Valuing the potential environmental benefits of the Environmental Impact Assessment Process: The Mooi River Mall Case Study

Environmental Economics Short Course Assignment

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1 Introduction

Environmental assessment (EA) is described as one of the more successful policy innovations of the 20th Century. While it did not exist prior to the early 1960s, it currently is a formal process used in more than 100 countries and organizations to help decision makers consider the environmental consequences of proposed actions. Environmental Impact Assessment (EIA) is a decision tool employed to identify and evaluate the probable environmental consequences of certain proposed development actions in order to facilitate informed decision-making and sound environmental management (Glasson et al., 1999; Sadler, 1996).

It is broadly accepted that the basic intention of EIA is to anticipate the significant environmental impacts of development proposals before a commitment is made to a particular course of action (Wood, 2003). The information generated by this predictive process contributes (albeit in a variety of ways) to the environmental design of development proposals and the formulation of decisions on whether, and potentially on what terms, development consent should be granted (Cashmore *et al*. 2004).

Internationally environmental assessment (EA) is experiencing increased pressure from decision makers and politicians to argue and prove its added value. The mere acceptance of traditional assumptions and perceptions that EA is a vitally important tool to ensure that environmental considerations are incorporated into decision making, does not seem to suffice any longer. Empirical evidence and proof is now demanded from politicians and decision makers on how effective EA has been in achieving its goals (Retief, 2007).

Concern about EIA practices has resulted in the progressive development of a substantial body of research on the issue of effectiveness. It is widely acknowledged that EIA legislation and practices rarely conform to idealised (and largely positivist and rationalist) models of the process (Glasson et al, 1997). However, this does not necessarily mean EIA is *de facto* ineffective. The concept of effectiveness includes both substantive (that is, whether it achieves its purposes) and procedural (that is, whether it is undertaken according to established expectations) criteria (Sadler, 1996). Research effort has focused overwhelmingly on the procedural criterion (Bond et al, 2004); even though the substantive criterion is the ultimate test of effectiveness (Doyle and Sadler, 1996 as quoted by Cashmore *et al*. (2004).

The primary challenges for effectiveness evaluation relate to identifying sound criteria and methods of evaluation. The 'litmus test' for effectiveness, according to Sadler (1996), is whether better decisions were made and if environmental objectives were realised.

In this paper, the potential use of environmental resource economic methodologies to value the negative environmental impacts of the project will be investigated. The information will also be used to assess the effectiveness of the EIA process in South Africa, specifically using the 'litmus test' to determine if the environmental objectives of minimising/mitigating environmental impacts were realised. A specific case study of a shopping mall development on the banks of the Mooi River in the city of Potchefstroom, in the North-West Province of South Africa will be used.

1.1 EIA regime in South Africa

EIA in South Africa was formalised in 1997 with the promulgation of legislation for compulsory EIA, in line with similar developments internationally. The aim of this legislation was to integrate and facilitate environmental impact management with development activities, and thus to lead to more responsible and environmentally sensitive development. The original EIA Regulations were promulgated in 1997 in terms of the Environment Conservation Act No. 73 of 1989 (DEAT 2007).

The original EIA regulations have been repealed in 2007 and replaced by new regulations promulgated in terms of the National Environmental Management Act No 107 of 1998. These new EIA Regulations are a total revisit of the concept of the EIA process. The revision is mainly due to significant changes in to the legislative framework in South Africa, as well as to formulate a product that is more in line with sustainable development objectives and environmental management (DEAT 2007).

The NEMA EIA Regulations establish procedures to be followed for the consideration, assessment and reporting on of those activities identified. The purpose of these procedures is to provide the competent authority with adequate information so that an informed decision may be reached. This decision must ensure that activities which may impact negatively on the environment to an unacceptable degree, are not authorised, and that those activities which are authorised are undertaken in such a manner that the environmental impacts are managed to acceptable levels (DEAT 2007).

2 Project case study

2.1 Development proposal

A single, enclosed, regional retail mall, offices, motor retail facility and hotel of approximately 80 000 m2 is being developed on the floodplain of the Mooi River adjacent to the Potchefstroom central business district. It involves two properties on the east and west banks of the Mooi River. As neither of the properties is large enough to accommodate the development, a section of the mall will span the Mooi River and allow shoppers to cross the river inside the mall (CEM, 2005).

The mall will mainly be a single storey structure with a portion of first floor offices and a basement as well as underground parking. The structure will be constructed of face brick, plastered and painted walls, aluminium and glass. Eighty per cent of the shopping centre will be enclosed and air-conditioned and twenty per cent will be exposed, facing the parking area and the river. The surrounding terrain will be landscaped to make it an aesthetically pleasing facility. In terms of infrastructure and municipal services, a permanent connection with the existing sewer line will be established for the operational phase of the mall, while potable water and electricity will be obtained through connections to the existing supply network of the Potchefstroom Local Municipality (CEM, 2005).

2.2 Alternatives investigated

In terms of the legal requirements for EIAs, alternatives had to be considered. As only one alternative site were deemed to be feasible for the project, the following three “practicable, feasible, relevant, reasonable and viable” alternatives aimed at meeting the need and purpose of development were considered in the EIA process (CEM, 2005):

- the no-go alternative;
- the base case Mooirivier mall design (without design mitigations);
- the modified Mooirivier mall design (with design mitigations).

Details of these alternatives are provided below.

