource economics provides an avenue to assess and deal with these challenges.

Throughout this chapter, therefore, the focus is on using resource economics in a practical and effective manner for decision-making. At the same time, the most pertinent shortcomings encountered with the methodologies are highlighted and alternatives provided where possible.

Why value the environment?

There are at least five reasons why we seek to place a value on our environmental and natural resources in the SIDS to ensure that they are put to their most efficient usage where possible. Valuation:

1 reminds us that the environment is not a free good despite the absence of a conventional market in environmental services[5];
2 signals changing scarcities of these resources as conventional economic theory postulates that in a competitive market, as the supply of a good falls with demand remaining constant, the price will tend upwards;
3 translates environmental impacts of projects into values which can be compared and

integrated with financial and economic criteria of cost-benefit analysis (CBA)[6], thus aiding decision-making;
4 provides a more realistic indication of economic performance as the environment is then taken as one of the factors of production as well; and
5 serves as a guide for public policy: taxation, subsidies, conservation and pollution abatement expenditures.

The process of environmental and resource valuation assesses the amount of goods and services that an individual is willing to forego in order to consume the good or service in question (Tietenberg, 2002). Within the process of economic valuation of an environmental asset attempts can be made to determine its wider value to society and place a monetary figure on this value. The justification for placing monetary values on non-market goods, such as environmental resources, is that they can then be considered more readily in the valuation of potential policies and projects. This process remains controversial in both economic and environmental spheres, with members of either grouping doubting the ethics, rationale and the accuracy of these valuations (Clark, 2002; Stavins, 2005, Pearce and Barbier, 2001, and Bromley, 1990).

On some occasions, the market mechanism provides monetary valuations by yielding prices from products derived from environmental assets in well-functioning markets (Boardman, et al., 2001). However, many of the markets are not often well functioning and in fact, distortions are a reality of life due to the presence of monopolies, distortionary public policies[7], and externalities[8]. In such circumstances, some adjustment to the quoted market price is often necessary. This adjusted price is often referred to as the 'shadow price' as it reflects the valuation to society in these States due to a particular activity. But where markets exist the opportunity is provided to observe the aggregate quantity purchased and, therefore, the chance to find the point of interaction between the supply and demand curves. The shapes of these curves allow us to determine changes in social surplus, which is the combination of consumers surplus[9] and producer surplus[10], minus any costs associated with the policy or action. Thus, where we are able to observe the demand function there are a range of valuation techniques available to us to value environmental and resource impacts. These include:
i) the travel cost method;
ii) the hedonic price method;
iii) the defensive expenditures method; and
iv) cost benefit analysis.

But we are not always able to observe the prices and quantities for goods and services provided by the environment and natural resources, or the proxies available are often inadequate for inferences to be made (Portney, 1994). In such circumstances, analysts have often shown a propensity to use what is referred to in the literature as contingent valuation (CV) (Alberini and James, 2006)[11]. Respondents are often asked to indicate a hypothetical value of 'willingness to pay' for an environmental amenity or 'willingness to accept' compensation for an environmental loss. However, their responses to such questions do not have to be matched by payment. Hence there is often some degree of scepticism attached to using these values as they tend to suffer from extreme values (outliers). However, whatever the faults of contingent valuation methods, they do involve the public in a dialogue with experts. Hence, any means that gives voice to the public in an age of public policy-making by managers, consultants, professional politicians, large firms and interest group leaders is at least an antidote to environmental managerialism.

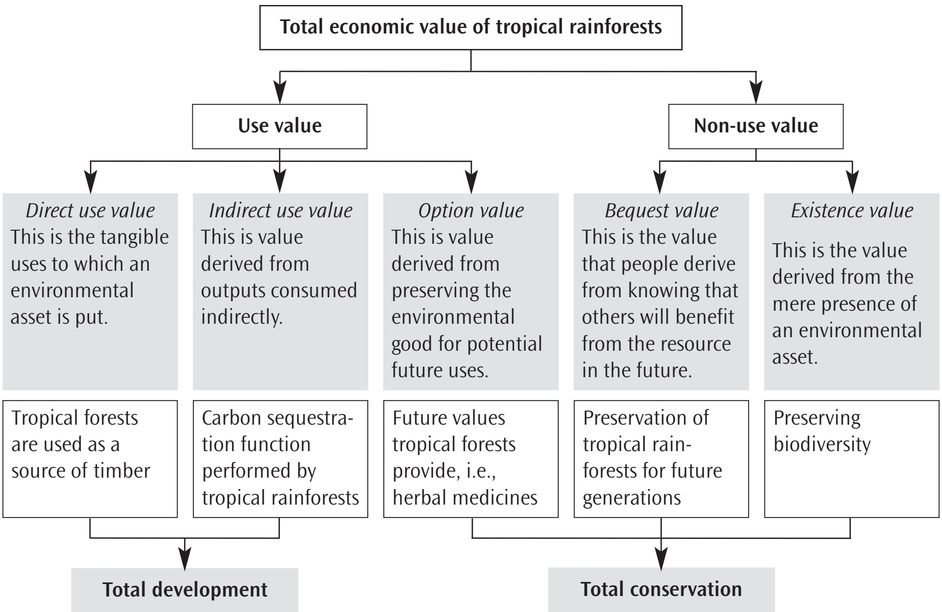
Total economic value

In recent years there has been considerable debate of how to measure total economic value (TEV) of an environmental asset in SIDS and globally. The TEV is suggested as having five component parts that can be further sub-divided into 'use' and 'non-use' values (see Figure 8.1). The values identified are direct use value, indirect use value, option value, bequest value and existence value. Figure 8.1 shows the relationship between these values.

While an accurate valuation of environmental assets in the SIDS should take into account each of these values, such values are not without their challenges. For example, in the absence of a conventional market place, it is often difficult to derive proper values for the many environmental services performed by environmental assets that include tropical forests, coral reefs, and watersheds, in these States. Furthermore, it is contended that conventional measures underestimate the true value of these assets (Tietenberg, 2002, Ison, et al., 2002). This is often due to the way we compartmentalise the environment, failing to appreciate the interdependencies, interrelations, and complexity of the systems that we work with.