2.2.1 No go

The properties identified for the proposed development on both sides of the river are severely degraded by human impacts and the natural context has largely been

destroyed. The site on the western side of the river is currently wasteland and degraded due to the negative influence of trampling, littering, uncontrolled fires and other informal human activities. Long distance truckers mostly use it as a truck stop, which at the same time promotes prostitution and littering. Due to its close proximity to the business area and the use as a truck stop, the area is also used as an informal toilet, which poses a health and environmental hazard. Trucks stopping at the site sometimes also spill diesoline, which could end up in the Mooi River (CEM, 2005).

Large quantities of mainly building waste and soil has been dumped at the site on the eastern side of the river. The bridges are mostly used as shelter by the homeless and criminals and at least one rape case and one murder case have already occurred in the area. A lack of appropriate landscaping and development surrounding the river in this area also creates an inhospitable environment, which does not encourage appropriate use of the river zone (CEM, 2005).

The banks of the Mooi River are modified extensively due to urban impacts in the past and are being reflected by the dominance of exotic trees, exotic forbs and general disturbance. The biodiversity along that part of the river is the lowest along the entire river. The river flowing through the site is also severely degraded and represents a site with major deterioration in water quality. Due to the inflow of storm water from nearby roads and the business area of the city prolific algae growth occurs in the river (CEM, 2005).

2.2.2 Base case

The base case design of the proposed Mooirivier Mall would totally change the physical aspects of the river as it entails the canalisation, boxing and redirection of the Mooi River underneath the shopping mall and around the initial design of the basement parking area for almost the entire site, with an artificial pond at the southern end of the site. This would fragment the riverine corridor and wipe out the river landscape and the associated ecological and other functions of the river. In addition, all the riparian vegetation, including the willow trees would be lost (CEM, 2005).

2.2.3 Modified design

The base case mall design were revised in line with environmental principles and modified to retain the natural flow of the Mooi River through the development and ensure that numerous environmental impacts are proactively addressed and mitigated through appropriate design solutions. The modified mall design proposes to retain and enhance the riverine corridor, as well as the river landscape and the associated ecological and other functions of the river. This will be done through maintaining a 30 m ecological corridor on the banks of the Mooi River throughout the development, keeping the trees that have been identified as preferred trees while eradicating the exotic invaders and modifying the design of the vehicle bridge and parking area to minimise the loss of an important patch of reeds (CEM, 2005).

Furthermore, the modified design promises to reconnect the community to the river and make them aware of the importance of the river and the surrounding habitat for the broader community life. If approved, it could also serve as a unique example that the concept of sustainable development can be achieved in practice (CEM, 2005).

It entails modifications to (CEM, 2005):

- minimise the impact on the river;
- restore the river to its semi-natural form;
- maximise the linear functionality of the Mooi River system by:
    - not altering the river bed characteristics;
    - reducing the bridging effect of the mall to an absolute minimum;
    - maintaining the river system as a flowing aquatic system, avoiding any ponds or dams;
- integrate the design of the mall with the river landscape;
- connect people with the Mooi River by means of life style design;
- minimise the loss of willow trees.

Other environmental impacts that are proactively addressed and mitigated include (CEM, 2005):

- Flooding and other hydrological impacts;

- Impacts on unique natural features;
- Impacts of flood lighting on birds;
- Impacts associated with landscaping and establishment of gardens;
- Impacts associated with waste management and recycling;
- Access and traffic flow impacts.

The micro-level design alternatives to reduce the environmental footprint of the proposed facility will be finalised in collaboration with the environmental management team as the detailed design of the proposed development is completed. These include (CEM, 2005):

- designed access for the disabled to all the facilities at the mall;
- conceptual design parameters for air conditioning;
- conceptual design alternatives for electrical and lighting installations, as well as environmentally friendly electrical equipment.
- conformation to the SAEDES standards for energy efficiency;
- implementation of water use efficiency mechanisms;
- appropriate waste handling facilities to ensure optimum separation and recycling of waste streams during the operational phase.

Construction and operation of the facility will also be done so as to minimise its impact on the functionality of the river.

2.3 Identified environmental impacts associated with modified Mooi River mall design

Seventeen overall highly significant impacts and twenty four overall medium significant impacts associated with this alternative related to the construction and operation of the modified mall design has been identified. The protection of natural features by creating no-go areas would only result in low significance negative impacts and medium significant positive impacts (CEM, 2005).

The environmental components that would be affected the most negative are water (surface water), soil, land use, biodiversity (habitat transformation, aquatic habitat transformation, ecological function), vision & aesthetica. All of these would be

affected by medium or highly significant impacts from more than 12 activity groups. The majority of negative impacts from activity groups on ground water, hydrology, air and society would be of medium or low significance, while a limited number of activity groups would affect traffic. The majority of impacts on the economy would be positive, while there are also a number of positive impacts on society. It is interesting to note that a number of impacts, especially on habitat transformation and the economy could either be negative or positive, depending on the way in which these activities are conducted (CEM, 2005).

Any development undertaken on the proposed site for the Mooi River Mall development would have certain negative environmental impacts, due to the sensitive nature of the riverine environment. In the light of the identification of this site in the Potchefstroom Municipality IDP as a commercial development node, it therefore is critical that any commercial activity undertaken there would have to take special cognisance thereof. On the positive side, it must be noted that a development on this site would prevent urban sprawl, which is also environmentally important. Furthermore, it also preserves the integrity of the Potchefstroom central business district (CEM, 2005).

Although it is not a direct environmental impact of the Mooi River Mall development, a process for the development of a development and management framework for the Mooi River corridor running through the urban area in Potchefstroom has been initiated by this EIA process (CEM, 2005).

3 Goals

This study will try to answer the following questions:

- Which of the key environmental impacts of the modified mall design could be quantified in monetary terms?
- Would it be possible to quantify the environmental benefits of the modifications to mall design that occurred as a result of the EIA process, providing a measure of effectiveness of the EIA process?
- Would it be possible to use policy instruments, including economic tools to ensure that the environmental objectives of reduced/mitigated environmental impacts are reached during the construction phase of the mall?

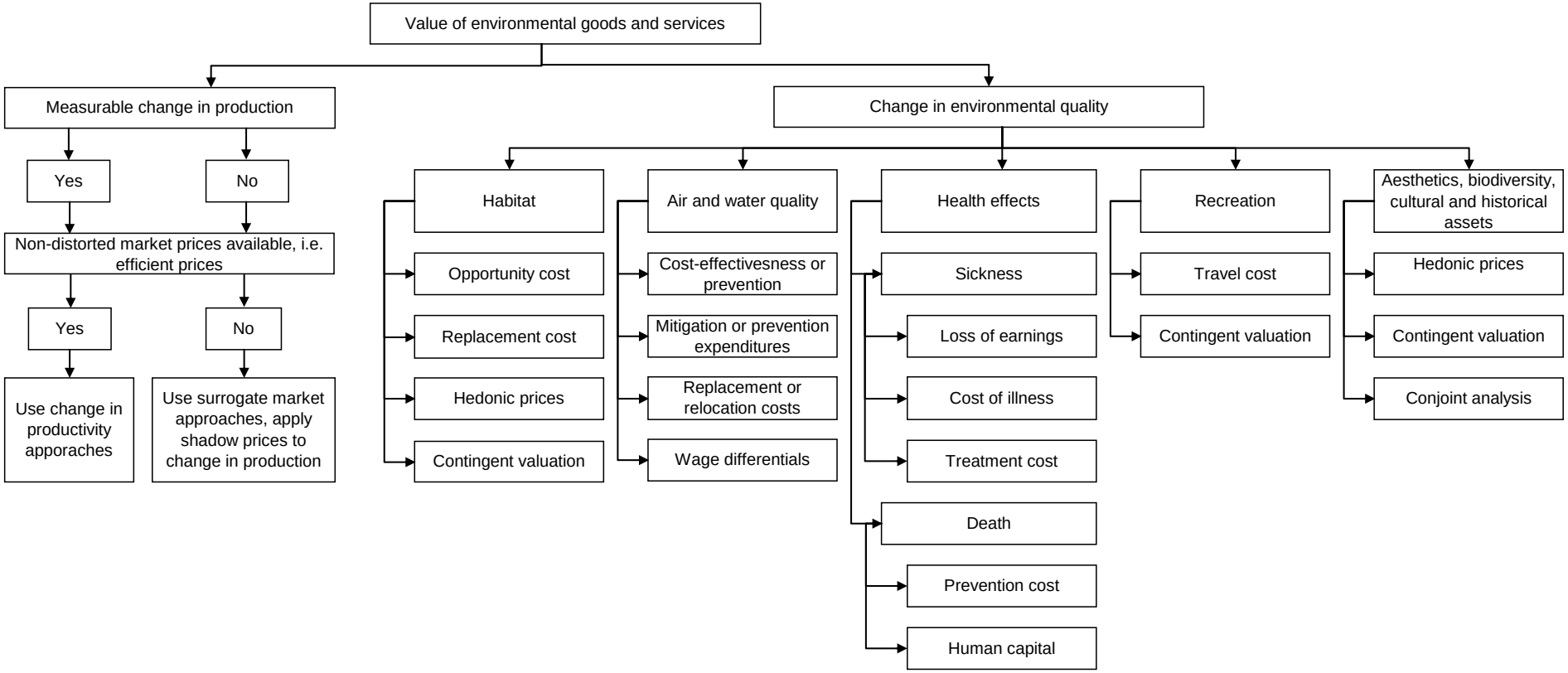

Figure 1: Classification of the more commonly used valuation methods relevant to the specific environmental impact (Kahn, 1998 as quoted by Blignaut & Lumby, 2004)

4 Methods/procedures/techniques

Environmental economics refers to the application of the principles of economics to the study of how environmental resources are managed. It focuses primarily on how and why people make decisions that have consequences for the natural environment. It is also concerned with how economic institutions and policies can be changed to bring these environmental impacts more into balance with human desires and the needs of the ecosystem itself (Field and Field, 2002).

Blignaut and Lumby (2004) cautions that although it is possible to value the impact of almost all forms of environmental degradation and depletion, one should never lose sight of the socio-economic and political context within which such a valuation exercise is conducted. This context will have both an influence on the assumptions made and a meaningful bearing on the way in which the valuation results should be interpreted.

Furthermore, one should not rely on the outcome of one valuation technique only, where possible. Application of a number of techniques to one research problem would be beneficial in determining the degree of convergence validity of the outcome, or the lack thereof. Such an approach will increase the validity of the outcome (Blignaut and Lumby, 2004).

4.1 Methodologies/techniques that could be used to measure the environmental impacts in monetary terms

One factor that complicates valuing the environment is that the benefits of environmental improvements are usually non-market in nature. It can therefore not be done by looking directly at market behaviour, because there is no market where people buy and sell the changes in environmental quality. Environmental economists have developed a series of non-market valuation techniques that are used to estimate the value of these types of environmental outcomes (Field and Field, 2002).