Additionally, an indication of what one is willing to pay in the present for a future benefit that may occur (as required under the option value categorisation) is generally based on

Figure 8.1. Derivation of total economic value



Source: Adapted from South Pacific Regional Workshop on Integrating Economic and Environmental Policies and Practices for Environmentally Sustainable Development, Commonwealth Secretariat, Economic Affairs Division p. 21–22

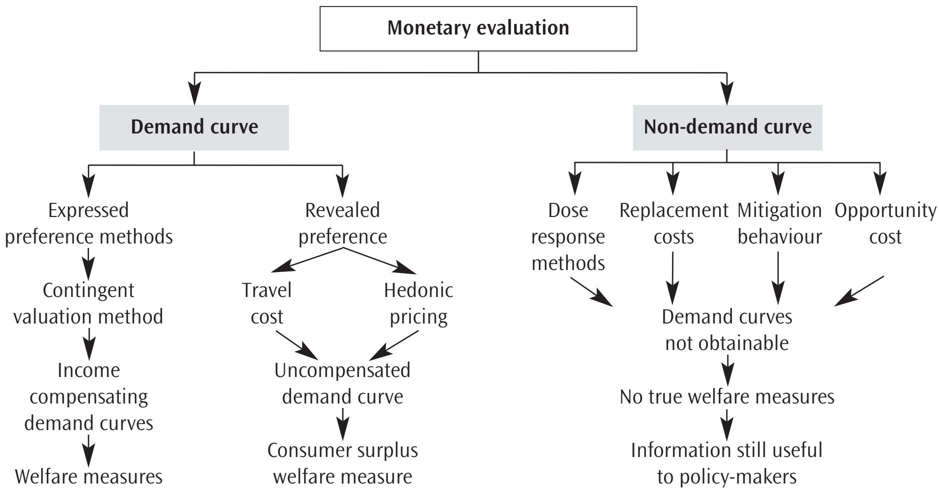
(Ison, 2002, Stavins, 2005). Thus, there is often a substantial amount of subjectivity present in such an approach. Lastly, using the concept of existence value, we may wish to have an environmental asset maintained in its present state so that we can pass it over to future generations un-depleted. But this conceptualisation assumes that future generations would want what it is the present generation wants! This may be an erroneous assumption. Hence, the debate continues.

But in studies conducted outside of SIDS it was found that the 'option' and 'existence' values of environmental assets often far exceeded their 'use' value (Pearce, 1991, O'Doherty, 1994).

Approaches to valuation

Valuing the resources of the SIDS can be achieved through a variety of means depending on the nature of the asset, i.e. the forests, biodiversity, corals, or land in question and the available information relating to its use. If the asset is bought or sold in a market of some kind, the market price for the asset provides one estimate of its value. But even this value may be distorted as a result of market failures due to, *inter alia*, few buyers and sellers, asymmetric information, and hidden externalities. These can lead to increased income inequalities, reduction in the quantity and quality of social services and a faster rate of liquidation of the environmental and natural resources. Furthermore, this method may miss some elements of TEV that are not captured by market activities, such as indirect use value, option value and existence value as discussed above due to the failures outlined. If the asset is not based in a market, it may have links with marketed goods that allow implicit techniques to be used. One of the most common of these methods is the hedonic pricing method that attempts to elicit environmental values using house prices that may implicitly contain estimates of these environmental valuations (Freeman, 2003; Triplett, 2006).

Figure 8.2. Methods of valuing impacts of development policy, plans and programmes on environmental assets



Source: Adapted from Turner, Kerry, Pearce, David and Bateman, Ian (1993) *Environmental Economics: An Elementary Introduction*, Prentice Hall, London

These techniques can capture direct and 'indirect values' but are unlikely to capture 'option' and 'existence' values. If, however, the environmental asset in question is not marketed or linked to a marketed good (or if this data is unavailable or deemed unreliable), valuation becomes decidedly more challenging. Methods such as stated preferences can be used to elicit these values. The most common of these methods is the **contingent valuation method** (CVM). This method draws out an individual's or household's willingness to pay for an environmental contingency. This information can then be used to extrapolate the value of society as a whole and, hence, the economic value of an environmental asset in a country. The advantage of this method is that it can capture many of the elements of total economic value, including existence values. Figure 8.2, adopted from Turner, Pearce and Bateman (1993), indicates graphically some of the valuation techniques available to decision-makers in SIDS and wider afield.

From Figure 8.2, two basic approaches are available to resource economists, such as those methods which value an impact via a demand curve[12] and those which do not and therefore fail to provide 'true' valuation information and welfare measures. These latter measures are still useful in at least being used to sensitise policy-makers to the effects of their decisions (Bateman and Willis, 1999; Ison, et al., 2002).

In many developing countries, inclusive of SIDS, the absence of data for measurement and valuation means that they are often coerced to employ methods referred to as non-demand curve approaches[13]. For example, the **dose-response approach** requires the existence of information that establishes a connection between an environmental condition, such as a loss of production from a fishery affected by water pollution, and the physiological responses of humans, plants and/or animals. But many SIDS, for example, in seeking to extract their mineral resources for faster economic growth, are forced to assess how increasing exposure to stock pollutants[14] that result from the extraction process are likely to affect human health. In conducting such an assessment, a dose-response methodology is often applied as this method seeks to determine the condition of one's health before the negative impact occurred, and what responses (conditions) emerged after the impact occurred. The forgone earnings and cost of illness to value an environmental good become critical tenets in utilising the dose-response method. The dose-response method, therefore, allows for an objective and realistic evaluation of the economic consequences of some actions pursued in the name of development. Furthermore, utilisation of the method is necessary to avoid decisions being taken that are in disfavour, while simultaneously improving resource allocation decisions and social welfare.

Additionally, the **replacement cost technique** (RCT) examines the cost of replacing or restoring a damaged or degraded environmental asset and uses this cost as a measure of the benefit of restoration. Its application, however, always requires careful thought and reasoning. For example, it remains a valid approach in situations where it is possible to argue that the remedial work must take place because of some other constraint. In such circumstances, where there may be a regulatory standard in place, the costs of achieving that standard may be used as a proxy for the benefits of reaching the standard (Tietenberg, 2002; Stavins, 2005).

However, the RCT does not provide strict measures of economic values, which are based on people's willingness to pay for a product or service. Instead, it assumes that the costs of replacing ecosystems or their services provide useful estimates of the value of these ecosystems or services. This is based on the assumption that, if people incur costs to avoid damages caused by lost ecosystem services, or to replace the services of ecosystems, then those services must be worth at least what people paid to replace the services. Thus, the method is most appropriately applied in cases where replacement expenditures have actually been, or will actually be, made, i.e., valuing erosion protection services of a forest or wetland by measuring the cost of removing eroded sediment from downstream areas.

In the process of pursuing economic growth, many households in SIDS are often affected by, for example, noise from the construction of a new highway or contamination of freshwater supplies from mining activities occurring upstream. In order to insulate themselves against the noise impacts that may negatively affect their sleeping pattern and, hence, their performance at work, householders may invest in insulation mechanisms to minimise this noise nuisance. The cost associated with such investment is used as an indication of that which the polluter should be paying to the household for its **mitigation behaviour**.

But as Pearce and Seccombe-Hett (2000) argued, if benefits were measured by costs then the benefit-cost ratio would always be at least one, begging the question as to what would have to happen for replacement not to be worthwhile. But where it is clear that the asset in question is unique and that benefits greatly exceed costs even on a limited inspection of the information available, then replacement cost becomes a minimum estimate of benefits. As a general rule, however, replacement costs should only be used in exceptional circumstances.

It is worthwhile to indicate at the inception that the opportunity cost[15] approach is not a valuation technique as no direct attempt is made to value the benefits of a particular action.

Photo 8.1. An open pit gold mining site at Kamarang, Guyana using a missile dredge in February 2007 (courtesy of M Bynoe).

Rather, it looks at the benefits of an activity that will result in environmental degradation – say drainage of a wetland to allow intensive agriculture – uses this to establish a benchmark for what the environmental benefits would have to be, at a minimum, to make the development (agriculture) worthwhile for society (Turner, et al., 1993).

Valuation techniques

While resource economists often commence from the premise of an idealised world in which there is perfect competition, in reality, all markets are 'imperfect' in some respect, leading to different types of **market failure**[16]. As such, the market price does not reflect the extra resource cost to society of producing the last unit of output of a product[17], and we encounter situations in which 'inappropriate' prices are established that distort valuations or where no prices at all exist. When a market 'fails' governments often take this as an indication that they should enter the market to correct for the imperfection. However, it is argued by Tietenberg (2002) and Stavins (2005) that governments should only enter the market if they can perform better than this mechanism. Otherwise, their intervention may worsen the situation leading to what is termed **policy failure**.

Policy failure occurs when the public policy required to correct market and institutional failures create unintended and usually negative environmental side effects (Barbier, 2000)[18]. For example, subsidies, taxes, tariffs, quotas, and many other policy interventions (such as grandiose public investments) are often made with the intention of improving social welfare. The goals of increased employment and agricultural output, adequate food supplies, or the protection of domestic industry may be well intentioned but are often economically inefficient. In some cases, the result is an increase in the supply of many products and services that are derived from natural resources whose input prices have been artificially lowered. This leads to resources over-use, often with negative environmental consequences. For example, low energy prices increase acid rain and the amount of carbon dioxide contributing to global warming.

Photo 8.2. Severely degraded mangrove forest along the Essequibo Coast, Guyana in April 2006 (courtesy of M Bynoe).

Market and policy failures: Valuation remedies

Where market prices exist, it is at least feasible to obtain monetary valuations of future net revenues from an environmental asset. However, where either a market or policy failure occurs, these prices may be deemed 'inappropriate' and in need of adjustments to more accurately reflect the true benefits and costs to society. Such adjustments give rise to **shadow prices**, i.e. prices which do not actually exist in the market place but which are assumed to exist for purposes of valuation (Boardman, et al., 2001; Ison et al., 2002; Londero, 2003). Box 8.1 illustrates the type of price adjustments which must be made when market and policy failures occur. As can be seen from Figures 8.3 and 8.4, the actual market price is too low ($22 and $14 respectively) when compared to the 'appropriate' market price ($26) corresponding to the best interest of society, in terms of efficiency gains, better resource allocation and improving public policy. Should government policy be unable to 'correct' this discrepancy (by tax or regulation) then, for valuation purposes, the product from this activity should be given a higher 'shadow price' and lower output. Within the remainder of this chapter, the focus will be on the valuation techniques available to policy-makers when there are market and policy failures and how these techniques can aid the resource allocation decisions to answer such questions as: Should funding priorities be given to areas with the worst environmental problems, or to areas that have made some environmental improvements? What criteria should be used to target resources for conservation? Should conservation programmes target least expensive resources or resources that are most vulnerable to environmental damage? What are the economic, environmental, and distributional implications of alternative targeting criteria? These issues are not only intellectually challenging, but also policy relevant.

Box 8.1. Market and policy failures, environmental impacts and 'shadow prices'

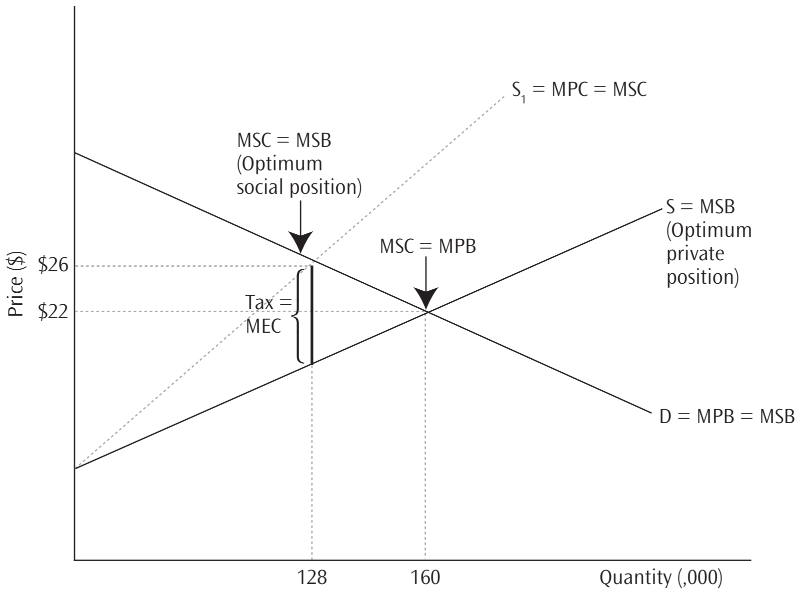
For the purposes of this chapter, we shall assume that two 'failures' occur in SIDS, a market and a policy failure.

In the first instance, we assume that a market failure occurs due to pollution that is produced during the production of agricultural output in SIDS. This externality, which is assumed to occur on the supply-side (cost) results in the cost to society being greater than the cost to the private operators, i.e., marginal social cost (MSC) is greater than the marginal private cost (MPC). The assumption here is that each extra unit of product produced by farmers adds more to the cost of society, i.e., MSC increases, than it does to the cost of the farmers. As such, since farmers are not currently paying for (internalising) the damage caused by the externality then society is worse off. This is so because the environmental damage may manifest itself in terms of deteriorating freshwater quality and declining health of the populace associated with this deteriorating water quality. This scenario is shown in Figure 8.3. The 'true' cost to society of producing the last unit of output does include the cost to the farmers, i.e. MPC of using factor inputs (since these scarce factors are thereby denied to other farmers). However, the true cost to society also includes any environmental damage caused by producing the last unit of output. We call any such damage the marginal external cost (MEC). This is the distance between S (the original supply curve without the MEC) and S1 (the new supply curve inclusive of MEC). The MSC, therefore, is equal to the MPC plus the MEC.

Primarily because the environment is a public good[19] it may be contingent upon the government to intervene in the market place to ensure that the polluter pays for the damage that is being caused and the suffering endured by other innocent parties. In this case, we assume that the government sets an environmental tax, i.e., MEC. With this environmental tax, the real cost of producing the agricultural output moves from $22 per unit to $26 per unit, while output declines from 160,000 tons to 128,000 tons. Clearly, there is 'nothing like a "free lunch"', but what policy-makers have to decide is if the fall in output is outweighed by the improvement in environmental quality and health of the society.