Blignaut and Lumby (2004) provide a classification of the more commonly used valuation methods relative to the specific environmental impact to be quantified (Figure 1). According to Kahn (1998) as quoted by these authors, the various categories of techniques are:

- changes in productivity when efficient markets are available;

- use of shadow price techniques within surrogate markets when non-efficient market prices are available;
- use of various techniques, such as replacement cost, cost of illness, loss of earnings, treatment cost, substitute prices, shadow projects, opportunity cost methods, productivity losses, human capital cost, mitigation cost, aid cost, cost-effectiveness approaches, relocation cost and benefit-transfer techniques when markets are not available, but proxies are;
- use the travel cost method, hedonic prices and wage differentials (these methods are also called revealed preference methods) when indirect proxies are available; and
- use contingency valuation methods or conjoint analysis (these techniques are called stated preference techniques, when no proxy is available.

4.1.1 The damage function (productivity changes)

When environmental degradation occurs, it produces damages. Therefore, the benefits of environmental quality improvements stem from the reduced damages this would produce. One approach to place values on these outcomes is to measure the damages directly, by looking at the monetary expenditures the damages produce. The effect of damages can be measured directly by assessing the effects of pollution on production costs or on damage to materials. In such as way, direct as well as indirect costs of the damage can be used to place an economic value on the damage and consequently also on the reduction in damage (Field and Field, 2002).

Air pollution can reduce the yields of exposed crops, while water pollution can adversely affects those producers that use the water for production purposes or domestic use. Soil contamination can have serious impacts on agricultural production, while pollution in the workplace can reduce the effectiveness of workers and can often increase the rate at which machinery and buildings deteriorate. In these cases the effects of pollution are felt on the production of goods and services. The damage caused by the pollution comes about because it interferes in some way with these production processes, in effect making it more costly to produce these outputs than it would be in a less polluted world (Field and Field, 2002).

Direct damage estimates are faced with a basic problem that almost all estimates are always seriously incomplete. Another major problem with attempts to measure damage functions directly is that people and markets normally will change and adjust to environmental pollution, and a full accounting of the damages of pollution must take these adjustments into account (Field and Field, 2002).

4.1.2 Direct valuation techniques

This analysis will focus on two direct valuation techniques, i.e. the opportunity cost approach and the replacement cost approach.

4.1.3 Indirect determination of willingness to pay

There are essentially two ways of trying to find out how much people are willing to pay for improvements in environmental quality. Indirect techniques look for ways of analysing market data to find out what they imply about the willingness to pay of people for closely associated environmental characteristics. The thought behind indirect techniques is that when people make market choices among certain items that have different characteristics related to the environment, they reveal the value they place on these environmental factors. But the concept must be used with care. In any real-world situation willingness to pay implies ability to pay; one cannot express a willingness to pay for something if one lacks the necessary income or wealth. One must therefore be sensitive to the income levels of the people whose demands you are trying to measure (Field and Field, 2002).

People are willing to incur certain expenditures in order to ensure a better environmental quality. Where one is able to find cases where market goods are purchased in order to affect a consumer's exposure to the ambient environment, one may be able to analyse these purchases for what they say about the value people place on changes in the ambient environment. Examples include the expenditures people make to try to avoid or avert adverse or uncomfortable environmental conditions, where the averting costs are an expression of their willingness to pay to avoid them (Field and Field, 2002).

Blignaut and Lumby (2004) refer to this technique as a **direct valuation techniques using mitigation or preventive expenditure**. The method focuses on the perceptions of potential damage and the measures people actually take to protect themselves and their property from such damage. The actual expenditures people make in an attempt

to avert damage from an offending activity are thought to represent a subjective valuation of the cost of potential damage and used as subjective values of the minimum costs of environmental damage caused. According to these authors, two assumptions underlie this technique, firstly that the full cost of environmental damage is reflected in the mitigation expenditure and secondly that there are no additional benefits associated with the expenditure (Blignaut and Lumby, 2004).

The quality of the environment in a specific location may impact on the value of goods and/or services. Whenever the price of some good or service varies in accordance with its environmental characteristics, one may be able to analyse these price variations to determine people's willingness to pay for these characteristics. A good example of this is people's willingness to pay to live in a less polluted environment, as reflected in house prices (Field and Field, 2002).

Blignaut and Lumby (2004) refer to this **hedonic pricing** technique as a revealed preference technique, based on an alternative consumer theory in which goods and services are defined by the attributes they embody and the value of these goods and services are the sum of the values of these attributes. When goods and services contain an environmental characteristic, the market value of the characteristic is embodied in the market price of the specific good or service. In this context, observed prices provide a measure of the implicit values placed by consumers on each of the characteristics or attributes that make up a good or service, including the environmental attribute. The hedonic pricing method focuses primarily on the property value approach and is based on the assumption that the housing and land market functions well, and that the prices are not distorted by market or policy failures (Blignaut and Lumby, 2004).

One of the first approaches that were used to estimate the demand for environmental amenities uses **travel costs** as a proxy for price. Although one does not observe people buying units of environmental quality directly, one does observe them travelling to enjoy, for instance recreational experiences in game reserves, swimming and fishing experiences in dams and streams etc. Travel is costly, both in terms of time as well as out-of-pocket travelling expenses. By treating these travel costs as a price that people must pay to experience the environmental amenity, one can estimate a value for those amenities (Field and Field, 2002).

Blignaut and Lumby (2004) stress the fact that the cost of travelling to the site is not directly used to value the site, but that it is used to establish the relationship between

the cost of travelling to the site and the number of visits to the site. This information is then used to derive a demand for the use of the amenities of the site, by assuming that visitors will respond to increases in admission in the same way as they do to increases in travel cost.