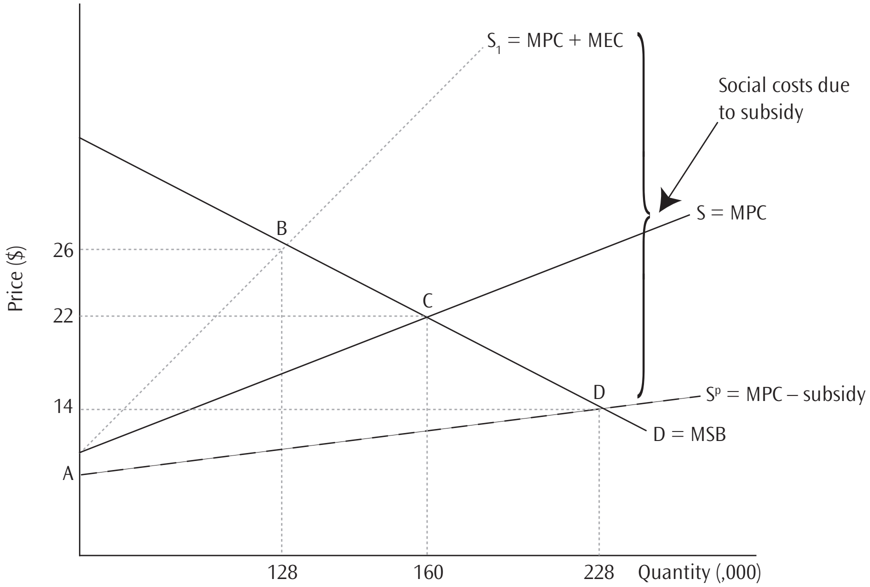
In the second instance, we assume that the government enters the market to offer subsidies to farmers on fertilisers to increase agricultural output and move the SIDS one step closer to the goal of food security (Figure 8.4). In this instance, the new supply curve is at *Sp*, with output increasing to 228,000 tons and MPC < MSC. This increase in output often comes at a cost, with the total cost to society (MEC) in the form of increased water pollution from fertilizer leachates, declining food quality and degradation of soil quality. Thus, without the subsidy, and instead with farmers being encouraged to grow more nutritious foods, the real price would have been $26 and the quantity produced would have been 128,000 tons. Thus, policy-makers are consistently called upon to make choices based upon their objectives and the scare resources that they have at their disposal to meet the myriad needs. This is where resource economics can assist with the attainment of making efficient and informed choices.

Figure 8.3. Market failure (negative externality)



Source: Author's construction

Figure 8.4. Policy failure: distortionary subsidy



Source: Author's construction

Revealed cost methods

The valuation techniques within this category and which are applied for a variety of the goods and services provided by SIDS in their pursuit of economic development, seek to observe consumers' responses to various substitutes or complementary goods and services to gain an estimate of value of a particular environmental asset or condition (Bennear, et al., 2005). The focus here is on the **revealed preferences** of the consumers as expected in the market place, even if this expression is indirect in that it involves surrogate goods and services rather the environmental amenity itself (Ison, et al., 2002; Gul and Pesendorfer, 2005; Rubinstein, 2006).

Travel Cost Method (TCM)
Many SIDS economically depend on tourism and the recreation sector. However, how do we know whether this sector is adding more to revenue than to cost if we do not cost the very thing that is most important to visitors, i.e., the environmental quality and assets of the area? The Travel Cost Method (TCM) which is often used to estimate demand for recreational sites, provides the framework to value those sites, particularly, when no entry price is charged (Hackett, 2006; Mendes and Proenca, 2005). Resource economists have often argued that this method provides complementary indicators to the consumption of the recreational good whose value is being estimated. The TCM is simple to apply in that the 'price' paid (in the form of petrol cost, entrance fee, parking fee, etc.) to visit any site can be estimated for each visitor by calculating the travelling costs from his/her location of origin. In applying the TCM, we first randomly select a sample of households using the recreational site. Second, we survey the selected population to derive information on their travel cost and other socio-economic, demographic and geographic variables, such as the

price of substitute sites (p_s), the income of the person (y) and variables that reflect the person's tastes (Z) (see Equation1). Thirdly, we specify a functional form for the demand function and estimate the same using the survey data.

$$q = ø(p, p_s, y, Z) \qquad \textbf{Equation 1}$$

Alternatively, by observing people's willingness to pay for the private complementary good or service, often via a questionnaire survey, it is then possible to infer a price for the non-price environmental amenity. Using this information one can estimate the average visitor's (V) total recreational value (Visitors x Price) for the site. Multiplying this by the total number of visitors per annum allows the analyst the opportunity to estimate the total annual recreational value of the site.

The attractiveness of the TCM is that while admission fees are generally the same for everyone, the travel costs tend to vary, and hence usage. Thus, this allows one to make inferences about the demand for a particular site in relation to cost of use. Not surprisingly, the relationship generally shows a downward sloping demand curve between cost of a visit and number of visits made per year[20]. The TCM, therefore, can be used to measure both the elimination of a site as well as the impact of access restrictions and changes in environmental quality, both valuable in terms of how public resources are allocated.

However, that which makes the TCM attractive may also be its main challenge, i.e., its simplicity. Some of the flaws in the methodology of TCM are explored below:

- **Time costs.** While TCM seeks to determine the cost of travel, the opportunity cost of time travel is often omitted from the estimation. Furthermore, there are some persons that enjoy travelling and therefore have a negative cost for travelling. Thus, it is quite possible that the actual cost is incorrectly specified.
- **Multi-purpose trips.** When visitors visit multiple sites on a single visit, apportioning costs has to be undertaken.

Photo 8.3. Visitors on the Valadero Beach in Cuba in November 2006 (courtesy of M Bynoe).

- **Benefit of the journey.** It is often assumed that benefit is only derived from the site visited. But, the journey itself may have value. However, if the journey is part of the reason for the visit to the site, then the trip has multiple purposes and the problem identified above resurfaces. In this case though, the cost is a net cost, allowing for travel benefits, which are negative costs.
- **Substitute sites.** One visitor may travel 20 kilometres to visit a site which they enjoy visiting, whereas another who has comparatively little enthusiasm for the site may travel the same distance from another direction simply because there is no other available site near their home. Using the simple TCM approach would yield the result that both visitors held the same recreational value for the site, which is clearly incorrect. Some analysts have tried to allow for this by asking visitors to name substitute sites; however, this is both statistically complex and open to error.

Case Study: Applying the Travel Cost Method to value the recreational amenities at the Splashmins Fun Park

In 2003 we applied the travel cost method to estimate the average household value of a trip to the Splashmins Recreational Fun Park on the Linden Soesdyke-Highway, Guyana and the average household value of improving the water quality at the site. A random sample of two hundred and fifty (250) visitors to the site was sampled on April 11, 2003. Our estimates of the travel cost assumed the marginal cost of operating a vehicle at G$420 per mile in 2003 (G$195 = US$1). Furthermore, for the time cost component of our travel cost, this value was set equal to the daily wage rate of that particular respondent's occupation, that ranged from G$481 per day to G$4,920 at constant 2001 prices. We logged our variables and estimated the following uncomplicated model, with the t-statistics in parentheses:

$$\begin{array}{lllllll} \text{Ln}q & = & -4.929 & -0.150\text{TC} & +0.005\text{y} & +0.011\text{Gn} & (\text{R2} = 0.233) \\ & & (-4.003) & (-3.109) & (+3.992) & (+1.901) & \end{array}$$

Where *TC* is travel cost, *y* denotes income, and *Gn* is gender, which was a dichotomous variable, with 1 indicating males and all others zero. Based on this model we estimated that the average annual value per household visiting the Splashmins Recreational Fun Park was G$18,532.50 and the average value of improving the water quality from boatable to swimming was estimated at G$20,100 in 2001 dollar terms.

Hedonic Price Method (HPM)

The hedonic pricing method is the most commonly applied revealed preference technique used in resource economics. The HPM attempts to evaluate environmental services that affect market prices. This method is applicable for the SIDS as it can be used for valuing certain tropical forest functions, i.e., micro-climate regulation and groundwater recharge in terms of their impact on agricultural land values, assuming that the link between forest functions and agricultural productivity is widely known and fully reflected in agricultural land prices. But its applicability is best known in the property market where it is used to indicate a household's willingness to pay for changes in the 'level' of a scenic view (Hidano, 2003). People have a positive willingness to pay to live close to an environmental amenity to reduce environmental risk or nuisance (Boardman, et al., 2001). This may come from health concerns or aesthetic considerations. It could be used equally to estimate the discounted house price resulting from living within easy access of a source of environmental concern. It can be assumed that areas of land degradation affect property prices through the latter channel. This willingness to pay is fully incorporated into markets if there is adequate information pertaining to the risk. Property market values encompass an array of implicit prices relating to a range of factors. Economic, social, environmental and physical factors help determine the choice of property and the willingness to pay for the said property. The hedonic pricing method can elicit prices for these individual factors using either cross-sectional or time series data.

In applying the HPM it is necessary to first focus on estimating the cost of properties with marginally better views, *ceteris paribus*. To do this, it becomes important to collect information on all the relevant attributes that would theoretically affect the affect property value. This often includes the use of geographic information systems (GIS) and aerial photography to assist them in determining these factors. Secondly, the analyst estimates the 'willingness to pay' for a better view, controlling for income and other socio-economic factors.

Statistical techniques (such as multiple regression analysis) can be used to estimate the influence of these possible 'explanatory' (independent) variables on house and property prices. Often it is assumed that the model has a multiplicative functional form of the type:

$$P = \beta_0 CBD^{\o}{}_1 Size^{\o}{}_2 View^{\o}{}_3 NBHD^{\o}{}_4 e^{\varepsilon}$$ **Equation 2**

Where P is the property price, CDB is a measure of the distance of the house from the central business district, SIZE denotes the floor space of the house, VIEW measures the level of its view, and NBHD is a variable indicating the neighbourhood characteristics.

The hedonic pricing method, however, has a number of problems that can limit its usefulness in SIDS. Specifically, application of hedonic pricing to the environmental functions of the natural and environmental resources of SIDS requires that these values be reflected in surrogate markets. The approach may be limited where markets are distorted, choices are constrained by income, information about environmental conditions is not widespread and data are scarce. Additional challenges that confront the technique are discussed below:

- **Multicollinearity**. According to Ison, et al., (2002) the variables influencing house prices may themselves be correlated, so that it may be impossible to separate out the influence of the environmental variables. For example, if detached houses with larger numbers of rooms tend to be located in areas with least noise pollution, then it will be difficult to quantify the separate influences of these variables on house prices.
- **Identification Problem.** House prices depend on a variety of factors, affecting both the demand for property (such as environmental quality) and the supply of such properties (such as land availability for house building and government incentives to house builders). Changes in house prices, therefore, may be influenced by variables which are not considered in the model and which are unrelated to environmental factors. As such, the demand curve for housing cannot be clearly 'identified'.

- **Data shortages.** The array of factors determining property prices are extremely broad and identifying all relevant determinants for a specific area is fraught with difficulty. The data requirements to identify implicit prices for these factors can severely limit this method's utilisation, especially in a developing country environment as obtains in most SIDS.
- **Overestimation.** Problems may also arise if the property market is not in equilibrium, if the wage effects arising from the source of the environmental risk is ignored and also if the issue of selectivity is ignored. The last issue relates to the fact that it is often the case that individuals with the lowest willingness to accept[21] often locate near sources of environmental risk; leading to bias that may overestimate the willingness to pay of the population as a whole.
- **Lack of awareness.** The hedonic method will also only capture perceived risks, costs and benefits from factors. A lack of education or information in society can reduce the ability to perceive accurately these phenomena and thus the true costs of environmental risks are not captured in property prices. This again can limit the use of hedonic pricing in a developing country scenario.

Expressed preference methods

But for many of the goods and services provided by the environment and natural resources in SIDS no market price exists. In such situations, it is best to solicit the way these resources are valued through expressed demand by applying surveys or questionnaires to determine how much individuals would be **willing to pay** for some specified environmental improvement, such as improved water quality or the preservation of a threatened local amenity (Tietenberg, 2002, Stavins, 2005). The menu of measures applied under this category is referred to as **contingent valuation methods** (CVMs). These include:

1. **Bidding games**: where individuals are simply asked how much they are willing to pay to bring about a particular environmental improvement (or willingness to avoid a particular environmental degradation). The 'option' and 'existence' values of an environmental characteristic can be assessed in this way.
2. **Convergent direct questioning**: where the individual is asked questions within pre-existing 'low' values (above which they would certainly be willing to pay; below which they would certainly be unwilling to accept) and 'high' values (above which they would certainly be unwilling to pay; below which they would certainly be willing to accept). These extremes are progressively narrowed (minimum raised, maximum reduced) until an 'equilibrium' value is attained.
3. **Trade-off games**: where each individual must rank various combinations of two items: one a sum of money, the other some environmental characteristic (e.g. clean water). For any pair of combinations, the individual must state a preference for one combination over the other, or state the indifference between the two combinations. The marginal rate of substitution between money and a particular environmental characteristic can then be estimated at the point of indifference.
4. **Priority evaluation**: where each individual is given a hypothetical sum of money to spend on different combinations of everyday products and environmental characteristics with 'assumed' prices (which are allowed to vary between different combinations).

In other words, an 'expressed preference' approach is taken to valuation. They can help capture 'use value' where market prices are inappropriate or do not even exist, as well as 'option' and 'existence' values. This latter point is particularly significant in SIDS comprised of ecosystems under great stress from human impacts, where increasing attention is being given to non-use values. The general approach of all the methods is as follows.

First, a sample of respondents is asked questions about their valuations of some good. Second, their responses provide information that enables analysts to estimate the respondents' WTP for the good. Third, these WTP amounts are extrapolated to the entire population. If the respondents are a random sample of the population, then their average WTP would simply be scaled up to reflect their proportion in the population.