It should be noted that there are problems associated with the travel cost method. One of the most likely ones are that the cost of visiting a site includes both the direct transportation costs plus the time taken to get to the site, which must be handled with caution, as it has an opportunity cost. Secondly, the data requirements of this approach are substantial. Surveys have to collect large amounts of data on many individuals to be able to distinguish between all the possible variables that could influence the costs incurred (Field and Field, 2002; Blignaut and Lumby, 2004).

Blignaut and Lumby (2004) highlights the fact that although the method can in theory be used to value almost any non-market good or service, in practice it is only used for the valuation of recreational sites such as parks and beaches. According to these authors, it can also be used to value changes in environmental quality at recreational sites, such as changes in water and air quality.

4.1.4 Direct determination of willingness to pay

The direct approach to estimating willingness to pay is to conduct surveys among affected people and ask them how much they are willing to pay to improve the quality of an environmental parameter. Virtually any feature of the natural environment that can be described accurately by people can be studied by this method (Field and Field, 2002).

This methodology is called the contingent valuation method (CV). It is based on the idea that if you would like to know the willingness of people to pay for some characteristic of their environment, you can simply ask them. It is called contingent valuation because it tries to get people to say how they would act if they were placed in certain contingent situations. Over time the method has been used for assessing the value of a long list of environmental factors and has even spread into non-environmental areas. Over time it has been developed and refined to give what many regard as reasonable reliable measures of benefits of a wide variety of public goods, especially environmental quality (Field and Field, 2002).

According to Blignaut and Lumby (2004) this method is a survey technique that attempts to elicit information about the preferences of individuals or households for a good or service by typically focusing on individuals' preferences for non-market goods and services. It is used to obtain values for non-market goods and services for which no direct or nearby proxy exists, especially ecosystem services. These authors claim that it is the only practical means of estimating some types of benefits, such as existence and option value.

One great advantage of contingent valuation is that it is flexible and applicable to a wide range of environmental amenities, not just those that can somehow be measured in conjunction with some marketable good. Virtually anything that can be made comprehensible to respondents can be studied with this technique (Field and Field, 2002).

The most problematic aspect of contingent valuation is its hypothetical character. People are faced by a hypothetical situation to which they may give hypothetical responses not governed by the discipline of a real marketplace. Despite the difficulties, this technique offers great flexibility and a chance of estimating many values that no other technique can match. As it is still evolving, it is expected that over time it will produce increasingly reliable estimates of the value people place on environmental assets of all types (Field and Field, 2002).

An alternative way of approaching the problem of valuing environmental improvements is to ask people how much they will be willing to accept to give up some environmental amenity. Clearly, willingness to accept is not constrained by one's income, as is willingness to pay. Therefore, it should not be surprising that when people are asked willingness-to-accept questions, their answers are usually higher than their willingness-to-pay responses to the same item (Field and Field, 2002).

According to Blignaut *et al*. (2004), the provider-gets principle is based on providing support or the necessary incentive structure to promote the delivery of public goods and services and should be applicable in the case of positive or collectively beneficial externalities. These authors argue that farmers and/or rural landowners have not received any remuneration for the provision of ecosystem services, as these are considered public goods. Accordingly, such goods are likely to be provided at a sub-optimum level. If the provider-gets principle is implemented, rural landowners could benefit significantly.

4.2 Policy instruments that could be implemented to mitigate the impacts

When there is a discrepancy between the actual level of environmental quality and the preferred level, a public policy problem arises. Something has to be done to change the way people behave on both the production and consumption sides of the economic system. There are a wide range of policy approaches available for doing this that includes amongst others decentralised policies, command and control policies, as well as incentive-based policies. Each type of policy has specific characteristics that make it more likely to succeed in some circumstances and not in others (Field and Field, 2002)

Decentralised policies are those that essentially allow the individuals involved in a case of environmental harm/pollution to work it out themselves. Decentralised approaches can have the following advantages over other types of public policy (Field and Field, 2002):

- because the parties involved are the ones producing and suffering from the environmental externalities, they have strong incentives to find solutions to the environmental problems;
- the people involved may have the best knowledge of damages and abatement costs and may be able to find the most efficient solutions.

A command and control approach to public policy is one where political authorities simply mandate the behaviour thought to be socially desirable in law and then use whatever enforcement mechanisms are necessary to force people to obey the law (Field and Field, 2002).

The economic incentive approach to environmental policy seeks to change the situation where people have been able to use environmental resources and the waste-disposal services of the environment virtually without cost. By introducing an economic cost, it provides an incentive so that people start thinking about the environmental consequences of their actions and to economise on the way they use environmental resources. There are basically two types of economic incentive policies, i.e. charges and subsidies, as well as transferable discharge permits (Field and Field, 2002).

Incorporating incentive-based policies more thoroughly into environmental policies can serve to put more teeth into environmental policies in many cases and substantially

improve the cost-effectiveness of these. However, it is important to keep in mind that incentive-based policies, like any other, have strengths that are sufficiently strong to encourage greater reliance on them in many circumstances, but also weaknesses in that there are many types of environmental problems where they may not be as useful as other policy approaches (Field and Field, 2002).

4.2.1 Liability laws

Liability laws are one mechanism of implementing decentralised policies to environmental issues. To be liable for some behaviour is to be held responsible for whatever untoward consequences result from that behaviour. Compensation requires that those causing the damage compensate those damaged in amounts appropriate to the extent of the injury. In terms of environmental issues, the polluters would become liable for the damages they cause. The real purpose of this is not to simply compensate people after they have been harmed, but rather to get would-be polluters to make careful decisions. Knowing that they would be held liable for environmental damages in effect internalises what would otherwise be ignored external effects (Field and Field, 2002).

Theoretically this approach appears to address the incentive question – getting people to take into account the environmental damages they may cause – as well as the question of compensating those that are damaged. This would appear to solve the problem of determining the efficient rate of harm/pollution. But whether this is actually true or not depends on the legal process through which the amount of liability and compensation is established. This might be done through common-law processes or the result of statutory enactments by legislators (Field and Field, 2002).

Common law systems rely on court proceedings in which plaintiffs and defendants meet to make claims and counterclaims, and in which judges are called on to decide questions of fact and amounts of compensation. Judgements are normally based on precedent established from similar cases in the past. A variety of legal doctrines related to nuisance and liability have developed over time. In South Africa, the law recognises the difference between strict liability, which holds people responsible for damages regardless of circumstances, and negligence, which holds them responsible only if they did not take appropriate steps to avoid the harm/damage (Field and Field, 2002).

Critical factors in a liability system are where the burden of proof lies and what standards have to be met in order to establish that proof. In South Africa, those who believe that they may have been harmed by environmental damage/pollution must file an action within a specified time period and in court must establish a direct causal link between the environmental damage/pollution and the harm. This involves two steps: first to show that the environmental damage/pollution was a direct cause of their harm, and then that the environmental damage/pollution was in fact caused by the specific defendant. Both steps are difficult because the standards of proof required by the courts may be more than current science can supply (Field and Field, 2002).

Another important factor in liability cases is transaction costs, or the cost of reaching and enforcing agreements. In liability cases where plaintiffs and defendants are competing in a court of law to determine the question of liability and the appropriate amounts of compensation, transaction costs are all the legal costs associated with gathering evidence, presenting a case, challenging opponents, awarding and collecting damages, etc. In relative simple cases, with one party on each side and a reasonable clear case of damage, the liability system may function with a minimum of transaction costs. In more complex cases, which include the majority of environmental externalities, where numerous parties are involved, causal linkages are not clear and damages difficult to measure, private liability arrangements may not be effective to identify efficient damage/pollution levels (Field and Field, 2002).

A liability system may also rely on statutory laws requiring the payment of compensation when a polluter causes damage. When polluter behaviour is extremely difficult to monitor, we would like to know that the polluters have undertaken all appropriate steps to reduce the probability of accidents. In such cases, liability laws may be very helpful. How well this type of statutory liability laws work in providing the correct incentive fro polluters depends heavily on the formulas specified for determining the exact amount of liability. The laws can provide the correct incentives only if the compensation approaches the actual amounts of damage (Field and Field, 2002).

4.2.2 Voluntary action

Voluntary action refers to cases where individuals engage in pollution-control behaviour in the absence of any formal, legal obligation to do so. In a market-driven, competitive world, it may be assumed that voluntary pollution control may be quite scarce, but there are many who are of the opinion that programmes based on voluntary restraint can be

used quite effectively. One sense in which voluntary actions can be important is when communities can put informal pressure on polluters to reduce their pollution/harm. It is informal because it is not exercised through statutory or legal means, and it is pressure because it attempts to inflict costs on those who are responsible for excessive environmental damage/pollution. The costs in cases of informal community pressure are in terms of things such as the loss of reputation, loss of local markets or a loss of public reputation that result in declines in stock market values. Informal community pressure is exercised through activities of local citizens groups, newspaper stories, demonstrations, discussions with polluters etc (Field and Field, 2002).

A major factor in voluntary action is the availability of information about the environmental damage/pollution caused by the polluters. If good data on the quantity and quality of environmental damage/pollution caused by particular parties/activities, it will be difficult to mobilise public concern and focus it on the responsible parties. One way of dealing with this issue is to lawfully require polluters to report on the quantity and quality of environmental damage/pollution caused and publish it in such a way that communities can access the information freely (Field and Field, 2002).

4.2.3 Environmental standards

The command and control approach that relies on various types of standards to bring about improvements in environmental quality has historically been the most popular approach to environmental pollution control. A standard is simply a mandated level of performance that is enforced in law. The spirit of standards is to pass laws that make certain types of undesirable behaviour illegal and then send out authorities to enforce the law (Field and Field, 2002).

Standards are popular because they appear to be (Field and Field, 2002):

- simple and direct by apparently setting clearly specified targets, therefore appealing to the everybody's sense of wanting to come directly to grips with environmental damage/pollution and get it reduced;
- congenial with our ethical sense that pollution is bad and ought to be declared illegal.

However, using standards in practice is a lot more complex than might first appear. In actual fact, they may permit far more flexibility in enforcement than might be apparent.

There are three main types of standards (Field and Field, 2002):

- ambient standards are never-exceed levels for some pollutants in the surrounding environment, e.g. the water in a particular river, that are normally expressed in terms of average concentration levels over some period of time;
- emission/effluent standards are never-exceed levels applied directly to the quantities of emissions/effluent coming from pollution sources that are normally expressed in terms of quantity of material per some period of time;
- technology standards are standards that do not actually specify some end result, but rather the technologies, techniques or practices that potential polluters must adopt and include technology standards, design or engineering standards and product standards.

Perhaps the most perplexing problem with using standards is where to set the standard and whether authorities should take only damage or both damage and abatement costs into account when doing this. A very practical problem in standard setting is whether it should be applied uniformly to all situations or varied across circumstances, relating to the issue of cost-effectiveness, as uniform standards cannot be cost-effective where marginal abatement costs differ among different pollution sources (Field and Field, 2002).