But CVMs are not without their drawbacks. These are often highlighted in the literature as follows:

- **'Free rider' problem.** According to Ison, et al. (2002:32) 'Analysis shows that people often understate their WTP in questionnaires by between 10 and 30 per cent of the amount they actually do eventually pay.' This finding, they argue, may indicate the respondents attempt to 'free ride', i.e. understating their true value WTP with the intension of restricting any actual payments, believing that the WTP of others will ensure that the environmental amenity is provided.
- **Biases.** The values given for WTP depend to some extent on the ways in which the questions are framed and respondents' understanding of the questions:
  - Starting point bias: the higher the initial values suggested for any starting bid, the higher the eventual WTP value declared is likely to be.
  - Route bias: the less realistic the route chosen for collecting the monies involved (e.g. charitable giving), the smaller the eventual WTP value declared.
  - It is often found that the observed distributions of WTP in CV are skewed toward extreme values. Thus, it is often necessary to draw larger samples for CV than other samples drawn for other purposes to increase the probability of achieving reliable estimates of population means. This is especially true for the dichotomous-choice method.
  - Non-response: This bias remains a critical issue in surveys either from refusal to respond or unavailability to respond. In the first case, stressing the legitimacy of the exercise may help. In the latter case, researchers typically account for under-representation and over-representation in the sample when extrapolating to the target population.
  - Interviewer bias: To minimise the interviewer bias, it is important to ensure that CV respondents do not perceive that any particular answer is preferred by the interviewer.
  - Hypotheticality bias: A major concern of CV is whether respondents would indeed be able to understand and conceptualise the questions they are being asked, and consequently, whether they can accurately value the good in question. Furthermore, the perception of the good in question may not be

Table 8.2. A summary of the major strengths and weaknesses of different CV elicitation methods

Elicitation method	Major strengths	Major weaknesses	Generic weaknesses
Open-Ended WTP Method	No starting point bias. May directly measure exactly what the researcher wants to know. A good check when used in conjunction with other methods.	High information complexity leads to unrealistic responses in hypothetical situations.	
Closed-Ended Interactive Bidding Method	Bidding provides 'thinking time' to elicit maximum WTP, as desired.	Sensitive to starting value. 'Bidding frenzy' may lead to some very high valuations.	
Contingent Ranking Method	Ordinal ranking requires low information complexity. Links quantities to prices, reducing hypotheticality.	Ordinal responses cannot be aggregated. Requires analyst to have statistical skills. Anchoring bias and highly dependent on the specific alternatives. Requires fairly large sample size.	Apply to most survey methods: sample selection bias, non-response bias, outliers, unintended interviewer bias.
Dichotomous-Choice Method	'Take it or leave it' choices reduce hypotheticality and approximate the market. Small strategic bias; very small starting point bias.	Less information per respondent so large samples are needed. Requires analyst to have statistical skills.	Apply especially to CV methods: Hypothetical bias, non-commitment bias, embedding bias, strategic bias.
Payment Card With Comparative Tax prices	Encourages realistic assessment of WTP, thus reducing hypotheticality and non-commitment bias.	Moderate to high information complexity. May be too sensitive to particular comparisons.	
Payment Card with a Range of Prices for the good	Moderately low complexity. Low interview bias.	Anchoring bias. Often, requires personal interviews. Anchoring bias. Often requires personal interviews.	

independent of the quality or quantity of the information provided. Given that the quantity and quality of information that can be provided when describing complex goods are virtually unlimited, there is no clear standard.

- Non-commitment bias: It is a well established fact that persons tend to overstate their willingness to pay or willingness to accept compensation for an environmental damage that may have occurred since they are not compelled to honour their statement.
- Embedding affects bias: A fundamental axiom of economics is that individuals value more of a good more highly than less of it. If CV respondents' valuations are only slightly higher for large changes in the amount of the good offered than for small changes, then the validity of their responses becomes a concern.
- It is constantly argued that respondents in CV surveys have incentives to behave strategically, that is, to answer dishonestly.

Non-demand curve valuations

Both the expressed and revealed preference methods make use of demand curve analyses to value environmental goods and services and natural resources that can then inform policy. However, a number of valuation methods may be used which depart from this approach.

Damage Cost Technique (DCT)
Damage cost avoided techniques are particularly useful in assessing land degradation, sea defence breaches, and damages resulting from natural disasters. This technique attempts to value an environmental good by assessing the cost avoided if the good is not damaged. For example, soil erosion can be measured by assessing the cost of removing sediment from rivers. These techniques, however, have many limitations. Firstly, costs do not always provide a good measure of benefits and can only be used as a rough approximation of economic value. These techniques as well are only accurate to make an ex-post assessment of projects.

Replacement Cost Method (RCM)
The RCM technique analyses the cost of replacing or restoring a damaged environmental asset that may have been affected, for example, during a flood. For example, it can be used to value land degradation by estimating the cost of physically recovering and replacing lost soil, nutrients and water. This estimate is used as a measure of the 'benefit' from such replacement or restoration. For example, if it costs $5m to restore the soil lost by flooding, then this $5m cost is used as an estimate of the benefit of the environmental improvement. But the same criticisms that were levelled against the DCT above are applicable here as well.

Preventative Expenditure Method (PEM)
Where SIDS may have the resources available to them, it is possible for them to take a proactive approach to natural disasters. In such instances, the PEM may be a useful valuation technique in determining how the resources should be allocated. PEM uses the costs incurred in an attempt to prevent some potential environmental damage as a measure of 'benefit'. For example, the repairing of sluices and dredging of canals to avoid flooding might be used as proxy variables of the value placed by policy-makers on abating floods. But like the other methods, PEM also has its drawbacks. First, it assumes implicitly that

individuals quickly adjust to the new equilibrium. It may actually take some time for individuals to adjust their purchases to return to equilibrium where the marginal cost of the substitute input equals its marginal benefit. Second, a defensive expenditure may not remedy entire damage so that reductions in this expenditure do not fully measure benefits. Third, the defensive expenditures may have benefits other than remedying damage. Lastly, not all of the defensive measures are purchased in markets. Some people clean their own drains – reductions in their opportunity costs should also be included as benefits.

Cost Effectiveness Analysis (CEA)
What can be done to guide policy when the requisite valuation for benefit-cost analysis is either unavailable or not sufficiently reliable? Without good measures of benefits, making efficient choices is no longer possible, hence compromising efficiency and, in some instances, productivity.

In such instances, it frequently is the case to set a policy target on some other basis other than strict comparisons of benefits and costs. One example is pollution control. What level of pollution control should be established as the maximum acceptable level? To answer this question, analysts often apply a cost effectiveness analysis (CEA).

Cost effectiveness analysis frequently involves an optimisation procedure. An optimisation procedure in this context is merely a systematic method of finding the lowest cost means of achieving the specific objective. This procedure does not, in principle, produce an efficient allocation of resources because the predetermined objective may not be efficient. Hence, cost-effectiveness analysis can be used to find the least-cost means of meeting a particular standard and its associated cost (Boardman, et al., 2001). Using this cost as a benchmark case, the analyst can then estimate how much costs could be expected to increase from the minimum if polices which are not cost effective are implemented.