The economics of enforcement is another point of contention, as it is not a foregone conclusion that enough resources will ever be devoted to enforcement to achieve acceptable levels of compliance. This has resulted in the essential characteristic of most standards approaches that they do not require a public agency to a costly enforcement process. This has led to a system of self-monitoring, where polluters themselves are required to keep records of pollution levels, which permits enforcement agencies to periodically audit the records or make random checks to measure pollution levels (Field and Field, 2002).

One common feature of environmental standards is that they are often set and enforced by different groups of people. This has a number of important implications. One is that standards are often set without much thought to the cost of enforcement. Another implication is that in practice, environmental policies incorporating standards end up having a lot more flexibility than might at first appear (Field and Field, 2002).

4.2.4 Emissions/effluent charges

The most straight-forward incentive-based approach to controlling environmental damage/pollution is to have a public agency offer a financial incentive to change the damage/pollution. This can be done in two ways: by charging for each unit of emission/effluent or by giving a subsidy for each such unit that the polluters cut back (Field and Field, 2002).

When an emission/effluent charge is put into place, polluters must essentially pay for the services of the environment, such as transportation, dilutions and chemical decomposition, just as they pay for other inputs into their operations. And just as they always had an incentive to conserve on conventional production inputs, they now have an incentive to conserve on their use of environmental resources - in any manner they wish. By leaving polluters free to determine how best to reduce their emissions/effluent, this type of policy attempts to harness their own energy and creativity and their desire to minimise costs, to find the most efficient way of achieving the desired result. The essence of this approach is to provide an incentive to polluters to find the best way of reducing emissions/effluent, rather than having a central authority determines how it should be done (Field and Field, 2002).

Charges face a different type of enforcement problem than standards. Any charge system requires accurate information on the item to be taxed. If emissions/effluent is to be taxed, they must be measurable at reasonable cost, which means that residuals from a source must be concentrated in a small enough number of identifiable streams that monitoring is possible. This rules out most non-point-source emissions, because they are spread thinly over a wide area in a way that makes them impossible to measure. It is probably fair to say that the monitoring requirements of an emissions/effluent charge policy are more stringent than those for a typical standards programme. When polluters receive their tax bills, they will have every incentive to contest them if they appear to be based on uncertain data or any other technical weakness (Field and Field, 2002).

5 Results

5.1 Methodologies/techniques that could be used to measure the environmental impacts in monetary terms

The following techniques could be used to value the environmental impacts of the construction phase of the Mooi River Mall (Table 1).

5.2 Policy instruments that could be implemented to mitigate the impacts

The policy instruments that could be used for ensuring that the environmental objectives of reduced/mitigated environmental impacts are reached during the construction phase of the mall is summarised in Table 2.

Table 1: Environmental economic techniques that could be used to value the environmental impacts of the construction phase of the Mooi River mall.

Technique	Application
Productivity changes	This technique could be used to value the impacts of reduced water quality in the Mooi River as a result of the construction activities. It may be done to either quantify the cost of the reduction in crop production due to increased levels of substances harmful to crops in the water or the cost of damage to the pumping equipment as a result of increased silt loads (suspended solids).
Mitigation or preventative expenditure	This technique could be used in three instances in this project. Firstly, the preventative expenditure (design and construction costs) associated with the modified design could be used to value the environmental goods and services provided by the river ecosystem. Without these, the developer might never have received authorisations to proceed with the development. Secondly, the mitigation costs associated with transplanting the old willow trees on the construction site which were to be retained, when it was found during the construction process that it would not be possible to retain them in their original positions, could be used to value the aesthetical aspects associated with these trees. Thirdly, the potential mitigation costs of technologies that the irrigation farmers downstream might have to implement in order to rectify the water quality problems before using the water for irrigation purposes could also be used to value the water quality.
Hedonic pricing	This technique could be used to assess the increased value of properties in an area around the mall development site. However, it would be very difficult to distinguish the marginal value of the modified mall design to minimise the environmental impacts thereof from the increased value of properties due to the construction of a mall without these modifications. Furthermore, such an assessment would also have to separately consider the values of residential and commercial properties.

Technique	Application
Travel cost	The travel cost method could be used to determine the travel cost that people would incur to visit this mall, with its modified design. However, the same challenge mentioned for the hedonic pricing technique would apply in this instance. It would be very difficult to distinguish the marginal value of the modified mall design to minimise the environmental impacts thereof from the increased value of properties due to the construction of a mall without these modifications.
Contingency valuation	This technique could also be used to assess people's willingness to pay to visit this mall with its modified design to protect the environment. Apart from the normal challenge of applying this method by linking the use thereof to different income groups, the additional challenge and perhaps the biggest one would be linked to the hypothetical character of this technique. In order to determine the marginal value of the modified mall design to minimise the environmental impacts thereof, people would have to hypothetically visualise the mall with and without these modifications in order to attach a value to the modified design.

Table 2: Policy instruments that could be used to ensuring that negative environmental impacts are reduced/mitigated during the construction phase of the Mooi River mall.