Impact Analysis (IA)
What can be done when the information needed to perform a benefit-cost analysis or a cost-effectiveness analysis is not available? In such circumstances, we use an impact analysis. An impact analysis, regardless of whether it focuses on economic impacts or environmental impacts or both, attempts to quantify the consequences of various actions. It makes no attempt to convert all consequences into a one-dimensional measure, such as dollars, to ensure compatibility. Further, it makes no attempt at resource optimisation. Rather, it places a relatively large amount of information at the disposal of the policy-maker, and it is up to the policy-maker to assess the importance of the various consequences and act accordingly. In principle, IA is meant to apply to the entire process, from the inception of a proposal through to environmental auditing and post-project analysis. In practice, IAs have tended to improve the quality of proposals rather than result in their abandonment. However, their main weaknesses are in the subjectivity of the positions reached and placing a lot of 'undigested' information at the disposal of the policy-maker.

Benefit-Cost Analysis (BCA)

The most ambitious and arguably best known technique is the BCA. While it is the most precise of all the techniques discussed thus far, it also imposes upon the analyst the greatest demand for information. Hence, the techniques discussed above are sometimes applied to assign monetary values to the gains and losses to different individuals and groups. These values are often weighted according to some perception of the contribution of these individuals or groups to social utility (social welfare). It is for this reason that this approach is sometimes referred to as 'social' benefit-cost analysis (Boardman, et al., 2001, Ison, et al., 2002).

There are at least two decision rules often applied to assist us in arriving at the best allocation of the societies' scarce resources. In the first instance, if the proposed reallocation of resources via new investments in some (environmental) project is estimated to create a greater benefit than those who lose, then the project is potentially viable from society's perspective. In other words, if the present value to society of a project is positive, then the project is at least worthy of consideration. Whether or not it will be undertaken may depend on what restrictions, if any, apply to the level of (finance) resources available. In some instances, decision-makers are called upon to pursue the project with the largest net present value to society.

In the second instance, the **benefit-cost ratio** criterion is utilised. The decision rule contends that an investment should be pursued if the ratio of the present value of benefits to the present value of costs exceeds 1.0.

A number of criticisms have been levelled against BCA in terms of valuing environmental and natural resources projects:

- By reflecting human preferences in the form of their willingness to pay, BCA is often criticised for paying too little attention to valuing nature and conservation for its own sake, independent of individual preferences.
- The BCA often suggests a piecemeal approach to environmental considerations and benefits are often excluded because of thin or absent markets. But such weaknesses are being addressed under some of the measures identified above.
- It is quite often the case that political decisions often override the 'efficient' considerations of BCA. While not a conceptual difficulty with BCA, it does demonstrate that decisions do not always follow rationale and reasoning.
- CBA does not explicitly identify who gains and who loses from a project. Data are invariably at the aggregate rather than the individual level, and redistributive issues between individuals (or groups) tend to be avoided.

Environmental accounting

As is often the case, the growth of gross national product (GNP)[22] may result in rising environmental damage, and hence, costs. It is often important to capture these costs so that we have a more accurate estimate of the 'true' GNP rate. This is a new and expanding branch of resource economics termed **environmental accounting** (Jackson et al., 1997). An *Index of Sustainable Economics Welfare* (ISEW) has been calculated for the USA and UK. Essentially, any increase in the GNP figure is adjusted to reflect the following environmental factors which are often associated with rising GNP:

1. Expenditure correcting environmental damage (i.e. 'defensive' expenditures);
2. Decline in the stock of natural resources (i.e. environmental degradation);

3 Pollution damage (i.e. monetary value of any environmental damage not otherwise counted).

By failing to take these environmental impacts into account, the conventional method of calculating GNP underestimates the sustainable economic welfare impacts. It is often argued that some of the growth in GNP is due to expenditures undertaken to mitigate (offset) the impact of environmental damages that are not factored into the GNP calculus (Hecht, 1999). Such expenditure may include efforts made by households to insulate themselves against noise and dust pollution, and the expenditure associated with a declining stock of natural resources, particularly those of the non-renewable type like gold, bauxite and petroleum. For example, the monetary value of minerals extracted from rock is included in GNP but nothing is subtracted to reflect the loss of mineral deposits. This type of 'environmental depreciation' ought to enter the GNP calculations and the conventional method needs to be adjusted accordingly.

Valuing human life

Many government programmes, including providing safer drinking water or reducing hazardous pollutants have, as their main aim, the saving of lives. Thus, the allocation of resources amongst the programmes is often a reflection of the value we place on life (Teitenberg, 2002; Viscusi, 1993). The economic approach often used to value life-saving reductions in environmental risks is calculated by estimating the change in the probability of death resulting from the reduction in environmental risk and to place a value on the change (Stavins, 2005). The value that is derived from this procedure is then translated in an implied value of human life, which is achieved by dividing the amount each individual is willing to pay for a specific reduction in the probability of death by the probability reduction (Tietenberg, 2002).

Furthermore, pollution remains endemic in many parts of the SIDS, where insufficient regulations and enforcement have left legacies of water and air pollution (Hanrahan, et al., 2007). Even when shut down or re-configured to reduce emissions, old facilities and mined-out areas often leave behind a legacy of toxic materials such as lead and mercury, that continue to poison local populations (Leigh and Hoskin, 2005). According to the World Health Organization (WHO) and the World Bank these pollution problems affect nearly a billion persons globally (mainly in developing countries), resulting in increased burden of diseases and reducing the quality of life and life expectancy.

In an attempt to estimate the cost of reducing these negative effects on the local populace in SIDS, policy-makers can apply low cost, efficient and practical strategies. These strategies are based on the concept that initial cleanup efforts at uncontrolled sites can produce large improvements at modest cost. This is a practical approach to making the maximum possible use of limited resources and falls under the rubric of the cost effectiveness approach to investment in health (Pruss-Ustun, et al., 2007).

The essence of the approach lies in the concepts of DALY (disability adjusted life years) and QALY (quality adjusted life years), both of which calculate the years of 'healthy life' lost due to the impacts of a particular cause or disease, in a specified area. Once this measure of health impact has been estimated, the benefits and cost effectiveness of different interventions and projects can readily be evaluated. The methodology has been developed and refined by WHO as part of their 'Burden of Disease' programme and is widely accepted by both the health sector and the regulatory agencies (such as USEPA) as a basis for making decisions on investments in disease prevention and pollution control.

A QALY is a comparable measure to a DALY. It is the arithmetic product of both life expectancy and a measure of the quality of the remaining life-years. A QALY assigns specific weights on time in different health states. A year of perfect health is assigned the number 1, a year of life spent in less than perfect health is assigned a number less than one and 0 signifies death.