Policy instrument	**Use**
Common law (liability)	People that could be affected negatively by the consequences of any negative environmental impact of the mall construction could institute a claim for damages, or even get an interdict to stop the damaging activities. These could include the irrigation farmers downstream of the development that extracts their irrigation water from the Mooi River, whose pumping equipment could be damaged by increasing silt loads in the river, while they could also suffer crop losses due to reduced river water quality. If it can be proven that the construction had increased the flood risk for other commercial or residential properties on the flood plain, the owners thereof could also institute claims for flood damage when a flood occurs.
Statutory law (liability)	Section 19 of the National Water Act No. 36 of 1998 requires an owner of land, a person in control of land or a person who occupies or uses the land on which any activity or process is or was performed or undertaken; or any other situation exists, which causes, has caused or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to cease, modify or control any act or process causing the pollution; comply with any prescribed waste standard or management practice; contain or prevent the movement of pollutants; eliminate any source of the pollution; remedy the effects of the pollution; and remedy the effects of any disturbance to the bed and banks of a watercourse. Section 20 of the same act requires any person who is responsible for an emergency incident (incident or accident in which a substance pollutes or has the potential to pollute a water resource; or has, or is likely to have, a detrimental effect on a water resource); who owns the substance involved in the incident; or who was in control of the substance involved in the incident at the time of the incident to take the following action. Such a responsible person must take all reasonable measures to contain and minimise the effects of the incident; undertake clean-up procedures; remedy the effects of the incident; or take such measures as the catchment management agency may either verbally or in writing direct within the time specified by such institution.

Policy instrument	Use
	These two sections clearly highlights the statutory liability of the developers/contractors of the Mooi River Mall for any environmental liabilities related to water pollution, caused advertently or inadvertently. In addition, section 152 of the National Water Act determines that where any person is convicted of an offence under this Act (as identified in section 151 and which includes damage/pollution of the water resource) and another person has suffered harm or loss as a result of the act or omission constituting the offence; or damage has been caused to a water resource, the Court may, in the same proceedings at the written request of the person who suffered the harm or loss; or of the Minister in respect of the damage caused to a water resource; and in the presence of the convicted person, enquire without pleadings into the harm, loss or damage and determine the extent thereof. Section 153 of the National Water Act determines that after making the determination in terms of section 152, the Court may award damages for the loss or harm suffered by the person referred to in section 152 against the accused; order the accused to pay for the cost of any remedial measures implemented or to be implemented; and order that the remedial measures to be implemented, be undertaken either by the accused or the relevant water management institution. The statutory liability in terms if the Act is thus clearly not just limited to addressing the environmental damage caused to a water resource, but could also be extended by a court of law to include damages suffered by a third party.
Voluntary action	As the Mooi River Mall development is such a high profile development, informal community pressure could be exercised through activity of local citizens groups, newspaper stories, demonstrations, discussions with the polluters etc. However, this could also be formalised through the statutory establishment of a public watchdog (environmental liaison committee), consisting of representatives of the developer, council members, as well as concerned citizens. By statutory forcing the developer to regularly provide information regarding the quality and quality of the ambient environment or any environmental damage/pollution, the effectiveness of this watchdog committee can be ensured.

Policy instrument	Use
Ambient environmental standards	In terms of regulations under the National Water Act, as well as specific conditions in the Water Use License obtained in terms of the same act, as well as the Record of Decision obtained in terms of the Act regulating the EIA process, the developer is required to meet specific ambient environmental standards for water quality.
Technology environmental standards	Although there are no ambient environmental standards for other components of the environment that could be affected by the development, the developer is required to meet specific technology environmental standards for those components in terms of the Record of Decision obtained in terms of the Act regulating the EIA process, as well as, as well as specific conditions in the Water Use License obtained in terms of the National Water Act. These standards would not actually specify some end result, but rather the technologies, techniques or practices that potential polluters must adopt and includes technology standards, design or engineering standards and product standards.
Emissions/effluent charges	Because there would be no residuals from any source that are concentrated in a small enough number of identifiable streams, and the bulk of the potential pollution would originate from non-point-source emissions that are spread thinly over a wide area in a way that makes them impossible to measure, emissions/effluent charges would not be an effective tool to be used. However, in terms of the contract conditions, sub-contractors or individuals can be held liable for any environmental damage/pollution or breaking of any legal environmental conditions through a system of fines. This would then become a site specific implementation mechanism to assist in meeting the environmental legal duties imposed in the environmental authorisations.

6 Conclusion

The results clearly indicate that a number of environmental economic techniques that could be used to value the environmental impacts of the construction phase of the modified Mooi River mall design. However, it is important to consider the limitations as well as the potential risks associated with each of the techniques when using them. Furthermore, it became clear that where possible, one should not rely on the outcome of one valuation technique only. Application of a number of techniques would be beneficial to determine the degree of convergence of the outcome, or the lack thereof, thereby increasing the validity of the results.

Although it seems as if there are sufficient valuation methodologies for most, if not all environmental impacts typically experienced as a result of the projects, it must be kept in mind that some impacts and environmental values are not economically quantifiable and some intangibles will remain, especially with regard to non-use values such as ecological services provided by the environment.

In using environmental economic techniques to value the environment and environmental impacts, caution should be applied so as to not create the impression that the environmental goods and services could be bought and destroyed by those who can afford to pay. Certain things have an absolute value that makes them not quantifiable, for example, life and beauty. The suggested approach is to threat these non-quantifiables as ‘off-bounds’ (Winpenny, 1991).

The application of these techniques could also be used to assess the effectiveness of the EIA process. By applying them to value the environmental impacts of the base case mall design as well, values would be obtained for the pre-mitigated (base case) as well as post-mitigated (modified) cases. Comparing these values should provide an answer to the question of whether the EIA process was effective in minimising/mitigating the potential harm/damage to the environment.

The results also indicate that a number of policy options could be used to ensure that the environmental objectives of reduced/mitigated environmental impacts are reached during the construction phase of the mall. These also include economic instruments, although the use of these is still fairly limited in South Africa.

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