Calculations for our cost-effectiveness study are as follow:

Cost per person	=	Project cost/affected population
Cost per DALY(QALY)	=	Cost per person/ DALY(QALY) impact

Many studies have indicated that the health benefits gained by the local population are substantial indicating that remediation of some active and abandoned sites is extremely cost effective (Trasande, et al, 2005; Chuang, et al, 2005). Millions of lives could be saved with further investments in this area. In addition to increasing life expectancy, these investments reduce health expenses for local communities. The low cost of this kind of intervention, along with its enormous health impact, justifies strong support for a concerted effort to deal with this issue frontally.

Conclusions

Within this chapter we have examined some of the techniques that are used, and which can be applied by SIDS policy-makers to mainstream environmental and natural resource concerns into development policy, plans and programmes. The list presented here is by no means exhaustive. The BCA does provide the most concrete examples of applying the techniques. However, these techniques merely offer us a guide in addressing the resource allocation and technical efficiency issues for countries.

Throughout the techniques, however, there are some recurring issues, especially for SIDS. These surround the quality and volume of data often required to implement these frameworks, and the availability of skilled and experienced professionals. Furthermore, the absence of such information can often lend itself to the introduction of biases. While we must remain cognisant of the issues involved, the techniques provide a useful starting point to commence to ensure that we arrive at more consistent values of our environmental, natural and human resources.

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http://www.elaw.org/resources/text.asp?id=1999
http://www.ucl.ac.uk/~uctpa15/envecontexts.pdf
http://www.elaw.org/resources/topical.asp?topic=Economics
http://www.elaw.org/resources/text.asp?id=2039
http://www.darp.noaa.gov/legislat.htm
http://www.elaw.org/resources/text.asp?id=1997
http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/homepage
http://www.whitehouse.gov/omb/circulars/a094/a094.html#top
http://www.elaw.org/resources/text.asp?id=1976
http://www.elaw.org/resources/text.asp?id=1978

Useful internet searches on the natural resources economics

International Experiences with Economic Incentives for Protecting the Environment.
Economic Impact of Tourism Visitation at National Parks in the U.S.
Estimating National Park Visitor Spending and Economic Impacts – The MGM2 Model.
Valuing Environmental and Natural Resources: The Econometrics of Non-Market Valuation: Eco-Economy: Building an Economy for the Earth.
ConservationEconomy.net
Economics, Trade Policy, and CITES (Convention on the International Trade in Endangered Species).
Environmental Valuation Reference Library.

Notes

1 According to the United Nations Statistics website, HIV prevalence in 15–49 year olds in the Atlantic, India Ocean, Mediterranean and South China Seas (AIMS) region varies from 0.1 per cent in Bahrain to 3.8 per cent in Guinea Bissau against the benchmark values of 0.4 per cent for developed regions, 1.19 per cent for developing regions and 7.3 per cent for sub-Saharan Africa.

2 It is a misnomer to think that the foundations for resource economics were laid in the 1960s. In fact, resource economics shares with other mainstream areas of economics certain foundations that go back at least to the 18th Century (Turner, et al., 1993), though there are indications that neo-classical environmentalism dates back to biblical times at least. Both the Bible and the Koran are replete with the metaphor of the ‘garden’ as the model of ecological balance; pursuit of MDG 7 target 10 Indicators 30 and 31 might be dated back at least to the Romans in their management of water systems; indeed one of the earliest examples of public investment in environmentalism might be seen as the first European water closet in Ionian times found preserved in Knossos on the small island developing province of Crete.

3 In analysing the metabolic rift Marx and Engels did not stop with the soil nutrient cycle, or the town-country relationship. They addressed at various points in their work such issues as deforestation, desertification, climate change, the elimination of deer from the forests, the commodification of species, pollution, industrial wastes, toxic contamination, recycling, the exhaustion of coal mines, disease, overpopulation and the evolution (and co-evolution) of species.

4 This is often referred to as the Materials Balance Approach.

5 A market is often defined as a place where buyers and sellers meet for the purpose of trading.

Many of the goods and services performed by environmental and natural resources, such as carbon sequestration, reduced soil erosion, and nitrogen fixation impacts of tropical forests are not traded at the market place.

6 This is a technique for the evaluation of projects, where all costs and benefits (direct and indirect) are considered. Costs and benefits would be quantified, but where this is not possible they are often listed.

7 These would include the provisions of subsidies on pesticides or taxes on agro-processed items.

8 This term refers to economic decisions that result in 'costs' (unfavourable outcomes) or 'benefits' (favourable outcomes) not included in the prices and which may affect the persons involved in the trading and others not involved. The externalities of unsafe vehicles affect vehicle users and non-users; tobacco use affects smokers and non-smokers as well as causing litter and accidental fires; private parkland benefits the private users and those beyond its boundaries. The core concept is unpriced costs and benefits.

9 This is the difference between what consumers were willing to pay and what they actually paid.

10 This is the difference between the price producers were willing to supply their product at and that which they actually received.

11 Some writers refer to them as hypothetical valuation surveys. Also see Portney (1994) and Hausmann (1996).

12 Demand curves are estimated directly through eliciting preferences from surveys, such as CVM, or indirectly through revealed preferences such as hedonic pricing and the travel cost method.

13 In general, non-demand curve approaches do not measure the entire surplus that accrues from what a consumer was willing to pay and what he/she actually paid, and hence they only provide a minimum measure of environmental value

14 These are pollutants that are not biodegradable.

15 It is the value of forgone opportunities or alternatives unable to be achieved because of time or money towards some other option.

16 This is a term used by economists to describe the condition where the allocation of goods and services by a market is not efficient. It is viewed as a scenario in which individuals' pursuit of self-interest leads to bad results for society as a whole. This phenomenon occurs for three main reasons. First, an agent in a market can gain market power, allowing them to block other mutually beneficial gains from trade from occurring. This can lead to inefficiency due to imperfect competition, which can take many different forms, such as monopolies or cartels. Second, the actions of an agent can have externalities, which are innate to the methods of production, or other conditions important to the market. Finally, some markets can fail due to the nature of certain goods, or the nature of their exchange. For instance, goods can display the attributes of public goods or common-pool resources, while markets may have significant transaction costs, agency problems, or informational asymmetry. In general, all of these situations can produce inefficiency, and a resulting market failure due to the fact that certain values are not included in prices (or are ignored) and consequently prices do not send correct messages about the true value of a resource, or the true extent of damage caused by an action, i.e., for example, ignoring the carbon sequestration benefits of increased tree planting will result in too few trees being planted.

17 In other words, price does not reflect marginal social cost.

18 Failure to act may also create similar negative consequences.

19 This is a good which when consumed by one individual does not reduce the amount of the good available for consumption by others; and no one can be effectively excluded from using that good.

20 People living closer to a site and facing a lower travel cost are likely to visit that site more than persons living a considerable distance away, *ceteris paribus*.

21 Willingness to accept is analogous to willingness to pay. It expresses people to desire to accept changes in goods (usually negative) for some amount of compensation.

22 This is an estimate of the total value of goods and services produced in any specified country in a given year.